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D2.2 SWOT ANALYSIS OF REGIONS AND VALORIZATION OF MINING HERITAGE

MIREU
MINING AND METALLURGY REGIONS OF EU

25/11/2019

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CONTENTS

European Commission

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1. INTRODUCTION

Aim of the project MIREU:

- Establish a network of mining and metallurgy regions across Europe with a view to ensure the sustained and sustainable supply of mineral raw materials to the EU => share knowledge and experiences when facing the challenge to establish and maintain an extractive industry – share good practices
- Facilitate an exchange between all interested stakeholders in the regions, namely regulatory authorities, political and administrative bodies, development agencies, mining companies, non-government organizations, as well as the general public.
- Development of a shared knowledge base, taking into account the region-specific geographic and economic features, cultural, societal and language diversity, and their historical developments => what has been conducive and what hampering to the development of extractive and metallurgical industries. It will also provide the context for a bottom-up integration of these activities into their respective socio-economic and socio-cultural context.
- Development is about people and, therefore, bringing people into the decision-finding procedure in order to achieve a 'social license to operate' will be a key aspect of the project.
- Guidelines and recommendations for actions to be taken to foster a sustained and sustainable development of the extractive industries will be developed in close co-operation with a range of selected regions from the European Union. These regions will form a nucleus and multipliers for a more extensive network beyond the life - time of the project.

1.1 GENERAL REGIONAL BACKGROUND INFORMATION FOR SWOT ANALYSIS

As preparation work for the SWOT analyses, GKZ has conducted SWOT literature review and developed the general SWOT indicators determining the regional information that are helpful for all the SWOT analysis-related tasks. In addition, it is expected that the regional background information collected could also provide an overview of regions and support networking activities. **It must be highlighted that the SWOTs were mainly built on written answers of the regions to the questionnaires and have not yet been reviewed/commented by the regional partners.** Further interviews with regional partners should be expected after the submission of this Deliverable, and possible update of the Deliverable can be expected. The MIREU tasks related to SWOT analysis is shown in **Table 1.1.1.**

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Table 1.1.1: MIREU Tasks related to SWOT analysis.

WP	Task	Description of Work	WP Leader	Task Leader
2	**3**	Mining heritage and research capacities in Regions – SWOT analysis and transferability (M3-M16)	GKZ	NTUA
2	**4**	Benchmarking all regions in terms of delineation of fields of demand and best practise for networking of Regions (M14-M26)	GKZ	GTK
2	**5**	Stakeholder workshops (M18-M35): • SLO • Policy making • Smart specialization • Cultural heritage and citizen science • Research and academia • Clustering • ESIF and regional investment	GKZ	GKZ
3	**4**	Recommendation derived from SWOT-analyses on framework conditions (M20- M30)	AGH/AGH-UST	MinPol
4	**3**	SWOT analysis for SLO relevant strategies (M3-M18)	LAY	GKZ
5	**2**	Conduct a SWOT analysis on Smart Specialization Strategies and benchmarking of the regions involved (M6-M18)	ICAMCYL	SIEMCALSA

Based on information gathered, GKZ organized the first SWOT online meeting where nearly every MIREU work package leaders and task leaders related to SWOT analysis attended. It was agreed that we should take a systematic approach and exchange information gathered to avoid repetitively contacting the regional partners regarding same questions.

1.2 DEVELOPMENT OF THE GENERAL SWOT INDICATORS

The general SWOT indicators are developed based on the regional SWOT analysis examples, the REMIX status reports, and the peer review cases from the Smart Specialization Platform. The regional SWOT analysis examples were collected in January 2018 via an e-mail inquiry about regional SWOT analysis from GKZ.

The general SWOT indicators developed were presented in the first SWOT online meeting. Afterwards, a test round of the general SWOT indicators began among the regions involved in the SWOT meeting. GKZ (Saxony), UMWD-IRT and AGH (Lower Silesia) and SIEMCALSA

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(Castilla y León) had gathered their regional information and reported back by the beginning of May 2018. The reports from three regions provide valuable insight for the revision of the general SWOT indicators. The revision will then be sent to other MIREU regional partners and gather the general regional background information of MIREU regions.

1. 3 MINING HERITAGE WITHIN THE EU

EU has a long tradition in the mining activity, categorized as the third biggest producer of industrial minerals in a world scale, with Asia and North America being at the first and second places, respectively (European Commission, 2016).

The entrance of other countries in the global market, consequently, lead to the decrease of the share of the EU of global production. Specifically, the 50% of global production recorded in the 1850s decreased to 5% in 2009, with the metal extraction record a low rate and mine production shift to other countries. Despite that, the EU is still one of the largest producers and net exporter of mining equipment, worldwide, mainly because of the long-standing mining history (European Commission, 2016).

In EU has been recorded several mines that produce base and precious metals, as well as critical raw materials, with the mines mainly concentrated in certain regions. On the other hand, the large number of the remains of the mining activities, can be used through the aspect of mining heritage, in order to convert the mine sites into tourist attractions, which could lead at the economic growth of the specific regions and the European countries, in general (European Commission, 2016).

1.4 RESEARCH POTENTIAL WITHIN THE EU

The Community Research and Development Information Service (CORDIS) constitutes a dataset that contains projects and related organizations funded by the European Union under the Horizon 2020 framework program for research and innovation from 2014 to 2020. According to the processing of CORDIS data, the countries with the highest frequency of participation in programs related to mining and metallurgy sectors, is Germany, Finland, Spain, France, and the United Kingdom (**Figure 1.4.2** & **1.4.3)**. As regards Germany, the country with the highest percentage of participation, its percentage is about five times bigger than the mean value of frequency's participation. Finland is in the second rank, with a percentage of about 10% lower than the first country. Regarding Greece, the country is close to the mean value, as can be seen in the following chart (**Figure 1.4.1**). Abbreviations of the countries (**Table 1.4.1**) mentioned on the chart (**Figure 1.4.1**) and the maps (**Figure 1.4.2** & **1.4.3**):

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Table 1.4.1: Abbreviations of the countries

AL	Albania	**LT**	Lithuania
AT	Austria	**LU**	Luxembourg
BA	Bosnia and Herzegovina	**LV**	Latvia
BE	Belgium	**MD**	Moldova
BG	Bulgaria	**ME**	Montenegro
BY	Belarus	**MK**	North Macedonia
CH	Switzerland	**MT**	Malta
CZ	Czechia	**NL**	Netherlands
CY	Cyprus	**NO**	Norway
DK	Denmark	**PL**	Poland
EE	Estonia	**PT**	Portugal
ES	Spain	**RO**	Romania
FI	Finland	**RS**	Serbia
FR	France	**RU**	Russia
GR	Greece	**SE**	Sweden
HR	Croatia	**SI**	Slovenia
HU	Hungary	**SK**	Slovakia
IE	Ireland	**UA**	Ukraine
IS	Iceland	**UK**	United Kingdom
IT	Italy	**XK**[1]	Kosovo[2]
LI	Liechtenstein		

[1] 'XK' is a code used for practical reasons and not an official ISO country code.

[2] This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo Declaration of Independence (with asterisk and footnote in written documents, only the first time that Kosovo is mentioned).

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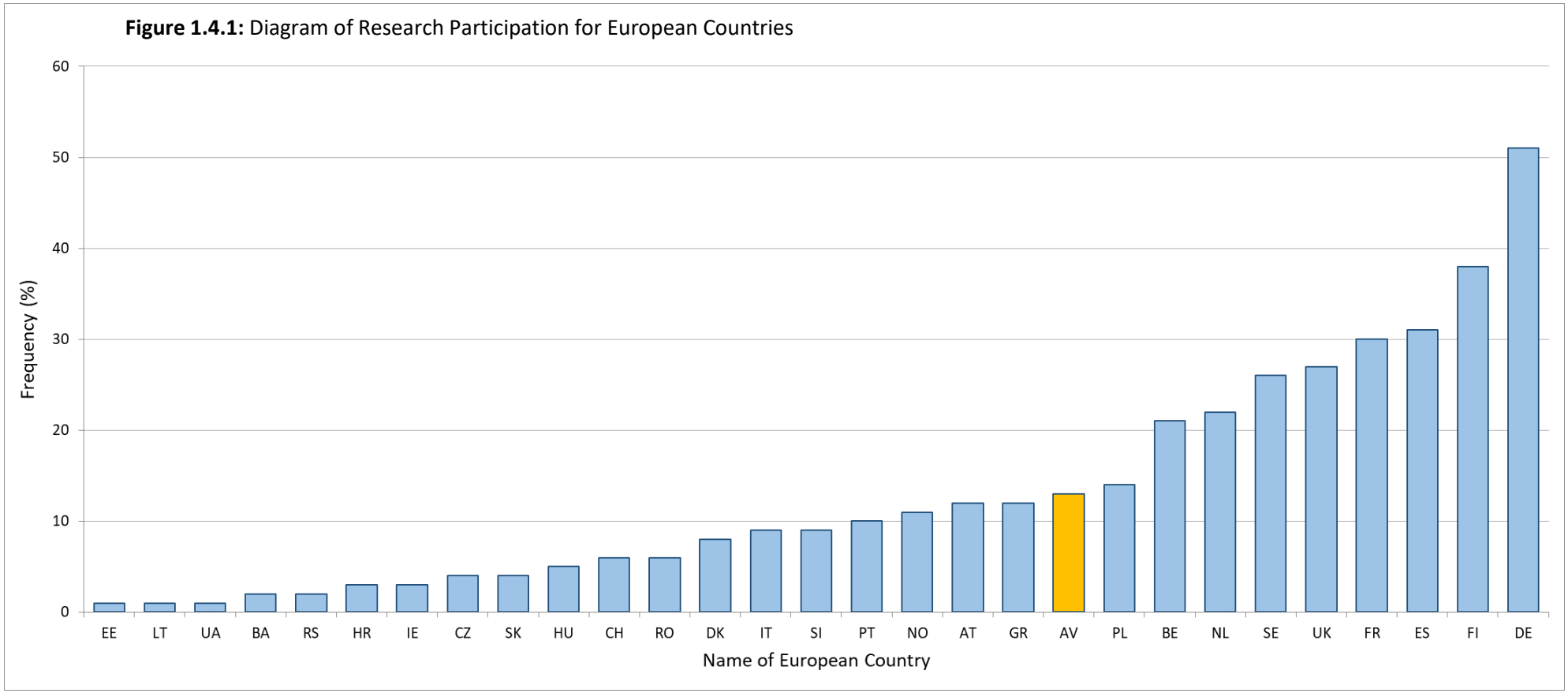


Figure 1.4.1: Diagram of Research Participation for European Countries in projects related to mining and metallurgy. Source: own work on the basis of cordis.europa.eu/.

Figure 1.4.2: Frequency Participation in Research Programs, 2018

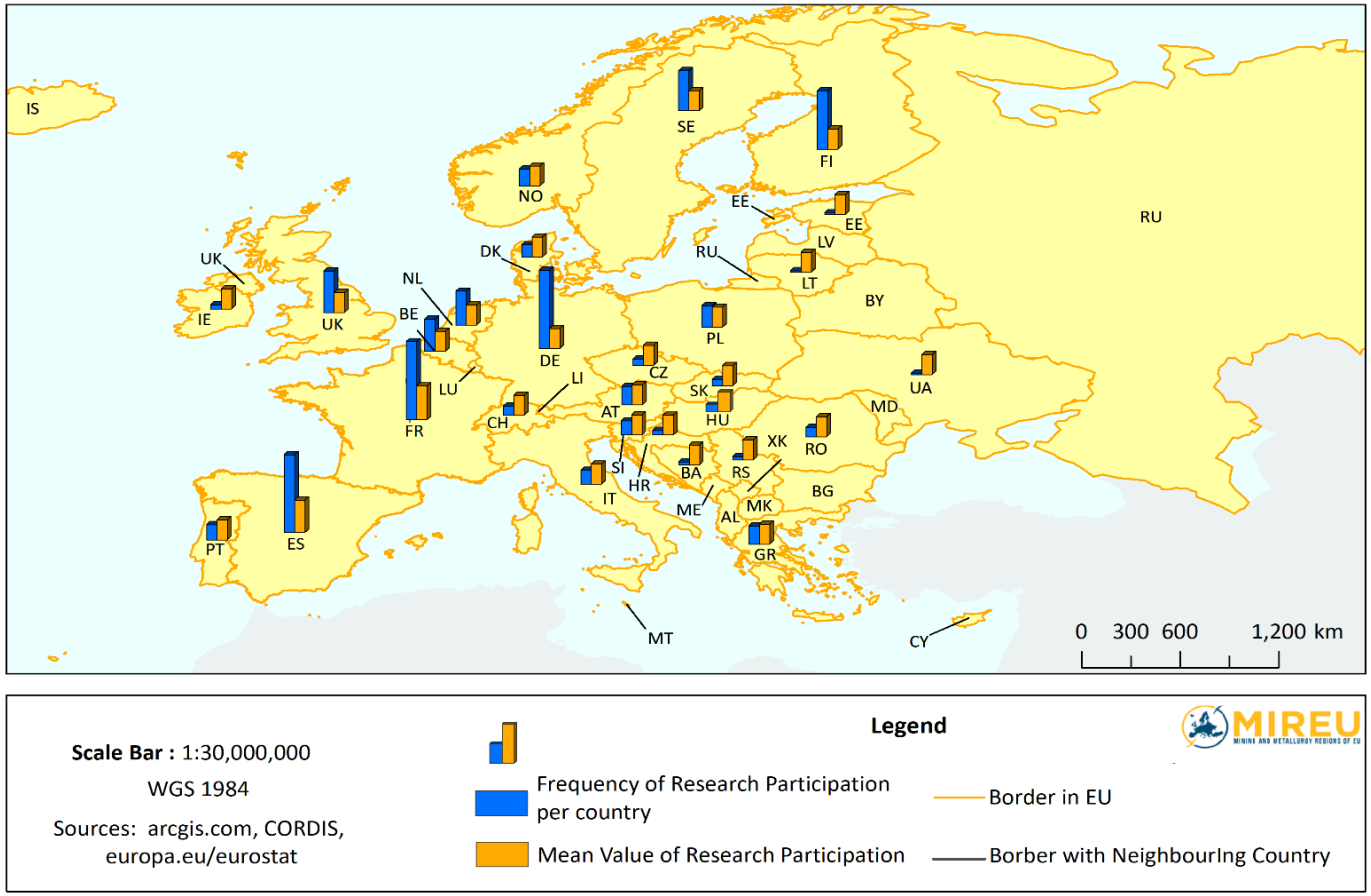


Figure 1.4.2: Map of Research Participation for European Countries and the av value of research participation symbolizes the average value. Source: own work on the basis of arcgis.com; cordis.europa.eu/; europa.eu/eurostat.

Figure 1.4.3: Funding per Country for Research Programs, 2018

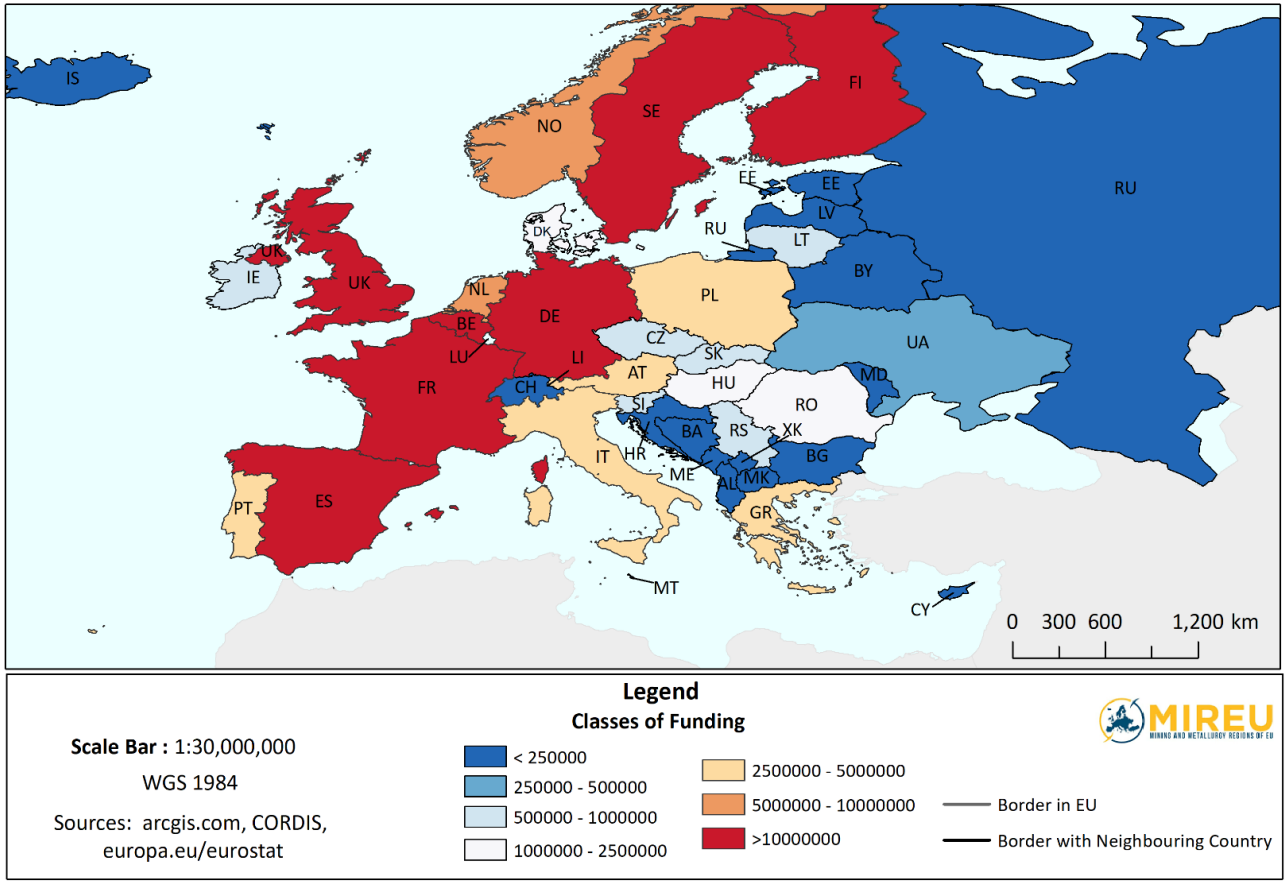


Figure 1.4.3: Map of Funding per Country for Research Programs. Source: own work on the basis of arcgis.com; cordis.europa.eu/; europa.eu/eurosta.

2. EDUCATION AND RESEARCH CAPACITY

2.1 CASE STUDY: REGION OF STEREA ELLADA

2.1.2 Academic potential related to mining and metallurgy

The educational system in Greece is controlled by the Ministry of Education, Research and Religious Affairs, which is the main supervisor of schools and universities. The Regional Directorates of Primary and Secondary Education supervise the main processes on behalf of the Ministry of Education Research and Religious Affairs at local level. Greece' s educational system includes 4 levels of education and the duration of compulsory education, for students aged 4 to 15 years old, is 11 years. Specifically, Greece's Primary education includes Pre-primary schools and Primary schools. With regards to the Pre-primary, the last years became compulsory for all 4-year-old children and spans 2 years while primary education, constituting the next stage of education, concerns children aged 6-12 years old with a span of 6 years.

The secondary education includes two cycles of study, Lower and Upper Secondary education, with the first one being obligatory, with a span of 3 years and the second one being optional, with the same duration. The next stages are optional, providing at the same time to pupils the opportunity to either continue their studies in General or in Vocational school. Finally, through Panhellenic exams students can reach the Higher education level (Universities or Technological Education Institutions). The education system in Greece is schematically represented in the following scheme (**Figure 2.1.1.1)** (eacea.ec.europa.eu). The university is a higher education institution in the sector of higher education, with the studies structured in a three-cycle system. The first cycle consists of attending undergraduate studies. After the acquisition of Bachelor, students are qualified to continue their studies through the Master' s Degree, and the last cycle of studies is the Ph.D programs (el.wikipedia.org [57]). As presented in the ELSTAT estimations for 2016 to 2017 which indicates the structure of the Greek universities, "Tertiary Education" consists of two domains:

i) University Sector including Universities, Polytechnic Schools, the Athens School of Fine Arts,
ii) Technological Sector including the Technological Educational Institutes (TEI), the School of Pedagogical and Technological Education (ASPETE), the Academies of Merchant Shipping, Ecclesiastical Academies, Schools of Service and Artistic Schools)".

The largest universities in Greece, according to the number of students enrolled in the higher education courses, include the National and Kapodistrian University of Athens, Aristotle University of Thessaloniki and University of West Attica. The following chart presents Greek universities in general, regardless of their relation to the mining and metallurgy procedures. Universities are classified according to the total number of undergraduate students, including the previous years, according to the most recently available timeline 2016 to 2017.

Universities in which undergraduate students can be trained, in order to join in mining and metallurgy industries are 11. They also include 26 departments, with very strong programs towards training students in those sectors.

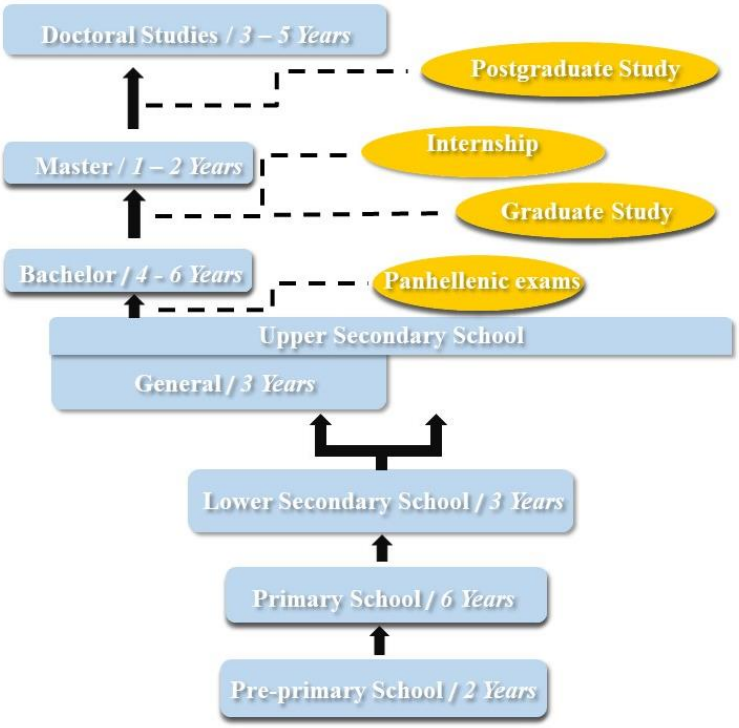


Figure 2.1.1.1: Scheme of the educational system in Greece. Source: own work on the basis of eacea.ec.europa.eu; 1lyk-kranid.arg.sch.gr

The following map (**Figure 2.1.2.3**) represents the most important academic centers, in which students benefit from training in scientific sectors, namely Sciences, Engineering, and Environmental Studies. The light purple percentage in the chart pies indicate the departments offering courses related to mining and metallurgy.

As it may be noted (**Figure 2.1.2.3**), the highest percentage of departments related to mining and metallurgy out of the total number of departments in Sciences, Engineering and Environmental Studies (2 from 3 departments) are located in the city of Kozani, at the University of Western Macedonia. Moreover, the next higher value is observed in Chania (about 5 out of 11 departments) and in Xanthi (2 out of 5 departments) at the Technical University of Crete and the Democritus University of Thrace, respectively.

It is worth mentioning though that the strict numerical evaluation is not representative of the educational dynamic of a region. For example, in the region of Athens the number of corresponding departments is 8 of 24 resulting to a low recorded percentage (33%). Yet,

National and Kapodistrian University of Athens constitutes the largest university in the country, by the enrollment number of students and that National Technical University of Athens is the only School that produces mining and metallurgy engineers. The same percentage noticed in the region of Mytilene (University of the Aegean) which exhibits more than 70% less graduates than the University of Athens. Finally, the Aristotle University of Thessaloniki includes 4 geology and engineering departments out of 13 departments of Sciences, Engineering, and Environmental Studies.

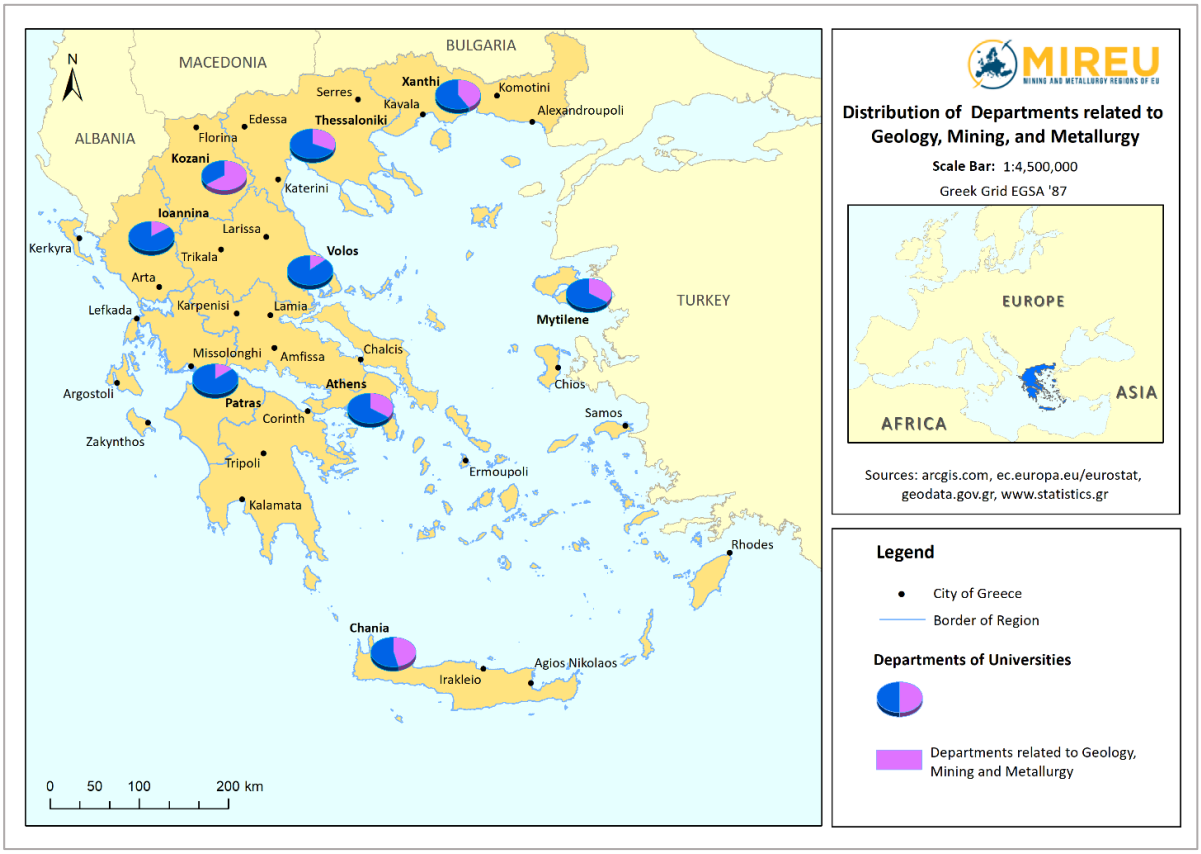


Figure 2.1.2.3: Map of the distribution of departments with higher education courses, related to geology, mining, and metallurgy. Source: own work on the basis of arcgis.com, ec.europa.eu/eurostat, geodata.gov, and www.statistics.gr.

2.1.4 Other types of training related to mining and metallurgy

In 2011, the certification procedures of technical professions were simplified, so the established categories, in relation to the mining and metallurgy sector, were identified as the following:

1. Categories related to the study of electrical or mechanical installations, construction, maintenance, repair and monitoring of these installations as well as handling of their equipment. Specifically, people of this type of technical professions are occupied in the following facilities:

- installations such as **industries** and **crafts**,
- installations for extraction of **ores** and **minerals**,
- installations for the extraction of **crude petroleum** and **natural gas**,
- installations for the production and distribution of **electricity**, **natural gas,** and **steam**,
- **electrical** or **mechanical facilities** for servicing buildings, electrical networks and associated facilities, hydraulic, refrigeration, combustion plants for liquid and gaseous fuels, as well as all kinds of boilers,
- other **electrical** installations,
- facilities for the collection, treatment, disposal of **waste** and **material recovery**,
- facilities for the storage of **hazardous materials** as well as freezing or maintenance facilities for **fragile products**.

2. Categories related to the execution of technical work and technical services, related to welding, gas welding, handling of construction machinery, loading and firing of explosives in technical works, as well as burning of fireworks. The personnel licencing for the above described technical professions, currently is performed in two stages:

a) At the first stage, students having completed their Upper - Secondary education (in General or Vocational schools) or the formal Secondary Vocational Training (at EPAs[3] of OAED) or the Institute of Vocational Training (I.E.K.[4]) have the opportunity to participate to the call for personnel licenses allowing them to exercise technical professions. The supporting documents for the personnel licenses are submitted to the Directorate of Development, of the Regional Unit. If the supporting documents are valid, the announcement of a personnel exercise-license is realized within a month allowing the candidates can exercise the specific profession as assistants, under the supervision of a licenced professional.

b) Upon the completion of 300-450 workdays for the graduates of Upper – Secondary education or 70-150 workdays for graduates from Vocational Schools, EPAs and I.E.K., the candidates are allowed to participate in dedicated exams in order to become fully licensed professionals. The exams are realized at the seat of the Regional Unit and the authorization/certification for exercising their specialty profession is rendered by the Directorate of Development, of the Regional Unit. It is estimated that the number of issued licenses is 500 per year. Nevertheless,

[3] EPAs OAED are vocational schools belonging to the Secondary Vocational Training. In these schools there are only classes with fields of specialization. The duration of study lasts 2 years during which pupils attend theoretical and laboratory classes, for 21 hours per week. Their studies should also be supplemented by a traineeship, related to their field of specialty (el.wikipedia.org).

[4] Greek abbreviated name of Institute of Vocational Training (en.wikipedia.org)

for the 2019, the estimated number was double the estimated, due to the fact that graduates from many fields of specialization were not examined during the previous years.

According to the special report of SEV about the demanding qualifications for the workforce of mining and metallurgy industries, the need to implement upskilling as well as reskilling policies at their workforce is highlighted. The fact that this type of industries is characterized by geographical dispersion, creates the necessity to implement decentralized policies of development and to exploit the modern technologies through distance learning (SEV, 2019).

In Greece, Industries related to mining and metallurgy sector tend to retain their staff and this fact enhances the development of training programs for employees in order to be able to meet with the needs of new knowledge and skills. According to the same report, 30% of Greek industries have difficulty to fill posts at their companies, with the main cause being the skills shortages of the staff. Other causes are the lack of the required working experience, as well as the high level of competition from other companies and the low salary levels. According to ELSTAT estimations, in a country level, the number of the workforce in the sector of mines and quarries that is participating in training programs of typical or not typical educational system[5] is characterized by low values[6] (less than 10%) (ELSTAT, 2016; SEV, 2019).

Furthermore, five of ten companies highlighted the lack of skills in their staff. The category of industrial facilities operators was identified as the one with the greater deficiencies in knowledge and skills (technical/professional knowledge, foreign languages and teamwork). As a result, industries try to organize training programs and seminars, purposing on the attendance of vocational and theoretical courses by their staff in the framework of basic and special training. According to the data collected by the following questionnaire, industries spend less than 100 hours per year for each employee for the training programs and seminars (Annex 3; SEV, 2019).

The training seminars and programs are mainly related to Health and Safety as well as to Human Capital Management. Apart from the categories referred to the questionnaire, other training courses focused on Technical and Professional issues, Induction training, Informatics, New Technologies, Management, e.tc. are realized. According to the latest data collected by SEV, 80% of industries have organized training programs. The main sectors of the training are: Health and Safety and Development of technical/ professional skills of their human resources. Finally, with regards to the employees' opinion, the sector they exhibit the most interest is that of Health and Safety (Annex 3; SEV,2019).

[5] Typical educational system is the regular, hierarchically structured and time-based educational system consisting of training activities which are part of the Hellenic Certification Framework. Not typical educational system includes any educational activity outside the typical education system, either individually or as a part of activities. It targets a specific audience and has specific educational goals.

[6] According to estimations of ELSTAT for 2016 for employees aged 25 – 64. The figures of participation in training programs are indicative.

2.1.6 Educational level in Sterea Ellada

The educational level of inhabitants in Greece and in the Region of Sterea Ellada, is classified into 3 categories:

- Presecondary & Lower diploma
- Upper Secondary diploma
- Postsecondary & Tertiary degree

The first category includes Preprimary, Primary and Secondary education, as well as people not educated. As for the Upper Secondary diploma category, this corresponds to the group of habitats that have completed either the General or the Vocational High School. Finally, the third category includes people holding a diploma at the Higher education level institutions (such as Universities, Technological Institutions, Master's degree). The recorded data by the special report of SEV about the demanding qualifications for the workforce of mining and metallurgy industries (SEV, 2019) mention that, at a national level, 85% of employees are at least middle-school educated (Presecondary, Lower or Upper Secondary diploma) and the corresponding percentage being Postsecondary educated is 4% of the total. This fact creates a necessity to examine the educational level of inhabitants, at regional as well as at national level.

Focusing on the educational level of inhabitants is observed that the statistics for the region are comparable to the statistics of the country and the relative data do not present significant deviation. Upper Secondary education corresponds to 25.8% for the Region of Sterea Ellada and to 24% for Greece while Presecondary or Lower education is estimated to 46.6% and 55% in a country and in the region level respectively. Finally, the category of not classified is represented with low values. The most significant difference between the Region and the country statistics concerns postsecondary or tertiary education level. In country level 21.4% of the inhabitants receive postsecondary or tertiary education, while the same percentage for Sterea Ellada is only 15.3%.

The number of inhabitants having a Presecondary or Lower diploma corresponds to about the half of the total. Despite the fact that the educational level in the Region of Sterea Ellada is at a satisfactory level (less than 1/5 of the total are higher educated) the region has to deal with issues, like for instance, the school abandonment, the alarming rates of illiteracy, the reduced participation number at vocational and technical education, the declining participation in lifelong learning, the school accessibility difficulties facing children from remote areas e.tc (ROP for Sterea Ellada, 2015).

Finally, according to the processing of most recent data (timeline 2014 to 2018), the number of inhabitants with Upper Secondary diploma present the highest value both at country and regional level. The next category with the greatest values is the group with Postsecondary and Tertiary education diploma at country level while at a regional level, the next class with the highest values is the Presecondary and Lower diploma category.

2.1.5 Co-operation between academia & mining and metallurgy industry

[Co-operation between academia – mining and metallurgy industries, based on the latest data provided for the five-year period, 2014 to 2018, from the School of Mining and Metallurgy of the NTUA and collected data of 2018 by SEV]

Although Greek Universities and mining and metallurgy industries try to establish gateways of communication, the data collected by SEV indicate that only 38% of the companies actually collaborate with higher education departments. The most common means of collaboration are training visits, lectures of company employees to students, conferences in which mining and metallurgy industries provide financial assistance, as well as through graduate / postgraduate studies and internships (SEV, 2019).

Regarding the exact number of internships as well as graduate and postgraduate studies, carried out at the companies, there is no detailed analysis for this information from the Departments of Greek universities. Detailed data for the internships in mining and metallurgy was elaborated on the example of the School of Mining and Metallurgical Engineering of the NTUA. In this department, the internship is implemented in two academic years, within the context of the following compulsory subjects:

- Internship I constitutes a subject to the compulsory courses of the 7th semester and it is conducted during the summer – between the 6th and 7th semester of studies. It includes a two-week tour in the Greek territory at mining quarries, mines, metallurgical units and processing plants of metallic products.
- Internship II is a mandatory subject of the 9th semester and it is conducted during the summer – between the 8th and 9th semester of studies. In the internship II, the students work in mining and metallurgy industries, construction sites and research centers that are related to the objective of the faculty. The Internship II has duration of one month and students choose the industry/construct site/research center of preference for their internship. Moreover, students are able to complete their vocational internship to foreign industries or laboratories, after consulting the officials responsible for Internship II.

2.2 CASE STUDIES: REGIONS OF NORTH KARELIA AND LAPLAND

2.2.1 Academic potential related to mining and metallurgy

[The following chapter is from Turunen K. 2019.]

In 2017 72% of the Finnish population older than 15 years had completed a tertiary level qualification and 31% had higher degree. Finnish women tend to be more educated than men, as 35% of the women had higher degree and 27% had only the basic education, whereas the same proportions for men were 27% and 29% (Official Statistics Finland, 2019). The Finnish education system is presented in **Figure 2.2.1.1**. Before the compulsory pre-primary and nine-year basic education (comprehensive school), children are provided early childhood education and care. The pre-primary and basic education are publicly funded and free of charge. The early childhood education and care has fees, of which most is publicly supported. After completing the basic education young people can choose to continue their educational track either in general upper secondary education or vocational education and training. The secondary education and training are publicly funded and free of charge for the students (EDUFI Webpage).

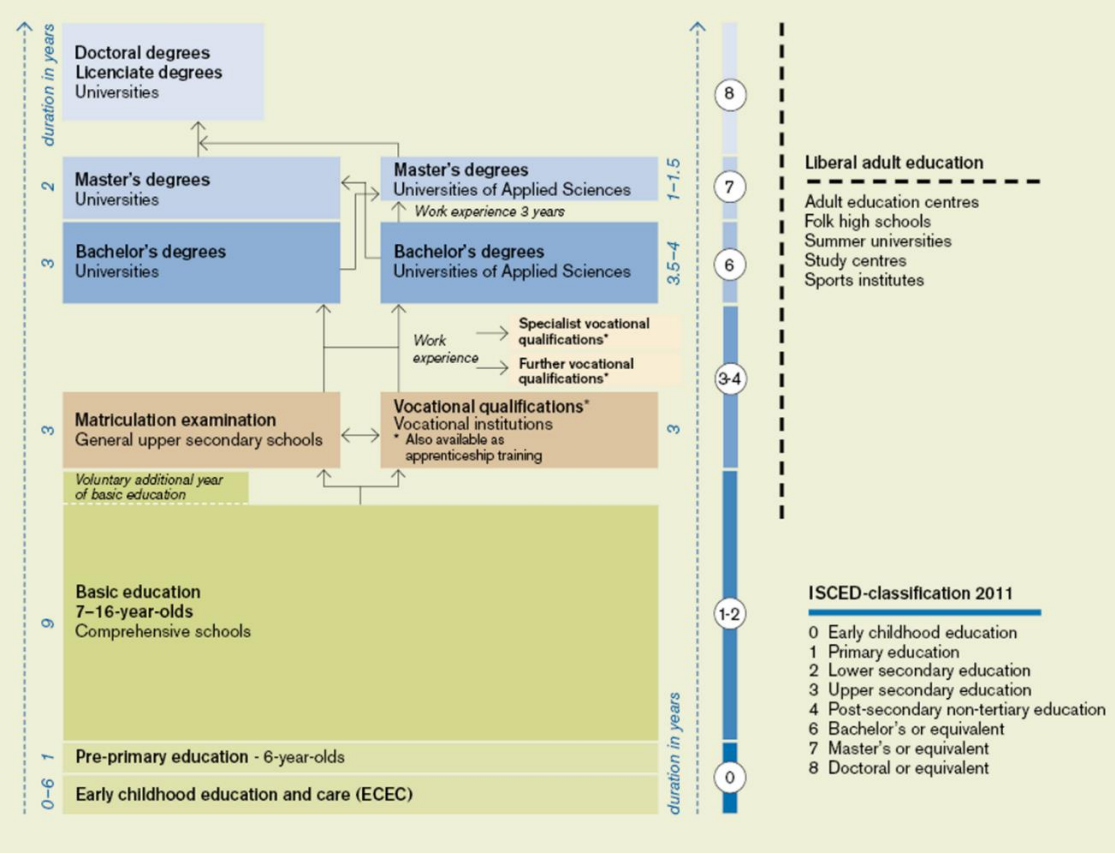


Figure 2.2.1.1: The Finnish education system. Source: EDUFI Webpage.

After completing a general upper secondary education and vocational qualification, students may continue their studies in higher education. The mission of universities is to conduct scientific research and provide education based on it, whereas universities of applied sciences (UAS) provide more practical education that aims to respond to the needs of the labor market. Universities, offering higher scientific and artistic education, award Bachelor' s and Master' s degrees as well as postgraduate degrees, i.e. licentiate and doctoral degrees. Universities of applied sciences award UAS Bachelor's degrees and UAS Master's degrees.

Adult education is available at all levels. Adult education and training can either be paid for by the student himself or herself or it can be apprenticeship training, labor policy education, or staff-development and other training provided or purchased by employers. Adult education and training encompasses education leading to a qualification, degree studies, training preparing for competence-based qualifications, apprenticeship training, further and continuing education updating and extending the professional skills, studies in subjects relating to citizenship skills, working life skills and society, and studies in different crafts and subjects on a recreational basis.

There are nine universities offering mining related education in Finland. Aalto University and Oulu mining school operating under The University of Oulu offer also degrees specialized in mining (e.g. mineral processing, mining technology), whereas University of Helsinki and University of Turku offer studies e.g. in ore mineralogy and environmental geology and Helsinki also in applied geophysics. The technical universities of Tampere and Lappeenranta are specialized in e.g. environmental and process engineering and water treatment technologies. University of Eastern Finland (UEF) and University of Lapland have education in societal issues, Policy and regulations and

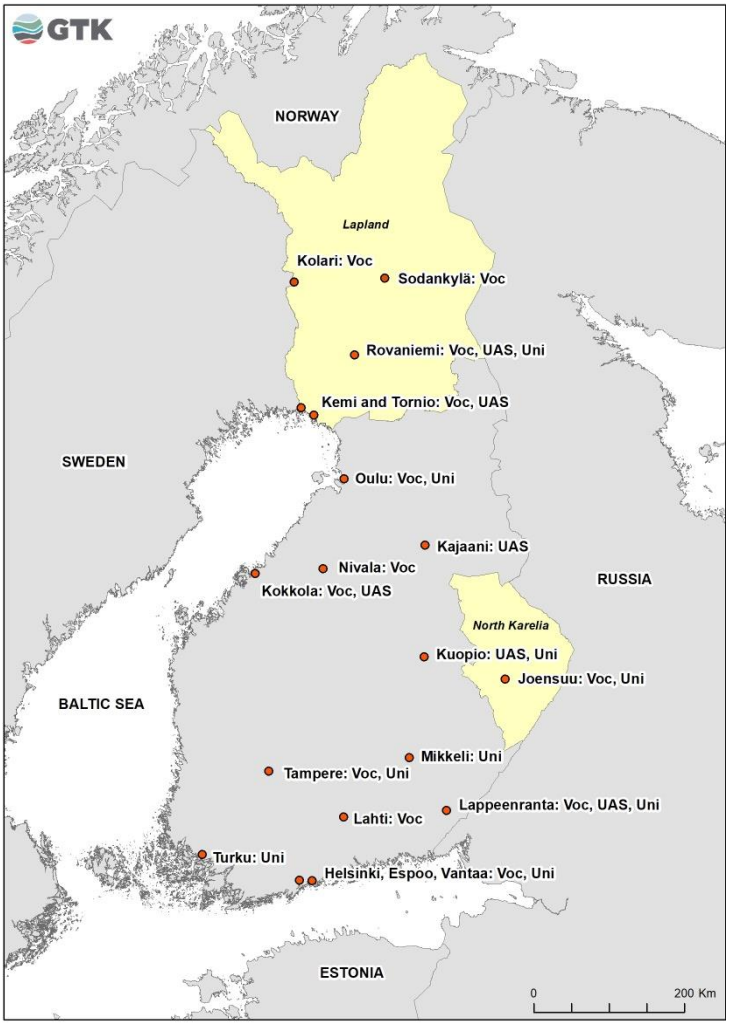


Figure 2.2.1.1. The location of mining related educational institutes in Finland. Voc=vocational education, UAS=University of Applied sciences, Uni=University.

UEF also in water treatment. In addition to these, there are other universities that have studies e.g. in environmental and ecological risk assessment, water treatment, machinery and economical geology.

There are five Universities of Applied Sciences offering education e.g. in mining and processing technology, mechanical and chemical engineering. In addition to basic education, the Kajaani and Lappi Universities of Applied sciences offer together specialized in competence training on mining. Based on the statistics, the higher-level degrees in minerals processing has increased steadily since 2014. In geosciences, the amount of graduates has been steady excluding the bachelor's degree which has decreased since 2014. However, most of the university students in Finland complete master's degree, as it is commonly the requirement of the employers and the deviation between BSc and MSc degrees might indicate e.g. geosciences being either a minor subject, and thus completed only at BSc level.

2.2.2 Other types of training related to mining and metallurgy

There are currently **seven educational institution**s providing mining related vocational training in Finland. The institutions are mainly owned by the regional governments which plan their education to serve the regional workforce needs. All vocational mining education institutions are **independent, owned by municipalities or joint municipal authorities**. They have their own administrations and approved budgets to make quite independent decisions. Based on the statistics, the lower degree graduates have been rather constant between 2014 and 2017, excluding a peak in basic vocational degrees in 2014.

2.2.3 Co-operation between academia & mining and metallurgy industry

Most of the educational institutions offer specialized courses for the mine workers at every level. In addition, specialists from mining and metallurgy companies teach at educational institutions. The higher-level institutions cooperate with the industry especially in research. Many Universities get most of their funding from outside as grants or e.g. through EU-funded projects in which the mining and metallurgy companies are involved. On job learning is often compulsory part of the education and especially in field of mining and metallurgy, it is common that many of the bachelors and masters' thesis are made for the mining companies. Many vocational colleges have been cooperating with major machine and equipment suppliers for a long time.

The mining companies are also sometimes funding the universities. For instance, the Kainuu University of Applied Sciences got funding from the Terrafame Oy mining company for three-year professorship in minerals processing. With the funding, KAMK was able to offer specialized education mineral processing. Whereas, the Oulu Mining School got 1 M € from the Agnico Eagle Finland Oy mining company.

The Ministry of Economic Affairs and Employment, Ministry of the Environment, Ministry of Agriculture and Forestry and Ministry of Transport and Communications decided on 2014 that the ELY Centre for Lapland will coordinate the planning of mine specialization program of the Lapland,

Kainuu and North Ostrobothnia ELY Centres. The aim was to increase the cooperation and sharing of good practices between the authorities and harmonize the procedures. The mine specialization program was launched in 2015 and focuses for example on improving the supervision and inspection of mines, environmental impact assessments (EIA) of mines, cooperation between the mine supervision and permitting authorities as well as increasing the expert knowledge on mine environmental safety.

One key task in the mine specialization program is to improve the expertise of mine authorities by arranging lectures, seminars and workshops and by giving guidance and developing guides for best practices. The lectures have been given by Finnish key experts and focused on best environmental practices (BEP) and best available technologies (BAT) in mine environmental safety in general, including extractive waste facilities and waste management, assessment and management of environmental impacts and risks, water balance, water management and treatment, mine closure and rehabilitation. The length of the lectures has been varying for couple of hours to two days. The costs of arranging the lectures and workshops are covered by the project "Development of environmental safety of extractive industry" that is funded by the development funds (OHKE) of the Ministry of the Environment, Finland. In addition to this project there are also four other OHKE-funded development projects ongoing in mine specialization program. Those include projects:

- Guide for supervision of mines in bankruptcy situations and related environmental damage, 2) Guide for designing and constructing environmental waste facilities of mines,
- Best practices and best available technologies in extractive waste management, and
- Developing life-cycle supervision of mines.

All these ongoing projects include education events, such as video lectures and workshops targeted to mine supervision and permitting authorities, personnel of mine companies, consultant and researchers.

2.2.4 Research centers, programs and events, and projects related to mining and metallurgy industry

Geological Survey of Finland (GTK)

- Type of organization: public research center, operating under the Ministry of Economic Affairs and Employment
- Area of specialties: Geosciences, Mining, Exploration, Mineral processing, Geodata, Marine Geology, Hydrogeology, Environmental geology, Geophysics
- High rate of collaboration with the EU institutions
- Medium to high rate of collaboration with Industry
- Source of funding: state budget 63%, jointly funded public 16%, commercial contracts 21%

Finnish Environmental Institute (SYKE)

- Type of organization: public research center, operating under the Ministry of the Environment

- Area of specialties: Environmental impacts, Freshwater, Marine Research, Biodiversity, Consumption and Production, Environmental Policy, Data and Information, and Laboratory centers.
- High rate of collaboration with the EU institutions
- Medium rate of collaboration with Industry
- Source of funding: state budget 43%, jointly funded or other public 49%, commercial contracts 8%

Technical research center of Finland (VTT)

- Type of organization: privatized, state owned research center
- Area of specialties: Services and logistics, Real estate and construction, Metal refining, Chemistry and environment, ICT, Forest industry, Machines and vehicles, Biotechnology and pharmaceuticals, Electronic, Energy
- Medium to high rate of collaboration with the EU institutions
- High rate of collaboration with Industry
- Source of funding: public funding 20%, commercial contracts 80%
- Patents: 1,324, (751 patents granted, 573 pending patent applications)

Natural Resources Institute Finland (LUKE)

- Type of organization: state owned research center operating under the Ministry of Agriculture and Forestry, Bioeconomy
- Area of specialties: Agriculture, Forest, Fisheries and hunting
- Medium to high rate of collaboration with the EU institutions
- Medium to high rate of collaboration with Industry
- Source of funding: 72M€ internal public funding, 50M€ external public and private funding
- Patents: 11

Finnish meteorological Institute (FMI)

- Type of organization: state owned research center, operating under the Ministry of Transport and Communications
- Area of specialties: observation and research on the atmosphere, climate and seas. Space and earth observation.
- High rate of collaboration with the EU institutions
- Medium rate of collaboration with Industry
- Source of funding: state budget 44M€, other public and joint funding 18,5M€, commercial contracts 14M€

Finnish institute for health and welfare (THL)

- Type of organization: state owned research center, operating under the Ministry of Social Affairs and Health
- Area of specialties: sustainability of the welfare society, reducing inequality and social exclusion, changing spectrum of diseases, preparing for health threats, transition of the service system
- High rate of collaboration with the EU institutions

- Medium rate of collaboration with Industry
- Source of funding: state budget 79%, other public and joint funding 15%, commercial contracts 6%

National Land Survey of Finland (NLS)

- Type of organization: state owned research center, operating under the Ministry of Agriculture and Forestry, Bioeconomy
- Area of specialties: Land Surveying, geospatial research
- High rate of collaboration with the EU institutions
- Medium rate of collaboration with Industry
- Source of funding: state budget 33%, commercial contracts 66%

Finnish Network for Sustainable Mining was established in 2014 to produce new instruments to enhance the sustainability of mining operations in Finland. Since then, the network has published separate sustainability standards for mining and ore exploration, a toolbox for local actions, and a corporate social responsibility report in Finnish covering the activities of 19 mining and ore exploration companies in Finland (https://www.kaivosvastuu.fi/finnish-sustainability-standard-for-mining-translated-into-english/)

The **Mining Finland program** promotes exporting Finnish mining know how. Finland has systematically developed its mining cluster. Today the cluster is strong consisting of more than ten mining related universities and research organizations, more than 200 mining technology and service providers, over 40 mines and ten smelters and steel mills (http://www.miningfinland.com/)

The **Finnish Mining Association (FinnMin),** founded in 1999, is a promoting and cooperative organization for Finnish companies operating in the extractive industry (https://teknologiateollisuus.fi/en/membership/branch-associations/finnmin)

Finnish Minerals group aims to build a leading ecosystem for battery production in Europe. We own, manage and develop companies, an investment programme and R&D projects related to the Finnish battery and mining cluster. Maximising the value of Finnish raw materials is the driving force of our operations. We want to create partnerships that take Europe one step closer to electric mobility and more responsible future (https://www.mineralsgroup.fi/)

Programs and events related to mining and metallurgy industry

Business Finland launched a *Batteries from Finland* activation program which aims speeding up development of national battery ecosystem and creating a totally new industry sector to Finland. The Finnish and Swedish Ministers for Economic Affairs launched in March 2018 a joint initiative to create a certificate concerning the sustainability of products in the mining industry. The aim is to provide information on the accountability of the entire chain of production.

There are several mining related events organized annually in Finland. For instance, the national scientific geological, geochemical and geophysical colloquiums are organized annually. The

mining association organizes every year several different stakeholder events as well as annual Mining seminar. Further there are multiple project seminars, conferences and workshops held every year around Finland. The two biggest regular mining events are organized biannually:

The **Fennoscandian exploration and mining conference (FEM)** is organized every other year in Levi, Lapland. FEM founded in 1998, is one of the largest and most significant exploration and mining industry events in Europe. It brings together exploration and mining industry leaders, experts and researchers from almost 30 countries (https://femconference.fi/)

The **FinnMateria** is held biannually in Jyväskylä in Finland. It is the leading exhibition for mining, metal processing, rock material industry and earth construction in Finland (https://www.paviljonki.fi/messut/finnmateria/briefly-in-english/)

Projects (European/National/Regional) related to mining and metallurgy industry:

Between 2010 and 2014 there were 118 mining related research projects, 10 PhD research studies ongoing and 9 different mining related networks operating in Finland. According to the survey, GTK is the most active in mining related projects (33%). Others more active institutes were University of Oulu (22%), VTT (15%) and SYKE (14%). The projects focused mainly on the mineral processing and beneficiation processes (28%), management of waste and other byproducts (15%), environmental impacts (7%), multidisciplinary projects (7%), monitoring (6%) and local community and economy (6%). Most of the projects were technology oriented (58%), about 33% were somehow related to water, 22% on international cooperation and 13% on risk and impact assessment.

The biggest funding sources have been the Finnish Funding Agency for Innovation - TEKES (65%) (Nowadays Business Finland), EU (20%), Finnish ministries (7%) and associations (3%). Tekes Green Mining project was ongoing during 2011-2016. The aim of the program was to “develop the mining cluster innovation infrastructure to make Finland the global leader of the sustainable mining industry by 2020”. Within the program all together 130 projects were funded, the total funding volume being 116 M €. The partners included 19 Research organizations, 23 Mining and exploration companies, 81 Technology and service companies, 7 Municipalities and associations and 45 International partners. The funding covered the whole mine life cycle from exploration to mine closure.

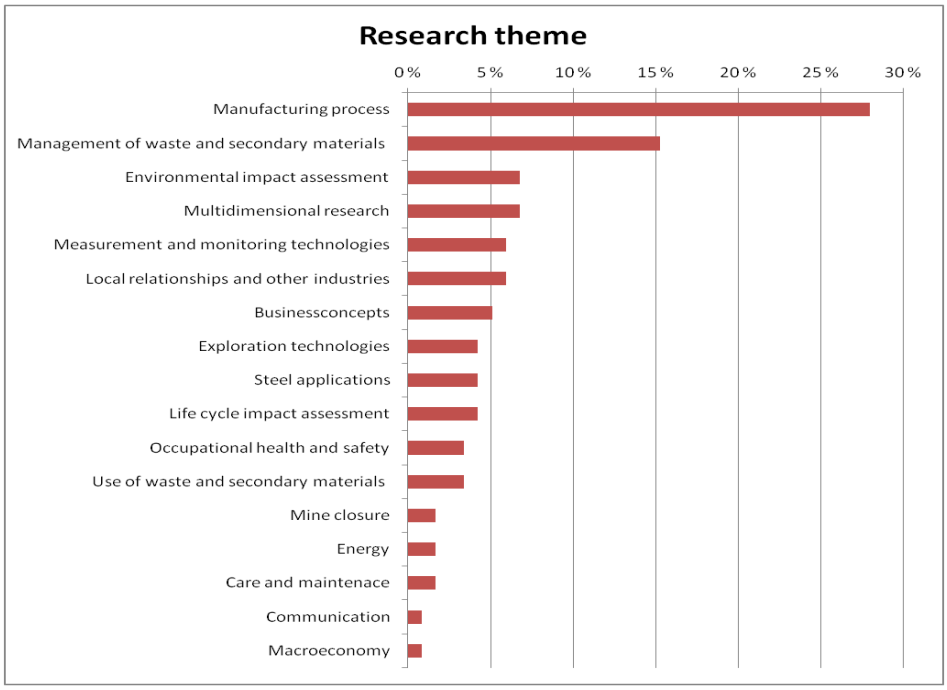


Figure 2.2.4.1 Different themes of research (from Solismaa and Lahtinen 2016, modified after Sitra 2014).

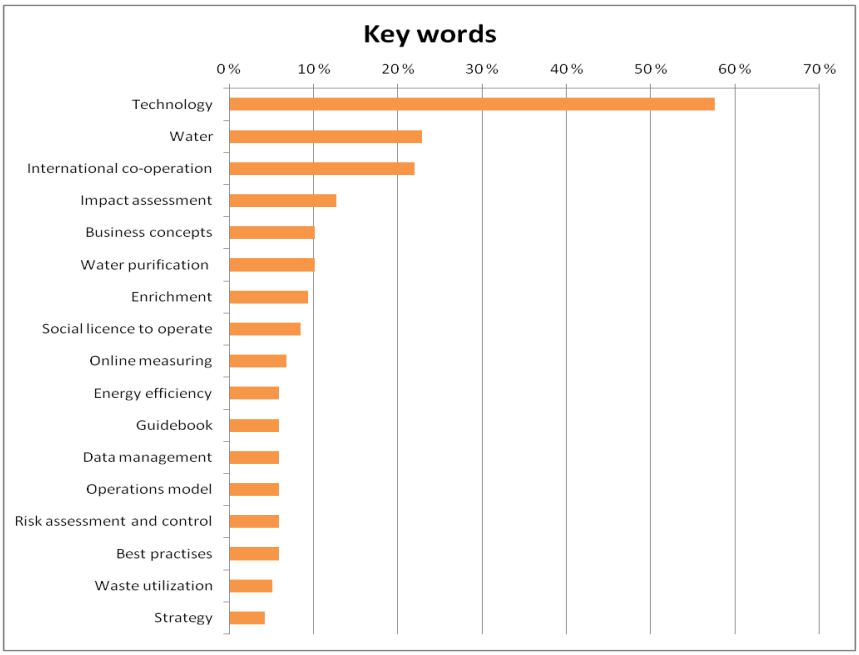


Figure 2.2.2.2 The most common keywords in project descriptions (from Solismaa and Lahtinen 2016, modified after Sitra 2014).

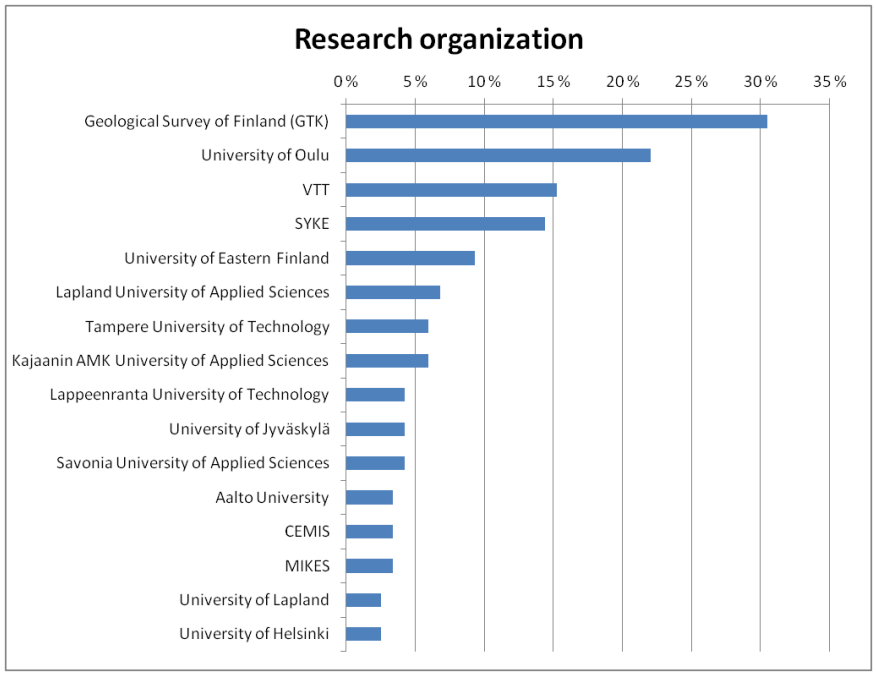


Figure 2.2.4.3 The participation percentages of different research organizations (from Solismaa and Lahtinen 2016, modified after Sitra 2014).

2.3 CASE STUDY: REGION OF STYRIA

2.3.1 Academic potential related to mining and metallurgy

After primary and secondary school, you have 3 major choices:

a) Gymnasium (high school, 4 years, from 15-18)
b) High school profession-orientated (technical college, economical college etc.; 5 years, from 15-19)
c) Apprenticeship (dual education – partly in company, partly in special school, 3-4 years)

After finishing (a) and (b) (or with a special examination also (c) you can inscribe to university.A detailed overview is given in the following image (**Figure 2.3.1.1)** (in optimal solution available at https://www.bildungssystem.at/en/.

Austria has **two technical universities** in Graz (Styria) and Vienna, a mining university in Leoben / Styria and various universities of applied sciences. In addition, geology and geosciences are taught at the universities in Vienna, Graz, Salzburg and Innsbruck. The **mining university in Leoben** is rated one of the best worldwide (e.g. the department for metallurgy was rated 2nd best in Europe 2019 behind Manchester in the Shanghai Ranking). Also, the departments for "mining" and for "oil, gas and petroleum engineering" are highly rated and recognized and among the most reputable worldwide. https://www.unileoben.ac.at/en. There is a broad range of studies: from mining to metallurgy, from recycling to applied geosciences, from raw materials to petroleum engineering. About 4000 students, study at the mining university, approximately 25 % from more than 80 countries from all over the world.

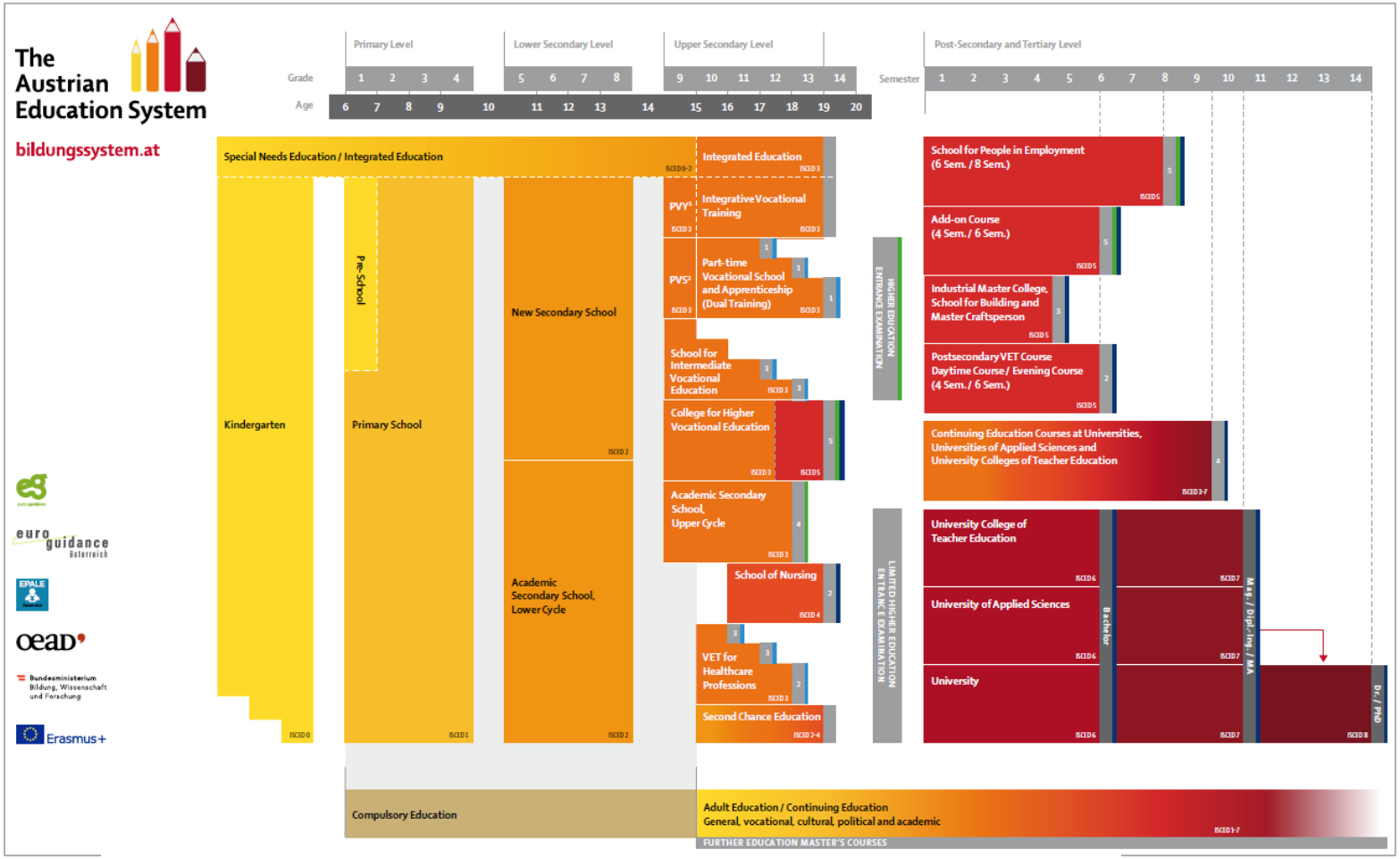


Figure 2.3.1.1: The Austrian Education System

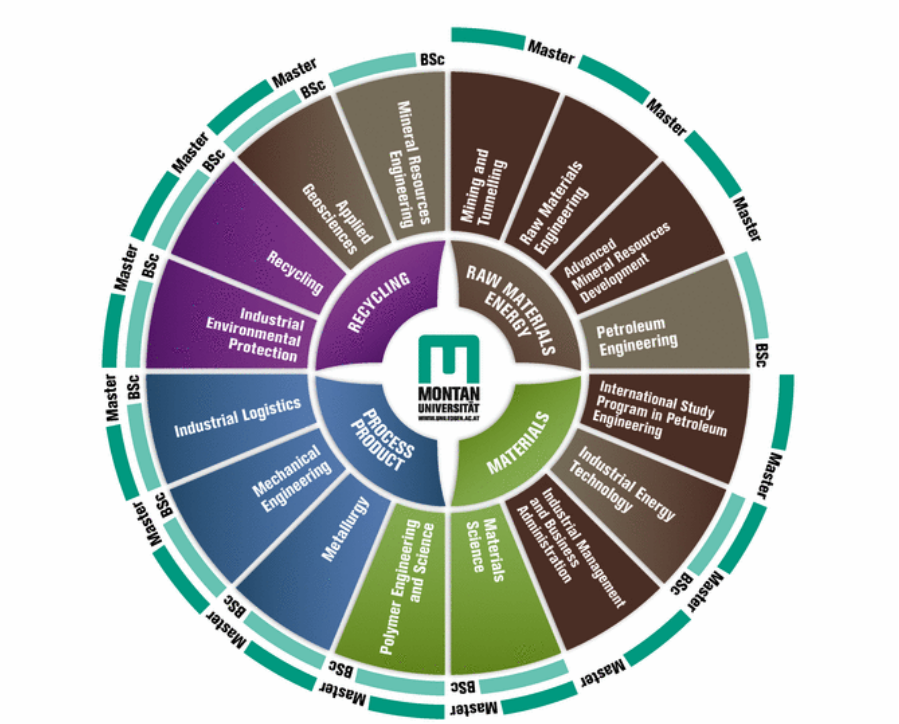


Figure: 2.3.1.2: Bachelor and Master studies in the Mining University Leoben (MUL).

2.3.2 Other types of training related to mining and metallurgy

In Leoben (Styrian Iron Route) it is located **Europe´s only college (technical high school) for mining and raw materials** (5 years, from age 15-19) https://www.htl-leoben.at/ausbildung/htl/rohstoff-und-energietechnik.html.

The mining university also offers **advanced training courses**: International Mining Engineer, Corrosion Expert NATM, New Austrian Tunnelling Method, Blasting, Engineering Advanced Drilling, Engineering, SafeDeepMining, Raw material processing, Recycling etc.

2.3.3 Co-operation between academia & mining and metallurgy industry

The mining university works and researches in strong cooperation with Austria´s M&M - related industry. Many R&D projects are carried out together with partners from industry. For the regional steel processing industry (Voestalpine etc.) the expertise is an essential factor for global competiveness. There is also a special department ("Ausseninstitut") for knowledge- and technology transfer – as an **intersection** between **science** and **industry/economy**.

2.3.4 Research centers, programs and events, and projects related to M&M industry

The **Mining University Leoben** (MUL) is the major research center related to M&M industry in Austria. Overview of all institutes (which are all engaged in research and international collaboration within Europe and worldwide: https://www.unileoben.ac.at/?id=3016&L=1). Institutes collaborating with the **M&M industry**:

Department Metallurgy:

- Chair of Ferrous Metallurgy
- Chair of Casting Research
- Chair of Simulation and Modelling of Metallurgical Processes
- Chair of Nonferrous Metallurgy

Department Mineral Resources Engineering:

- Chair of Mineral Processing
- Chair of Mining Engineering and Mineral Economics
- Chair of Ceramics
- Chair of Subsurface Engineering

Department Petroleum Engineering:

- Chair of Drilling and Completion Engineering
- Chair of Petroleum and Geothermal Energy Recovery
- Chair of Reservoir Engineering

Department of Environmental and Energy Process Engineering:

- Chair of Waste Processing Technology and Waste Management
- Chair of Energy Network Technology
- Chair of Thermal Processing Technology
- Chair of Process Technology and Industrial Environmental Protection

Department Physical Metallurgy and Materials Testing:

- Chair of Functional Materials and Materials Systems
- Chair of Atomistic Modelling and Design of Materials
- Chair of Physical Metallurgy and Metallic Materials
- Chair of Materials Physics
- Lehrstuhl für Stahldesign
- Institute of Structural and Functional Ceramics

Several **international** and **national conferences** and **events** related to M&M industry take place every year at the MUL. Specifically, the MUL is involved in many national & international projects related to M&M industry – e.g. in the Horizon2020 program. Many of them are carried out in cooperation with partners from industry. List of EC funded projects in the field of M&M: see evaluation in MIREU WP6 (see attached document "Task 6.2_EC-funded projects - PP23 VESTE – STYRIA").

2.4 CASE STUDY: REGION OF SAXONY

2.4.1 Academic potential related to mining and metallurgy

As the education system (**Figure 2.4.1.1**) is defined at the regional state level in Germany, the graphic is **only** applicable to Saxony. M&M are subjects only at the tertiary education level.

In Saxony, Bachelor and Master studies in M&M can be found in the **Technical University Bergakademie Freiberg** or Freiberg University of Mining and Technology (TUBAF) which sees itself as a modern **research university** with a strong focus on natural energy resource systems; based on its long tradition in silver mining and metallurgy, it consistently aligns its profile areas geo(science), material, energy and environment.

Currently, TUBAF is the **only university** in Germany offering training options in all mining and geosciences subjects including (1) Mining and specialized foundation engineering, (2) Drilling technology and fluid mining, (3) Geology, (4) Geophysics, (5) Geotechnics, (6) Mining surveying and geodesy, (7) Mineralogy[7], and (8) Metallurgy. In addition, TUBAF has a **research mine**, **Reiche Zeche**, for research and education purposes. The **Tables 2.4.1.1-2.4.1.4** below show study programmes in TUBAF directly link to M&M in yellow. The programmes are mainly placed in Faculty of Geosciences, Geoengineering and Mining, Faculty of Mechanical, Process and Energy Engineering, and Faculty of Materials Science and Materials Technology.

[7] Saxon Raw Material Strategy, 2017

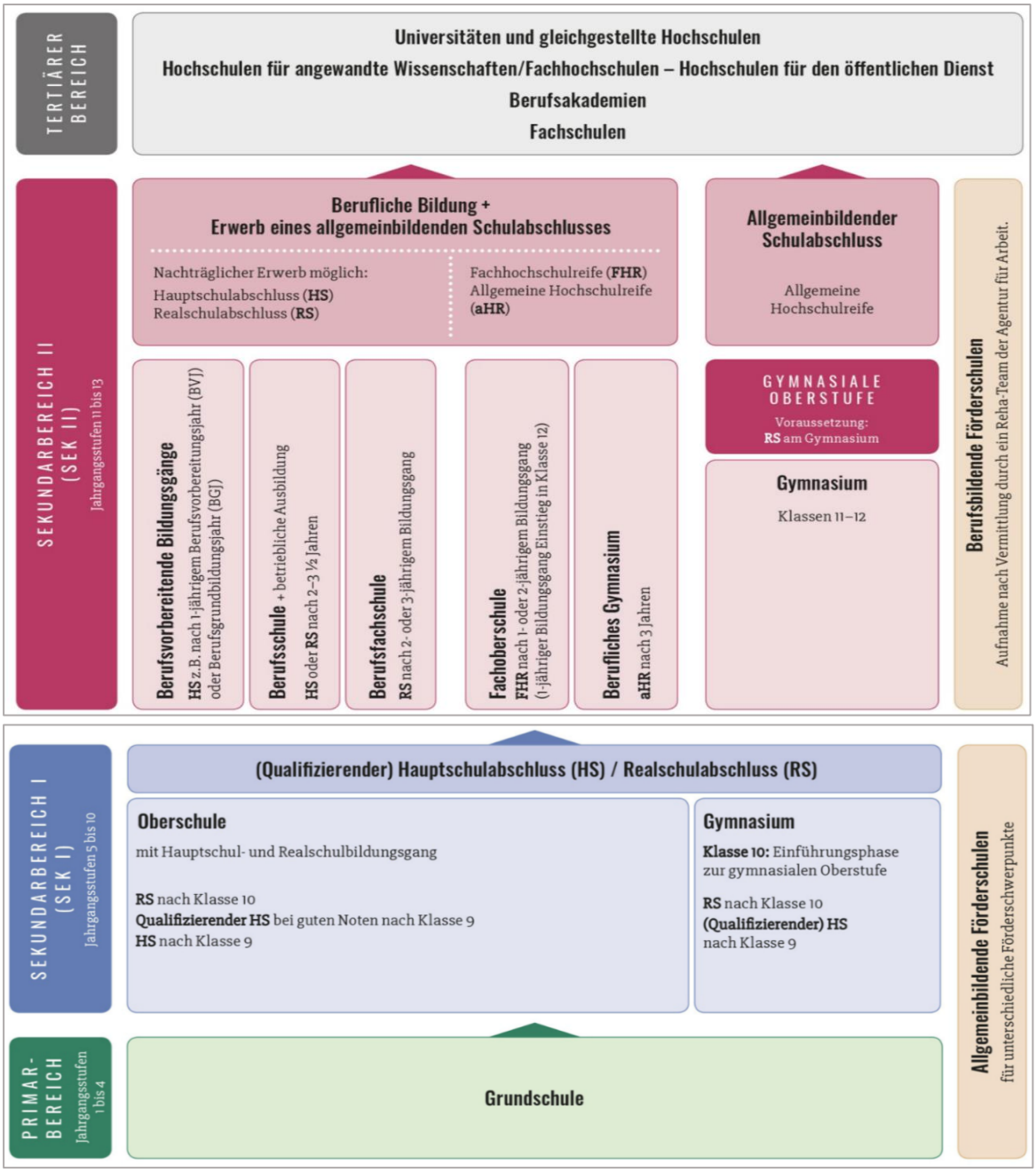


Figure 2.4.1.1: Educational system at Regional level, for Saxony. Source: Bundesagentur für Arbeit – Schulsystem-Grafik Sachsen, 2019 from http://planet-beruf.de/lehrerinnen/berufswahl-aktuell/schule-berufswahl/grafische-uebersichten-der-schulsysteme-nach-bundeslaendern/

Legend

Ba.	Bachelor programme
Ma.	Master programme
Dipl.	Diploma programme
Number (3 – 10)	Indicates the regular study period (semesters)
Lang.	Language of instruction, German, English

1. Mathematics, Computer Science & Natural Sciences / Mathematik, Informatik & Naturwissenschaften

Degree programme name English	Degree programme name German	Ba.	Ma.	Dipl.	Lang.
Applied Computer Science	Angewandte Informatik	6	4		
Applied Natural Science	Angewandte Naturwissenschaft	6	4		
Business Mathematics	Wirtschaftsmathematik	6	4		
Chemistry	Chemie	6	4	10	
Applied Mathematics	Angewandte Mathematik			9	
Internet of Energy	Internet der Energie	6			
Sustainable and Innovative Natural Resource Management (SINReM)			4		

2. Earth Sciences / Geowissenschaften

Degree programme name English	Degree programme name German	Ba.	Ma.	Dipl.	Lang.
Advanced Mineral Resources Development (AMRD)			4		
Geoecology (Earth System Science)	Geoökologie	6	4		
Geo-Engineering and Mining	Geotechnik und Bergbau			9	
Geoinformatics	Geoinformatik		4		
Geoinformatics and Geophysics	Geoinformatik und Geophysik	6			
Geology/Mineralogy	Geologie/Mineralogie	6			
Geomatics for Mineral Resource Management			4		
Geophysics	Geophysik		4		
Geoscience			4		
Geosciences	Geowissenschaften		4		
Groundwater Management			4		
Mine Surveying and Applied Geodesy	Markscheidewesen und Angewandte Geodäsie			10	
Sustainable Mining and Remediation Management (MORE)			3		

3. Engineering Sciences / Ingenieurwissenschaften

Degree programme name English	Degree programme name German	Ba.	Ma.	Dipl.	Lang.
Advanced Materials Analysis (AMA)			4		
Ceramic, Glass and Building Materials Technology	Keramik, Glas- und Baustofftech.		3	10	
Computational Materials Science (CMS)			4		
Computational Science and Engineering[1]			4		
Energy Engineering	Energietechnik	7	3		
Environmental Engineering	Umwelt-Engineering	7	3		
Foundry Technology	Gießereitechnik	7	3		
Industrial Engineering and Management	Wirtschaftsingenieurwesen	7	3	10	
Materials and Components for Vehicles	Fahrzeugbau: Werkstoffe und Komponenten		3	10	
Materials Science and Materials Technology	Werkstoffwissenschaft und Werkstofftechnologie			10	
Mechanical and Process Engineering			4		
Mechanical Engineering	Maschinenbau	7	3	10	
Metallic Materials Technology			3		
Nanotechnology	Nanotechnologie		4	10	
Process Engineering	Verfahrenstechnik	7	3	10	
Technology and Application of Inorganic Engineering Materials (TAIEM)			4		

4. Economics and interdisciplinary degree programmes / Wirtschaftswissenschaften und interdisziplinäre Studiengänge

Degree programme name English	Degree programme name German	Ba.	Ma.	Dipl.	Lang.
Business Administration	Betriebswirtschaftslehre	6	4		
Business Administration for the Resources Based Industry	Betriebswirtschaftslehre für die Ressourcenwirtschaft			9	
Business Analytics			4		
Business and Law		8			
Energy and Resource Management	Energie- und Ressourcenwirtschaft		4		
Industrial Archaeology	Industriearchäologie	6			
Industrial Engineering and Management	Wirtschaftsingenieurwesen	7	3	10	
Industrial Heritage	Industriekultur		4		
International Business in Developing and Emerging Markets (IBDEM)			4		
International Management of Resources & Environment (IMRE)			4		
Technology Law	Technikrecht		4		

Tables 2.4.1.1-2.4.1.4: Tables with the study programmes in TUBAF, and the directly linked to M&M in yellow Source: TUBAF International Office, 2019 from https://tu-freiberg.de/sites/default/files/media/internationales-universitaetszentrum-alexander-von-humboldt-170/pdf/tu-bergakademie-freiberg_degree_programmes.pdf)

This section listed **universities and universities of applied sciences** in other Federal states having study programmes or faculties relevant to M&M. The data that follow represent the **number of Universities with departments / schools**, in which students have the opportunity to attend courses related to M&M and the number of participating students per University (per year or data for a certain period).

Technical University of Clausthal

- Faculty of Natural and Materials Science
  - Institute of Electrochemistry
  - Institute of Energy Research and Physical Technologies
  - Institute of Inorganic and Analytical Chemistry
  - Institute of Materials Science and Engineering
  - Institute of Metallurgy
  - Institute of Non-Metallic Materials
  - Institute of Organic Chemistry
  - Institute of Physical Chemistry
  - Institute of Polymer Materials and Plastics Engineering
  - Institute of Technical Chemistry
  - Institute of Theoretical Physics
- Faculty of Energy and Economic Sciences
  - Institute of Disposal Research
  - Institute of Electrical Power Engineering and Energy Systems
  - Institute of Energy Process Engineering anf Fuel Technology
  - Institute of Geology and Paleontology
  - Institute of Geophysics
  - Institute of Geotechnical Engineering and Mine Surveying
  - Institute of German and International Mining and Energy Law
  - Institute of Management and Economics
  - Institute of Mineral Waste Processing, Disposal and Geomechanics
  - Institute of Mining
  - Institute of Petroleum Engineering

RWTH Aachen University

- Faculty of Georesources and Materials Engineering
  - Division of Mineral Resources and Raw Materials Engineering
  - Division of Materials Science and Engineering
  - Division of Earth Sciences and Geography

Technical Hochschule Georg Agricola

- Faculty Geo-Resources and Process Engineering
  - Applied Geology
  - Geotechnical Engineering
  - Mineral Resource Engineering
  - Post-Mining
  - Process Engineering
  - Surveying

Hochschule Nordhausen

- Master study: Geo-Engineering

Regarding the **number of participating students/graduates per department/schoo**l related to M&M (per year or data for a certain period), the Tables that follow represent data for the two universities).

TUBAF (Saxony)

Year	Total # of students
2018	4,060
2017	4,293
2016	4,624

Table 2.4.1.5: Total number of students for the university of TUBAF, in the Region of Saxony.

TU Clausthal (Niedersachsen)

Year	# of students in MM related faculties			Total # of students
	Natural and Materials Science	Energy and Economics Sciences	Sum	
2018	519	2,187	2,706	4,093
2017	527	2,483	3,010	4,460
2015*		3,324		4,877
2010*		2,353		3,569
2005*		1,589		3,070
2000		-		2,625

Table 2.4.1.6: Students in Natural and Materials Science and Energy and Economics Sciences, as well the total number of students for the university of TU Clausybal. *Study programme in faculties varied so the number is only an estimation.

2.4.2 Other types of training related to mining and metallurgy

- Regarding the Region of Saxony: **Julius Weisbach** (BSZ Freiberg): **Vocational training** in geological engineering, drilling technique and mining engineering.

2.4.3 Co-operation between academia & mining and metallurgy industry

An example of **close collaboration** between education system and industry given here is the **German Vocational training** (Duale Ausbildung) which combines theoretical and practical training. Trainees spend 3 days a week in the company for practical training. The remaining two days are spent at school for more theoretical learning.
In general, there is **medium-high cooperation** between academia and industry due to networking organisations such as GKZ and regional economic development agencies.

2.4.4 Research centers, programs and events, and projects related to mining and metallurgy industry

Institutes that can have collaboration with the M&M industry or other institutes in EU, are the following:

1. Technical University Bergakademie Freiberg (TUBAF)

- Type of organization: Public university
- Area of specialties: Subjects along the raw materials value chain (See 6.1 for details)
- Collaboration at the EU level: High
  - 3 MM focused H2020 projects in active
  - Also participated in FP7 and RFCS
  - Collaboration with industry: High level of cooperation
    - The TUBAF-department 2 - Studies and Research has the right to conclude the following agreements with the industry:
      - R&D contracts, R&D framework agreements and research cooperation agreements
      - service level agreements
      - Cooperative applications for research funding
      - Non-disclosure/confidentiality agreements
      - Agreements on intellectual property matters
    - The university has also a Technologietranfer Centre under university research department which serves as contact point for knowledge and technology transfer. It advices on research funding and third-party funded research and on inventions, industrial property rights and their exploitation. Other focuses are:
      - Mediation of offers for further education in higher education
      - Central university continuing education in ACATRAIN e. V.
      - Professional Schools of EIT RawMaterials
      - Promotion of spin-offs through the SAXEED start-up initiative
      - Preparation and review of research and development contracts
      - Cooperation with the IHK (Chamber of Industry and Commerce) and with business development institutions

2. Helmholtz Zentrum Dresden Rossendorf (HZDR) – Helmholtz Institute Freiberg for Resource Technology

- Type of organization: Non-profit public institution supported by the Federal Government and the Free State of Saxony and a member of the Helmholtz Association of German Research Centres
- Source of funding: 90% from the Federal Government and 10% from the Free State of Saxony
- Area of specialties:
  - Exploration
  - Processing
  - Biotechnology
  - Metallurgy and recycling
  - Analytics
  - Modelling and valuation
  - System integrated metal production
- Collaboration at the EU level: High
  - 9 H2020 projects in active
    - Coordinator of IONS4SET and NetFlot
    - European Research Council Starting Grant: SMaRT and XFLOW
  - (More details can be found here: https://www.hzdr.de/db/Cms?pNid=2194)
- Collaboration with industry: Active in joint research projects, technology transfer and knowledge transfer (More information https://www.hzdr.de/db/Cms?pNid=1991&pOid=55051)
- MM related Spin-offs:
  - ERZLABOR Advanced Solutions GmbH
  - i3 Membrane

3. Geokompetenzzentrum Freiberg e.V. (GKZ)

- Type of organization: Non-profit organization
- Area of specialties:
  - Linking up regional administrative, industries and research institutions in mining and metallurgy sector
- Collaboration at the EU level: High, actively participating in H2020 and Interreg projects
- Collaboration with industry: High, most of the GKZ members are SMEs in MM industries

It follows the most important **programs & events** related to M&M industry:

- **GKZ**
  - **Annual Saxon Raw Materials Day (Sächsischer Rohstofftag)**
    - An event participated by regional administrative, national and regional research institutes, national and regional companies and international partners in MM sector
    - Aim to provide participants the latest development in MM sector at the European level, (national level?), and regional level
    - Networking opportunities

- **Annual Stone Excursion**
  - German natural stone extractors and processors, restorers, spatial planners, and monument/restoration building dealing natural stones.
  - The purpose of this excursion is to link-up natural stone businesses through visiting quarries (extraction and processing activities) as well as learning of construction/restoration of natural stone abroad.

- **IHK**

2.5 CASE STUDY: REGION OF KOŠICE

2.5.1 Academic potential related to mining and metallurgy

The educational System of Slovak Republic is **compulsory** from ages 6 to 16 and is fully funded by the state at all levels. The schools are funded from the State budget (according the number of pupils and students), regional and district budget, fees, institutional entrepreneurship, donations. The adult literacy rate of Slovak Republic is 99.6 %.

Pre-school education is composed of **nurseries** and **kindergartens**. Nurseries provide care for children up to 3 years of age, mainly for the children of employed mothers. Kindergartens are assigned for children from 3 to 6 years of age. Their main function in addition to caring for children is preparation for primary school.

Primary schools are providing general education. Elementary education lasts for 9 years. These schools consist of two levels: The 1st level (1st – 4th grade) and the 2nd level (5th – 9th grade), which is usually differentiated according to the interests and skills of students. Students are accepted in the 1st grade after reaching 6th year of age. The compulsory education in Slovak Republic lasts for 10 years. After their graduation from primary schools, students must apply to secondary schools.

Secondary education is comprised of three types of secondary schools: **gymnasium, secondary specialized school** and **secondary vocational school**. The applicants for secondary school education must pass selective exams for all types of secondary schools. **Secondary Grammar Schools** called **Gymnasiums** provide general secondary education and prepare students particularly for further study at higher educational institution. The study lasts four years and ends with the "Maturita Examination" (graduation examination). This examination is given after at least 12 years of total school attendance. Students must pass this examination successfully if they plan to apply for study at a university or a college. **Secondary Specialized Schools** prepare students mainly for occupations in technical and economic sectors, pre-school education, medical nursery care, and fine arts and design. They educate specialists for individual industries, such as the construction, transportation, agriculture, food industry, services, economics, financial sector, culture, state administration and other areas of social life. Students at these schools must pass the “Maturita examination” (graduation examination) in both general and specialized subjects. They are then prepared for work in the field of study or may continue to study on institutions of higher education. **Secondary Vocational Schools** prepare students for various occupations and working activities, which may or may not require training and the “Maturita Examination”. Education and training comprise general and vocational part. Study at secondary vocational schools takes 2-4 years to complete. Students who successfully complete the vocational education and pass the “Maturita Examination”, however, may continue to study at a higher education institution.

Post-Secondary Education: Many secondary vocational schools offer the possibility for graduates to continue with the education for 2 or 3 years of study. This education is leading to upgrading the already gained qualification, obtaining of additional and new scientific and practical knowledge in

the respective field of study or training and education in a different field of study. After finishing the studies, the graduates obtain a certificate which entitles them to become a certified specialist in the respective field.

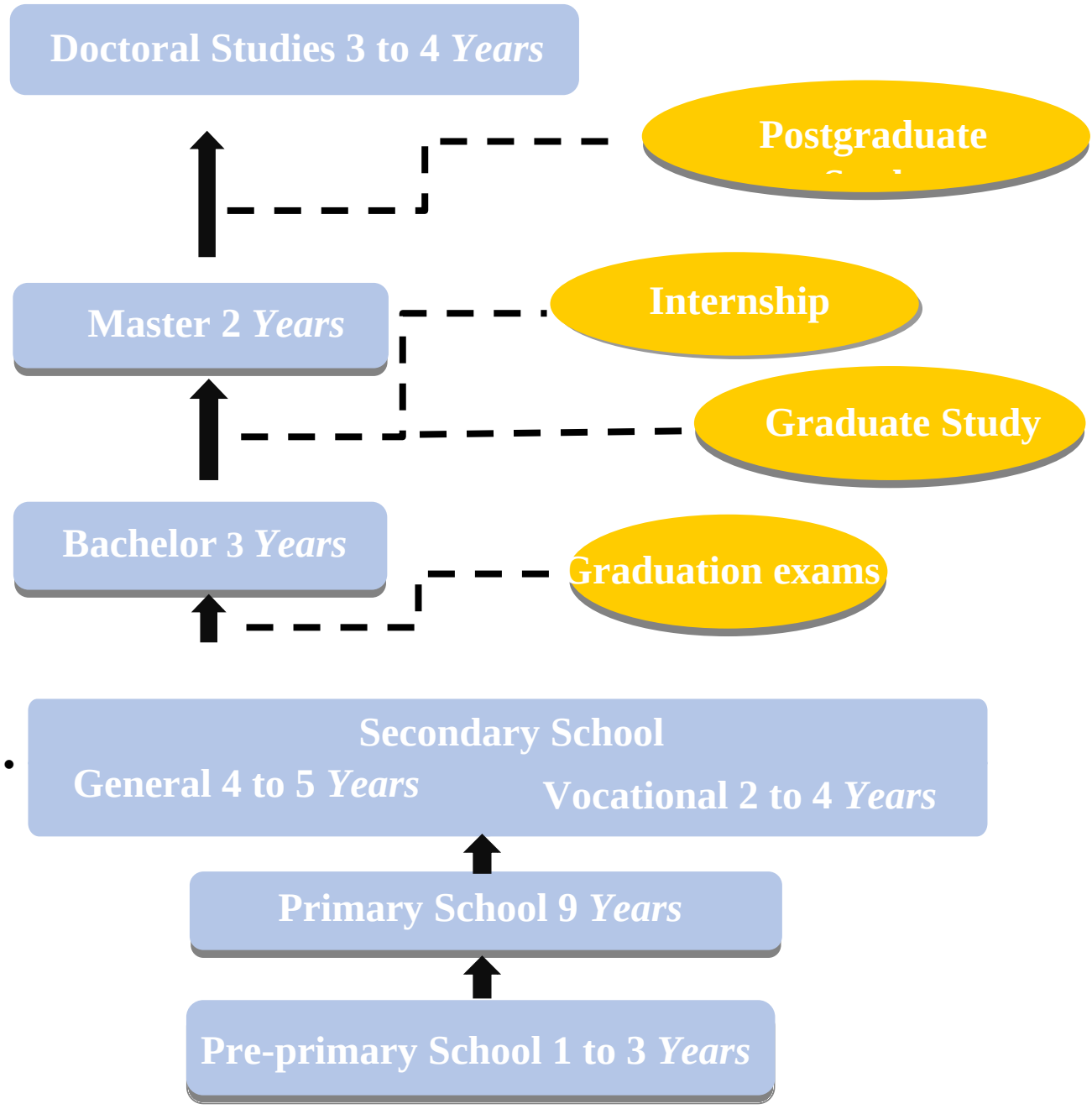


Figure 2.5.1.1: The educational System of Slovak Republic.

Faculty of Mining, Ecology, Process Control and Geotechnologies (FBERG) which is the part of Technical University of Košice is the **only** higher educational school in Slovakia that is targeting the higher education in the field of **mining**. Faculty of Mining, Ecology, Process Control and Geotechnologies historically refers to the Mining Academy in Banská Štiavnica, promoted to the academic level by Maria Theresa, queen of Hungary and Bohemia, in 1762. As one of the three founding faculties, the Faculty of Mining, Ecology, Process Control and Geotechnologies (Mining Faculty in that time), was involved in the establishment and formation of the Technical University of Košice.

On this deep and strong basis, FBERG provides education in traditional mining disciplines, including geology; mining; minerallurgy and environmental technologies; technologies in fuel and gas industry; mining mechanization, transport and deep drilling. Attending to growing society needs for the knowledge economy development, the faculty also provides education in attractive and requested study programs (**Table 2.5.1.1**) covering economy of Earth resources; geodesy and geographical information systems; geotourism and mining tourism, informatization and process control; industrial logistics; and rescue, fire and safety techniques.

The higher education in the field of **metallurgy** is provided in the Slovakia by the **Technical University of Košice (TUKE)** with the Faculty of Materials, Metallurgy and Recycling.

The TUKE Faculty of Materials, Metallurgy and Recycling consistently bases on the cultural and technical fundamentals of the metallurgical traditions and claims to follow the spiritual and civilization values and traditions, origin of which had been the Academia Montanistica Schemniciensis – the Academy of Mining of Banska Stiavnica - founded in the year 1762 by Maria Theresa, the Queen of Hungary and Bohemia. Nowadays Faculty offers Bachelor, Master and Doctoral degrees in the field of Metallurgy, Materials and Recycling (**Table 2.5.1.2**).

Table 2.5.1.1: Study programs provided on the Faculty of Mining, Ecology, Process Control and Geotechnologies.

Study programs	Level of study	Form of study	Study length	Title	Study language
Automation and Process Control of Raw Materials Extraction and Processing	1.	FT/PT	3/4	Bc.	SK, EN
Mining and Geotechnics	1.	FT/PT	3/4	Bc.	SK, EN
Transport Logistics of Enterprise	1.	FT/PT	3/4	Bc.	SK, EN
Geodesy and Geographical Information Systems	1.	FT/PT	3/4	Bc.	SK, EN
Geodesy and Land Cadastre	1.	FT/PT	3/4	Bc.	SK, EN
Geology and Regional Development	1.	FT/PT	3/4	Bc.	SK
Geological Prospection	1.	FT/PT	3/4	Bc.	SK, EN
Geotourism	1.	FT/PT	3/4	Bc.	SK, EN
Urban Water Management	1.	FT/PT	3/4	Bc.	SK, EN
Informatization of Processes of Raw Materials Extraction and Processing	1.	FT/PT	3/4	Bc.	SK, EN
Commercial logistics	1.	FT/PT	3/4	Bc.	SK, EN
Management of Processes	1.	FT/PT	3/4	Bc.	SK
Management of Earth's Resources	1.	FT/PT	3/4	Bc.	SK, EN
Mineralurgy and Environmental Technologies	1.	FT/PT	3/4	Bc.	SK, EN
Environmental Protection and Ecotechnologies of Raw Materials	1.	FT/PT	3/4	Bc.	SK, EN
Industrial Logistics	1.	FT/PT	3/4	Bc.	SK, EN
Quality Control of Processes of Raw Materials Extraction and Processing	1.	FT/PT	3/4	Bc.	SK, EN
Raw Materials Engineering	1.	FT/PT	3/4	Bc.	SK, EN
Technologies in Oil and Gas Industry	1.	FT/PT	3/4	Bc.	SK, EN
Use of Alternative Energy Resources	1.	FT/PT	3/4	Bc.	SK, EN
Rescue, Fire and Safety Technics	1.	FT/PT	3/4	Bc.	SK, EN
Process Control of Raw Materials Extraction and Processing	2.	FT/PT	2/3	Ing.	SK, EN
Transport Logistics of Enterprise	2.	FT/PT	2/3	Ing.	SK, EN
Geological Engineering	2.	FT/PT	2/3	Ing.	SK, EN
Geotourism	2.	FT/PT	2/3	Ing.	SK, EN
Informatization of Processes of Raw Materials Extraction and Processing	2.	FT/PT	2/3	Ing.	SK, EN
Engineering Geodesy and Real Estate Register	2.	FT/PT	2/3	Ing.	SK, EN
Management of Earth's Resources	2.	FT/PT	2/3	Ing.	SK, EN
Mineralurgy and Environmental Technologies	2.	FT/PT	2/3	Ing.	SK, EN
Industrial Logistics	2.	FT/PT	2/3	Ing.	SK, EN
Quality Control of Processes of Raw Materials Extraction and Processing	2.	FT/PT	2/3	Ing.	SK, EN
Technologies of Mining and Tunnelling	2.	FT/PT	2/3	Ing.	SK, EN

Technologies in Oil and Gas Industry	2.	FT/PT	2/3	Ing.	SK, EN
Use of Alternative Energy Resources	2.	FT/PT	2/3	Ing.	SK, EN
Rescue, Fire and Safety Technics	2.	FT/PT	2/3	Ing.	SK, EN
Mining Geology and Geological Exploration	3.	FT/PT	3/4	PhD.	SK, EN
Mining Mechanization, Transport and Deep Hole Drilling	3.	FT/PT	3/4	PhD.	SK, EN
Mining Surveying and Geodesy	3.	FT/PT	3/4	PhD.	SK, EN
Economy of Earth's Resources	3.	FT/PT	3/4	PhD.	SK, EN
Mineralurgy and Environmental Technologies	3.	FT/PT	3/4	PhD.	SK, EN
Industrial Logistics	3.	FT/PT	3/4	PhD.	SK, EN
Process Control	3.	FT/PT	3/4	PhD.	SK, EN
Process Control of Raw Materials Extraction and Processing	3.	FT/PT	3/4	PhD.	SK, EN
Mining and Engineering Geotechnologies	3.	FT/PT	3/4	PhD.	SK, EN
Use and Protection of Earth Resources	3.	FT/PT	3/4	PhD.	SK, EN

* Level of study – 1. Level ("Bachelor" degree), 2. Level ("Magister" and "Engineer" degree), 3. Level ("Doctoral" degree)
* Form of study – FT (Full-time study), PT (Part-time study)
* Study language – SK (Slovak Language), EN (English Language)

Table 2.5.1.2: Study programs provided on the Faculty of Materials, Metallurgy and Recycling

Study programmes	Study level	Study form	Study length	Title	Language
Metallurgy	1.	FT/PT	3/4	Bc.	SK
Integrated Management Systems	1.	FT/PT	3/4	Bc.	SK
Materials	1.	FT/PT	3/4	Bc.	SK
Waste Treatment and Recycling	1.	FT/PT	3/4	Bc.	SK
Heat engineering and gas industry	1.	FT/PT	3/4	Bc.	SK
Integrated Management Systems	2.	FT/PT	2/3	Ing.	SK
Metallurgy	2.	FT/PT	2/3	Ing.	SK
Materials Engineering	2.	FT/PT	2/3	Ing.	SK
Waste Treatment and Recycling	2.	FT/PT	2/3	Ing.	SK
Heat engineering and gas industry	2.	FT/PT	2/3	Ing.	SK
Materials Forming	2.	FT/PT	2/3	Ing.	SK
Foundry	2.	FT/PT	2/3	Ing.	SK
Production Quality Engineering	3.	FT/PT	4/5	PhD.	SK, EN
Metallurgy	3.	FT/PT	4/5	PhD.	SK
Materials Science	3.	FT/PT	4/5	PhD.	SK, EN
Plastic Deformations	3.	FT/PT	4/5	PhD.	SK, EN
Waste Treatment and Recycling	3.	FT/PT	4/5	PhD.	SK
Heat engineering	3.	FT/PT	4/5	PhD.	SK

* Level of study – 1. Level ("Bachelor" degree), 2. Level ("Magister" and "Engineer" degree), 3. Level ("Doctoral" degree)
* Form of study – FT (Full-time study), PT (Part-time study)
* Study language – SK (Slovak Language), EN (English Language)

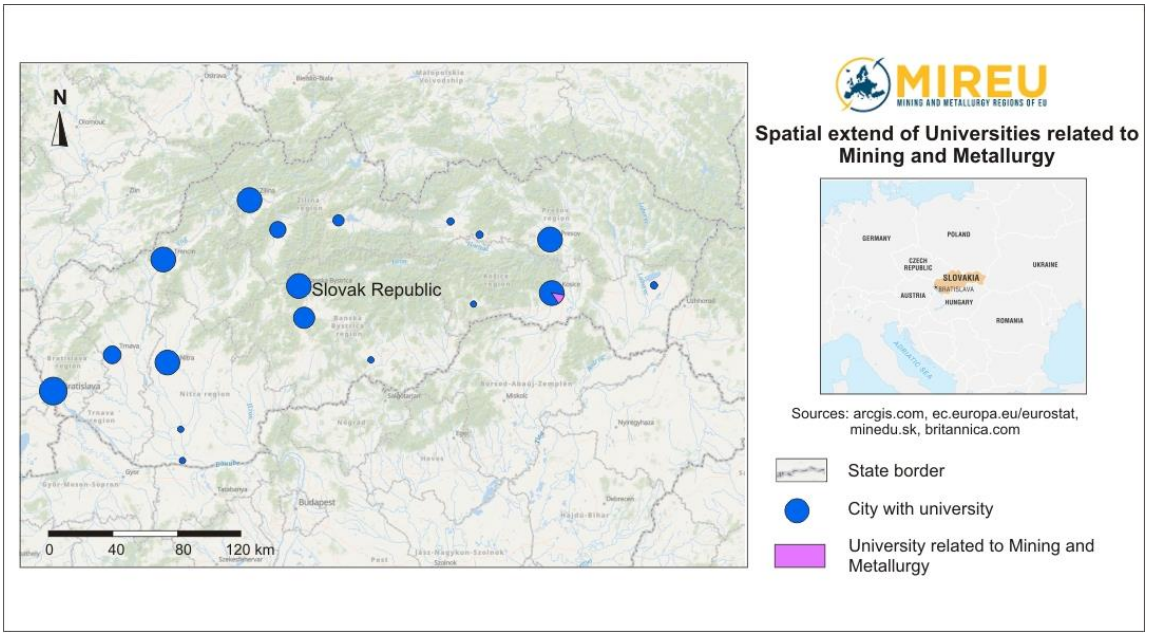


Figure 2.5.1.2: Spatial extent of the Universities with studies related to the MM sectors in Slovakia.

2.5.2 Other types of training related to mining and metallurgy

- Other types of training in the field of MM in Slovak Republic consist of **training** provided by the employers in these fields. Most common type of training associated with the start of working for the employer is the **Health and safety** at work training which is mandatory for new employees.

- **Lecturing activities** are also covered by the **Main Mining Authority office** in various forms of training and courses, where inspectors of the office give lectures on mining regulations, especially regulations on safety and health protection at work, safety of technical equipment and operation safety. This lecturing and training activities are mostly covered by various professional trainings and seminars organized in close cooperation with the Slovak Mining Society, Slovak Society for Blasting and Drilling Works and the Slovak Association of manufacturers stone. It is obvious that such a form is acceptable for the interested group of interested parties, because it provides an overview of the latest knowledge in the above areas.

2.5.3 Co-operation between academia & mining and metallurgy industry

Regional Industry entities are cooperating with academia very intensively. Since the only academic institution in Slovakia dealing with MM operates at the Technical University of Košice, industry cooperates only with this university.

This cooperation consists of 3 pillars:

1. Networking - meeting with industrial partners, presenting opportunities for cooperation, discussing bilateral needs, facilitating cooperation in innovation communities, facilitating cooperation with other entities from the university network, preparing for joint submission of project plans (domestic and foreign grants), building the join project consortia
2. Education activities - it is education of professionals according to market requirements, education of students according to the needs of industry, workshops and seminars on professional topics with the invitation of speakers from industry, cooperation on the creation of study programs, cooperation on solving diploma theses in real industry environment
3. Business creation - support for young and start-up entrepreneurs through workshops, idea competitions and placement in business incubators, support for entrepreneurs in applying for grants and assistance from various competitions.

Many of the above activities are related to Faculty of Mining, Ecology, Process Control and Geotechnologies, Faculty of Metallurgy, University Science Park Technicom, programs as Horizon 2020 or EIT Raw Materials.

2.5.4 Research centers, programs and events, and projects related to mining and metallurgy industry

Kosice Self Governing Region

- Public organization
- The region self-governing and development
- High rate of collaboration with the EU institutions
- High rate of collaboration with Industry
- Funding depending on the public sources

Technical University of Kosice

- Public organization
- Higher education, education, research and development
- High rate of collaboration with the EU institutions
- High rate of collaboration with Industry
- Funding depending on the public sources
- Around 100 patents/ year

Slovak Academy of Science

- Public organization
- Research and development

- High rate of collaboration with the EU institutions
- High rate of collaboration with Industry
- Funding depending on the public sources
- Around 20 patents/ year

EIT Raw Materials Regional Center Kosice

- Organization rated as other
- Consultancy and support
- High rate of collaboration with the EU institutions
- High rate of collaboration with Industry
- Funding depending on the public sources

The **EIT Regional Innovation Scheme** (EIT RIS) is a structured **program** to support the integration of the Knowledge Triangle (connecting partners from leading business, research and education) and increase the innovation capacity in areas and regions in Europe not directly benefiting from the EIT and its Knowledge and Innovation Communities (KICs).
EIT Raw Materials Regional Center Kosice is currently working with partners in the following countries: Czech Republic, Hungary, Romania, Slovakia, Ukraine. Country and regional activities focus on professional education, ideation and acceleration, inter-regional activities include capacity-building, scaling and demonstration.
Events in the region related to the MM industry are mainly conducted by the Faculty of BERG, Technical University of Kosice, projects and events related to EIT Raw Materials or Horizon 2020 and initiatives of local mining associations (approximately 10-15 events in the Region per year).
The **project activity** in this area is extremely dependent on the above mentioned EIT Raw Materials and Horizon 2020 schemes. We do not count small projects of domestic character and projects not financed from public sources. All these projects are led or participated by the BERG Faculty, Technical University of Košice.

2.6 CASE STUDY: REGION OF LOWER SILESIA

2.6.1 Academic potential related to mining and metallurgy

Early Childhood Education and Care

Early childhood education and care (ECEC) in Poland is divided into two stages:

- for children aged 0-3 years in crèches and, as from 2011, kids' clubs, or settings where care is provided by child minders and nannies;
- for children aged 3-6 years in nursery schools, pre-school classes in primary schools and other pre-school education settings, including pre-school education units and centres.

In accordance with the Act of 14 December 2016, the Law on School, pre-school education is considered the first level of school education. Pre-school education institutions in Poland are attended by children from the age of 3 years up to the start of primary school.

Primary education

The basic legislation for **primary education** is the Act of 14 December 2016, the Law on School Education, supplemented by the School Education Act of 7 September 1991 (still partly in force). Detailed arrangements are laid down in the Regulations of the minister responsible for school education.

Primary education is compulsory. The eight-year primary school is attended by children between the ages of 7 and 15. Primary education is divided into two stages:

- **Stage I, grades I to III**, offering integrated early school education,
- **Stage II, grades IV to VIII**.

No compulsory test or examination is taken between the two stages.

Local government units (communes) are the managing bodies for most primary schools. Primary schools managed by private entities receive grants from local government budgets. Relevant provisions are included in the Act of 27 October 2017 on the Financing of School Education Tasks and resolutions adopted by communes.

Subsequently, young people continue education in post-primary schools (upper secondary schools) or in other forms of education, as defined by law, such as practical vocational training at a workplace, combined with theoretical training, or vocational qualification courses (education is compulsory until the age of 18).

Secondary education

Since 1 September 2017, a process has been underway to abolish gradually the model of education referred to as "6+3+3". Lower secondary schools have been replaced with 8-year primary schools, which cover two levels: ISCED 1 (primary education) and ISCED 2 (lower secondary education). This is combined with a far-reaching reform of upper secondary education. The current model of education can be briefly described as "8+4 (+5)" (4-year education cycle in general secondary schools; longer, 5-year education cycle in vocational secondary schools). The new system is expected to be fully in place in the school year 2022/2023. The new structure includes:

- 8-year primary school
- 4-year general upper secondary school
- 5-year technical upper secondary school
- Stage I 3-year sectoral vocational school
- Stage II 2-year sectoral vocational school
- 3-year special school preparing for employment
- Post-secondary school.

Transformation of previously existing upper secondary schools, education stage IV, into secondary (post-primary) schools, education stage III in the new school system

- As from 1 September 2017, previously existing 3-year basic vocational schools are transformed into a new type of stage I sectoral vocational schools. Those finishing the new school will receive a diploma upon passing exams confirming vocational qualifications. They may continue education either in a stage II sectoral vocational school training for an occupation, which embraces a qualification common to the occupation for which students are trained in stage I and stage II schools, or in a general upper secondary school for adults, starting in grade II. However, stage I sectoral vocational schools continue to provide training as in the previously existing basic vocational schools until the cohorts of students enrolled in the old school system complete their education.
- As from 1 September 2019, 3-year general upper secondary schools where students may obtain a maturity certificate upon passing the maturity exam, will be transformed into a new type of 4-year general secondary schools.
- As from 1 September 2019, 4-year technical upper secondary schools, where students may obtain a diploma upon passing exams confirming vocational qualifications and may also take the maturity exam and obtain a maturity certificate, will be transformed into 5-year technical secondary schools.
- As from 1 September 2020, stage II sectoral vocational schools, providing 2-year programmes, will be established. Upon passing an exam confirming vocational qualifications, students may obtain a diploma confirming vocational qualifications in an occupation at the level of Technician which embraces a qualification common to the occupation for which students are trained in stage I and stage II schools. They may also obtain a maturity certificate upon passing the maturity exam.
- The education system will continue to include 3-year special schools preparing for employment, which are intended for pupils with moderate and severe intellectual disabilities and pupils with multiple disabilities, and which award a diploma confirming preparation for employment.

Higher education

First-cycle programmes are divided into practically oriented and academically oriented programmes (a so-called practical and general academic orientation / profile). The official duration of first - cycle (Bachelor's degree) programmes in both university-type and non-university HEIs is at least 6 semesters for programmes leading to a *licencjat* degree and at least 7 semesters for programmes leading to an *inżynier* degree, depending on the area of study. A Bachelor's degree

(*licencjat* or *inżynier*) entitles its holder to practise a given profession and provides access to second - cycle (Master's degree) programmes.

Second - cycle programmes are divided into practically oriented and academically oriented programmes (a so-called practical and general academic orientation / profile), and this is reflected in curriculum design.

Second - cycle programmes offered by both university-type and non-university HEIs end with the final (diploma) examination, except in medical areas. It is conducted by an examination board composed of academic teachers of the organisational unit of a HEI (e.g. faculty or department), which provides the programme concerned. Students who have passed the final exam are awarded a higher education diploma, which confirms the completion of a given programme and the award of the relevant degree in a given area.

A Master's degree or equivalent degree entitles its holder to practise a given profession and provides access to third - cycle (doctoral) programmes.

Detailed organisational arrangements for **third - cycle programmes** are laid down by the Law on Higher Education and Science. Doctoral programmes, offered by university-type HEIs and research institutions other than HEIs, prepare for the award of a doctoral degree

Doctoral programmes / studies at doctoral schools, operating within Higher education institutions (HEI) and research institutions other than HEIs, last 3 to 4 years, the predominating model being a 4-year programme.

Higher education institutions

There are **two main types** of HEIs in Poland: university-type HEIs and non-university HEIs.

A university-type HEI is an institution, which conducts research activity and has the A+, A or B+ research rating in at least 1 discipline of science or arts. (Ratings are awarded based on an external evaluation of the quality of research.) It may provide first-cycle programmes leading to a Bachelor's degree (ISCED 6), second-cycle or long-cycle programmes leading to a Master's degree (ISCED 7), and third-cycle (doctoral) programmes (ISCED 8).

A non-university HEI is an institution, which offers programmes responding to the needs of the socio-economic environment and does not fulfil the criteria for a university-type HEI. It provides first - cycle programmes and may also provide second- and long-cycle programmes. This type of institutions also includes HEIs earlier classified as schools of higher professional education, which are authorised to provide only first-cycle programmes. Non-university HEIs offer only practically oriented programmes.

In the academic year 2017/2018, Poland had 390 HEIs in total, including 267 non-public institutions. HEIs can be divided into the following types (according to the Central Statistical Office): universities (19), technical universities (23), agricultural institutions (7), universities / schools of economics (58), pedagogical institutions (13), medical universities (9), universities / institutions of maritime studies (2), universities / institutions of physical education (6), academies of fine arts (22), theological institutions (15), and institutions supervised by the minister responsible for national defence and the minister responsible for internal affairs (7).

Most public HEIs (around 70%) are university-type institutions, which provide first- and second - cycle and third - cycle (doctoral) programmes, while the remaining ones (around 30%) are non-university HEIs providing only first- and second cycle programmes.

It should be noted here that doctoral programmes may also be provided by research institutions other than HEIs, e.g. Polish Academy of Sciences, and research and development institutions, which are authorised to award post-doctoral degrees. Such research institutions are separate type of institutions whose primary task is to conduct research rather than provide degree programmes.

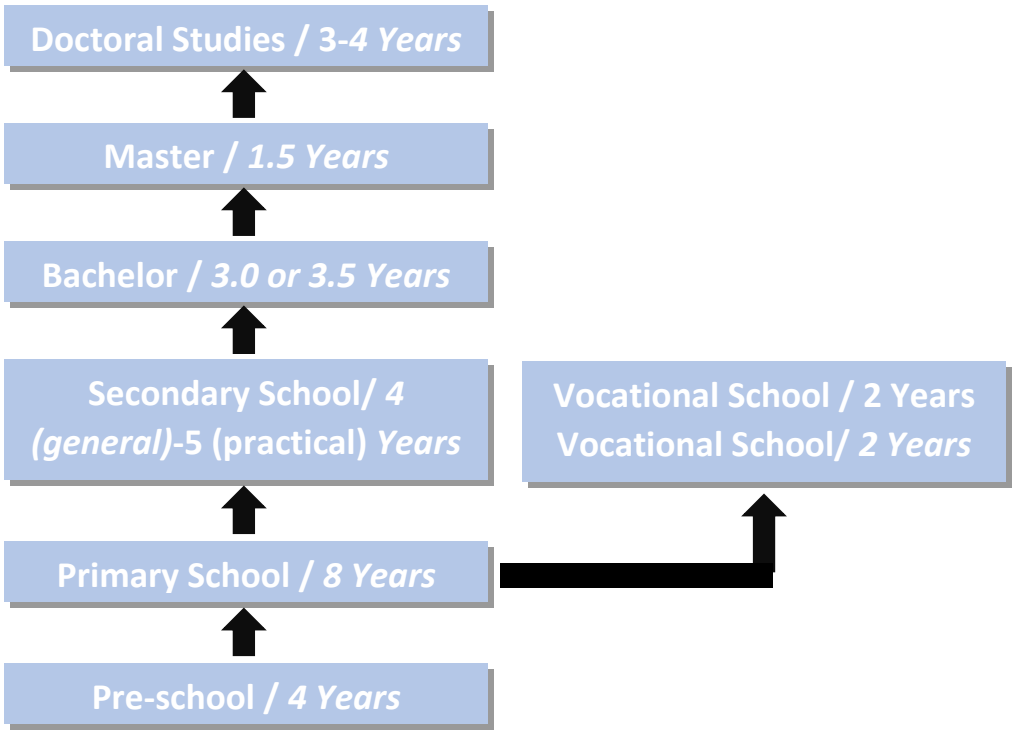


Figure 2.6.1.1: Simplified chart of the Polish education system

In Poland there are **three main technical universities** offering Bachelor and Master degree fields of study related to mining and metallurgy sector. These are: Wroclaw University of Science and Technology (located in Wroclaw in the Lower Silesia region), AGH University of Science and Technology (located in Cracow), and Silesian University of Technology (located in Gliwice). However, it should be noted that graduates of various fields of study such as geology, geodesy and cartography, chemistry, power engineering, environmental engineering and so on, offered by other universities and technical universities also find employment in the M&M sector.

At the **Wroclaw University of Science and Technology** the following Bachelor and Master programmers are offered by the Faculty of Geoengineering, Mining and Geology:

- Bachelor Degree in Mining and Geology,
- Bachelor Degree in Geodesy and Cartography,

- Master Degree in Mining and Geology. Specialisation Underground and Open Pit Mining of Deposits,
- Master Degree in Mining and Geology. Specialisation Raw Materials Economy and Environmental Protection,
- Master Degree in Mining and Geology. Specialisation Geoengineering,
- Master Degree in Mining and Geology. Specialisation Exploratory and Mining Geology,
- Master Degree in Mining and Geology. Specialisation Machine Operation Management,
- Master Degree in Mining and Geology. Specialisation Geoinformatics,
- Master Degree in Mining and Geology. Specialisation Geotechnical and Environmental Engineering (GEE) (in English language),
- Master Degree in Mining and Geology. Specialisation Mining Engineering (MGE) (in English language),
- Master Degree in Mining and Geology. Specialisation Geomatics for Mineral Resource Management) (English language double degree course with TU Freiberg, Germany),
- Master Degree in Geodesy and Cartography. Specialisation Geomatics.

At the AGH University of Science and Technology the following Bachelor and Master programmers are offered:

Faculty of Mining and Geoengineering

- Bachelor Degree in Mining and Geology
- Master Degree in Mining and Geology,
- Master Degree in Mining and Geology (in English language)

The Faculty of Geology, Geophysics and Environmental Protection

- Bachelor Degree in Geophysics,
- Bachelor Degree in Mining and Geology,
- Master Degree in Geophysics,
- Master Degree in Mining and Geology (also in English language)

The Faculty of Mining Surveying and Environmental Engineering

- Bachelor Degree in Geodesy, Surveying and Cartography,
- Master Degree in Geodesy, Surveying and Cartography,

The Faculty of Non-Ferrous Metals

- Bachelor Degree in Metallurgy,
- Master Degree in Metallurgy,

The Faculty of Drilling, Oil and Gas

- Bachelor Degree in Oil and Gas Engineering,
- Bachelor Degree in Mining and Geology,
- Master Degree in Oil and Gas Engineering,
- Master Degree in Mining and Geology

At the Silesian University of Technology the following Bachelor and Master programmers are offered by the Faculty of Mining, Safety Engineering and Industrial Automation:

- Bachelor Degree in Mining and Geology,
- Bachelor Degree in Mineral Resources Management,
- Master Degree in Mining and Geology. Specialisation Electrical engineering and automation in mining,
- Master Degree in Mining and Geology. Specialisation Underground construction and surface protection,
- Master Degree in Mining and Geology. Specialisation Resource exploitation and waste management,
- Master Degree in Mining and Geology. Specialisation Mining geodesy,
- Master Degree in Mining and Geology. Specialisation Mining and exploration geology,
- Master Degree in Mining and Geology. Specialisation Engineering geology and geotechnics,
- Master Degree in Mining and Geology. Specialisation Surface mining,
- Master Degree in Mining and Geology. Specialisation Computer science and management in mining,
- Master Degree in Mining and Geology. Specialisation Mining construction and road machines,
- Master Degree in Mining and Geology. Specialisation Mining and drilling machinery and equipment,
- Master Degree in Mineral Resources Management.

In addition, there are public **8 universities** offering geology fields of study and **11 public universities** offering geodesy and cartography programmes. The following ones located in the **Lower Silesia region**: University of Wroclaw and Wroclaw University of Environmental and Life Sciences. Location of the main universities offering M&M related study programs is shown in **Figure 2.6.2.2**.

Figure 2.6.2.2: Distribution of public technical universities offering fields of study related to mining and geology

At the **Wroclaw University of Science and Technology** in Lower Silesia the number of places available for first year students is 105 (bachelor degree in mining and geology) for day time studies and 75 (bachelor degree in geodesy and cartography). Whereas, the number of places for master studies is approx. 60 for mining and geology field of study and approx. 30 for geodesy and cartography field of study. The number of graduates of bachelor programmes is between 2/3 and 3/4 of the number of students starting education.

It is observed that the number of candidates interested in especially mining and geology field of study decreases. This is in accordance with the general trend in Poland. Over the past 10 years, the number of students in the country has steadily decreased from 1,927.8 thousand persons in the 2008/09 academic year to 1,230.3 thousand in the 2018/19 academic year. The largest number of graduates - 497.5 thousand people was reported in the 2010/11 academic year (**Figure 2.6.2.3).**

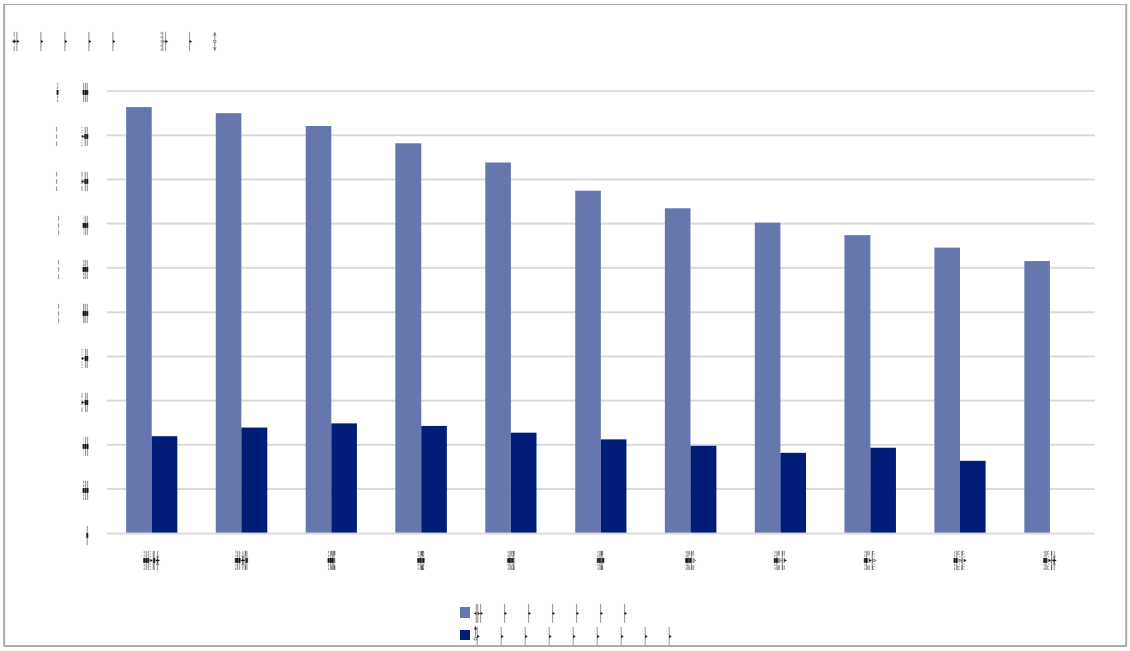


Figure 2.6.2.3. Students and graduates of higher education institutions, where "studenci" = "students" and "absolwenci" = "graduates" (www.gus.gov.pl)

2.6.2 Other types of training related to mining and metallurgy

The **Jan Wyżykowski University** located in Polkowice and Lubin offers Bachelor Degree in Mining and Geology in the following specializations: Mining techniques, Mining machines and equipment, Geodesy in mining and geology. The Faculty of Geoengineering, Mining and Geology at the **Wroclaw University of Science and Technology** offer 1-year post-graduate programme in Geographic information systems.

2.6.3 Co-operation between academia & mining and metallurgy industry

The **cooperation** between academia and M&M industry in the Lower Silesia takes place in various forms. The most important are **collaboration in R&D projects** financed from the European, national or regional funds (examples of these project are given later). Other forms include **activities** within the Association of Mining Engineers and Technicians, celebration of the St. Barbara (patron of miners) Day on the 4th of December, **organization** and **support of various conference**s related to the problems of mining, internships and trainings for students of mining and geology fields of study. The association brings together nearly 14,000 members of various specialties employed in the mining industry. It operates throughout Poland through 18 Branches and circles in the amount of almost 200, covering both underground mining and surface and borehole mining. The basic statutory tasks of the Association include inspiring organizational and technical projects, promoting education and technical culture, integrating the environment of engineers and technicians, strengthening friendliness, and organizing social life. The Lower Silesia Branch of the organization associates about 400 members representing: rock mines (8 circles),

universities, research institutes and design offices (3 circles), brown coal mines (1 circle) and a circle of seniors.

2.6.4 Research centers, programs and events, and projects related to mining and metallurgy industry

The following R&D institutions are important in the Lower Silesia region. Specifically:

Faculty of Geoengineering, Mining and Geology of Wroclaw University of Science and Technology:

- Public,
- Education, research and development in the fields of underground and open pit based mining of deposits, exploratory and mining geology, mining transport, geoinformatics, engineering geology and hydrogeology, and geoengineering,
- Yes, the Faculty takes part in EU funded and national funded research projects, e.g. Horizon2020, EIT+ KIC Raw Materials, National Centre for Research and Development, National Science Centre, etc.
- Yes, in the form of joint research and development projects, commercial orders, diploma theses, internships,
- Ministry of Science and Higher Education, public and commercial projects
- Approx. 1-2

Lower Silesian Branch of the Polish Geological Institute (PGI):

- Public,
- founded in 1919 PGI is the oldest Polish nation-wide scientific institution. It is involved in comprehensive studies of geological structure of the country for practical use in national economy and environmental protection. In addition to scientific activities in all fields of modern geology the Institute was entrusted with the tasks of the Polish Geological Survey and the Polish Hydrogeological Survey. Moreover, it is responsible for the country's security in supply of mineral resources, the groundwater management, for monitoring of the geological environment and warning against natural hazards and risks. The Institute belongs to the association of European geological surveys – EuroGeoSurvey (EGS) with its seat in Brussels.
- o Yes, participates in EU funded and national funded research projects

KGHM Cuprum sp. z o.o. - Research and Development Centre:

- Private,
- The organization was created for the needs of KGHM Polish Copper and conducts research, whose final phase is its implementation in the KGHM's mines. The company's activity is not limited only to the cooperation with the entities from the capital group of KGHM Polish Copper and include projects for bituminous coal mines in the Upper Silesia and for the Salt Mine in Wieliczka, exploration works outside the territory of Poland. Areas of activity include mining, ventilation, electrification, mechanization and automation of mines, geology and hydrogeology, ore processing, environmental protection, modern energy technologies, as well as geodetic and

cartographic services. The services comprise all phases of the research & development activities from testing to design, environmental impact assessment, feasibility study and supervision of the implementation stage.

- Yes, European Funds such as Horizon 2020 and its predecessors (5th, 6th and 7th Framework Programmes), EIT+ KIC Raw Materials, Interreg Baltic Sea Region; as well as domestic projects National Centre for Research and Development (CuBR plus KGHM)
- KGHM CUPRUM has 30 active patents, including 21 inventions, 8 for utility models and 1 registered trademark.

“Poltegor-Institute" Institute of Opencast Mining:

- Public,
- The Institute deals with the development and implementation of industrial innovative technologies, processes, methods and technical solutions for the needs of opencast mining as well as broadly understood environmental protection. Approximately 43 people are employed in scientific positions, including 16 people with a scientific degree; main fields of activity are: opencast mining technology, processing and enrichment of minerals, mining machines and conveyor belts - technology, design and research, environmental protection and geoinformation - biotechnology and utilization of waste, geology, hydrogeology and geotechnics - deposit geology and modelling,
- European Funds projects from the Smart Growth Operational Programme, from the Operational Programme Innovative Economy, from the Research Fund for Coal and Steel, from the Central Europe Programme, from the Sectoral Operational Programme – Improvement of the Competitiveness of Enterprises, as well as National Centre for Research and Development,
- Institute has implemented over 200 results of its research since 2013, most of which concerned the implementation of products (93) and technology (83), the remaining are related to inventions. In addition, Poltegor Institute was granted 33 patents, 16 of which are still valid

Poltegor-projekt sp. z o.o.:

- Private,
- The company's activities are concentrated on planning, designing and engineering services. The company focuses on the engineering services for the following branches: surface mining, geology and geomechanics, waste disposals, hydrogeology, dewatering and deep water protection, hydrotechnics and surface water protection, machinery and equipment, power and heat generating plants, civil engineering and sanitary infrastructure, energy supply, control, automation and visualization, environmental protection.

Łukasiewicz Research Network – PORT Polish Center for Technology Development (formerly Wrocław Research Centre EIT+):

http://www.eitplus.pl/dane-teleadresowe/

- Public,

- research infrastructure allowing the implementation of tasks for industry in the form of research projects and basic research that take into account global development trends. The institution employs approx. 73 people in scientific positions , including 39 people with a degree /scientific degree
- Yes, European Funds: Horizon 2020, KIC Raw Materials, Climate KIC, as well as national funds: National Science Centre, National Centre for Research and Development, Foundation for Polish Science,

University of Wroclaw, Institute of Geological Sciences

- Public
- Research and teaching institution dealing with earth sciences. It employs over 50 teaching staff (including 5 with the title of professor). The Institute's research and teaching activities cover practically all areas of geology.
- At present, the Institute does not have active patents for inventions. It has only protection rights for two trademarks.

Examples of **European**, **national** or **regional projects**[8] related to M&M industry realized by the R&D institutions described above:

Horizon 2020 programme:

- SIMS - Sustainable Intelligent Mining Systems,
- DISIRE - Integrated Process Control based on Distributed In-Situ Sensors into Raw Material and Energy Feedstock, January 1, 2015 - December 31, 2017,
- BIOMORE - New Mining Concept for Extracting Metals from Deep Ore Deposits using Biotechnology,
- THING – Stimulate scaleups to develop novel and challenging technology and systems applicable to new markets for robotic solutions,

KIC Raw Materials platform:

- Re-Activate - Reactivating former mine sites
- Rock Vader - Smart Hard Rock Mining System,
- Virtual Mine - A modeling tool for Wider Society Learning;
- VISUAL 3D - Visualisation of 3-4D – models in geosciences
- Safe Deep Mining - Continued education program in rock engineering for deep mines
- MaMMa - Maintained Mine & Machine

In INTERREG Programme – Baltic Sea Region:

- BSUIN - Baltic Sea Underground Innovation Network

Financial Mechanics EEA and the Norwegian Mechanism:

- Geothermal Energy: the Basis of Low-Emission Heat Engineering and Improvement of Living Conditions and Sustainable Development - Preliminary Studies for Selected Areas in Poland". July 7, 2017- October 31, 2017.

[8] Detailed information on these projects can be found on the project web pages

Central Europe Programme:

- Effective development of dispersed renewable energy in combination with conventional energy in Regions, 3CE393P3 (2011-2014),
- Environmental and Economic Benefits from Biochar Clusters in the Central area 4CE535P3 (2012-2014),
- Dynamic Light – Towards Dynamic, Intelligent and Energy Efficient Urban Lighting CE452 (2016-2019),
- CE-HEAT – Comprehensive model of waste heat utilization in CE regions CE622 (2016-2019)

European Regional Development Fund:

- REMIX Smart and Green Mining regions of EU, 2017-2021, project encourages resource efficient and environmentally and socially acceptable production of raw materials, including critical raw materials. Growth and competitiveness of European industry is currently limited by the state of play in these two areas and policy instruments have been set up across Europe to address these important topics.

Interreg Poland – Saxony:

- MineLife – Living with and from mining, April 2017 – March 2020, Mining authorities from Saxony and Poland collaborate in the project to exchange about latest technologies and to adopt new approaches for conflict management of mining sites close to the international border line. Activities in the project include excursions to mining sites, workshops and a travelling exhibition to highlight the history and importance of mining for Saxony and Lower Silesia

National Centre for Research and Development:

- Innovative Methods for Making Deep Deposits of Copper Ores Available (ACRONYM: I-MORE) January 1, 2015 - December 31, 2017,
- Development of a High-Performance Technology for Enriching Polish Copper Ores (Acronym: HighCopper), May 1, 2015 - April 30, 2018,
- Smart System for Automatic Testing and Constant Diagnosis of Conveyor Belts' Condition, NCBiR National programme - Applied Research Programme, October 1, 2012 - September 30, 2015,
- Connectors of Multi-Ply High Endurance Conveyor Belts, April 1, 2015 to March 31, 2018.
- Linear Indirect Drive Improving Conveyors' Functionality, May 1, 2010 - April 30, 2013,
- Conveyor Belt Featuring Increased Resistance to Wear and Tear Damage Applicable Particularly in the Coal, Copper Ore, and Rock Mining Industries, September 1, 2010 - February 28, 2013.

National Science Centre:

- NCN – OPUS 4 competition, Project "Development of a Numeric Modelling Method for Mining Terrain Deformations in Complex Geological and Mining Conditions of Use", July 19, 2013 to January 18, 2016,

- NCN – SONATA 4 competition, Project "The Mechanism of Development and Disruption of a Three-Phase Contact at the Junction of the Solid-Liquid-Gas Phases in Various Flotation Devices", July 11, 2013 - July 10, 2016,
- NCN – PRELUDIUM 2 competition, Project "Resources of Metallic Raw Materials and Their Deposits on Regular Chondrites' Parent Bodies", September 5, 2012 - March 4, 2016,

European Regional Development Fund:

- Operational Programme Innovative Economy - Priority 1 - research and development of modern technologies, Sub-action 1.3.1 - Development projects. Project "Technological Strategies and Scenarios for the Management and Use of Rock Material Deposits", November 26, 2009 to April 30, 2013,

Operational Programme Innovative Economy:

- Strategies and scenarios of technological development and utilization of natural stone deposits UDA-POIG.01.03.01- 00-001/09-00 (2009-2014),
- Mechatronic control, diagnostic and security system in opencast mining machines UDA-POIG.01.03.01-00-043/08-00 (2008-2013),
- A device for cleaning mineral aggregate UDA-POIG.01.03.02-00-015/09 (2011-2013),
- The way of hydrocarbon degradation in soils with use of slaughterhouse waste of III category UDA-POIG.01.03.02-00-034/09 (2010-2013),
- Pre-drying of brown coal for energy purposes UDA-POIG.01.03.01-00-040/08-00 (2010-2013),
- Projects funded under the Research Fund for Coal and Steel:
- Bucket wheel excavators operating under difficult mining conditions including unmineable inclusions and geological structures with excessive mining resistance RFCR-CT-2015-00003 (2015-2018),
- Smarter Lignite Open Pit Engineering Solutions RFCR-CT-2015-00001 (2015-2018),
- Hydrogen oriented underground coal gasification for Europe RFCR-CT-2007-00006 (2007-2010)

Sectoral Operational Programme – Improvement of the Competitiveness of Enterprises:

- Scenarios of technological development of brown coal mining and processing industry WKP_1/1.4.5/2/2006/4/7/585/2006 (2006-2008)

2.7 CASE STUDIES: REGIONS OF ANDALUCIA AND Castilla y León

2.7.1 Academic potential related to mining and metallurgy

Spain

Education in Spain is regulated by the **Ministry of Education.** The current system is known as LOE, named after the Ley Orgánica de Educación, or Fundamental Law of Education, and is supported by the government in each region. Under this system, education is **free** and **compulsory** for a total of 10 years, from age 6 to 16 years of age, although families have to pay for the books and materials used in class. The system of education in Spain is essentially broken down into **five levels**: preschool, primary school, compulsory secondary education, post-compulsory secondary education, and tertiary education, which can include vocational studies or university education. The last cycle of secondary school, which goes from 16 to 18 years old, is also free.

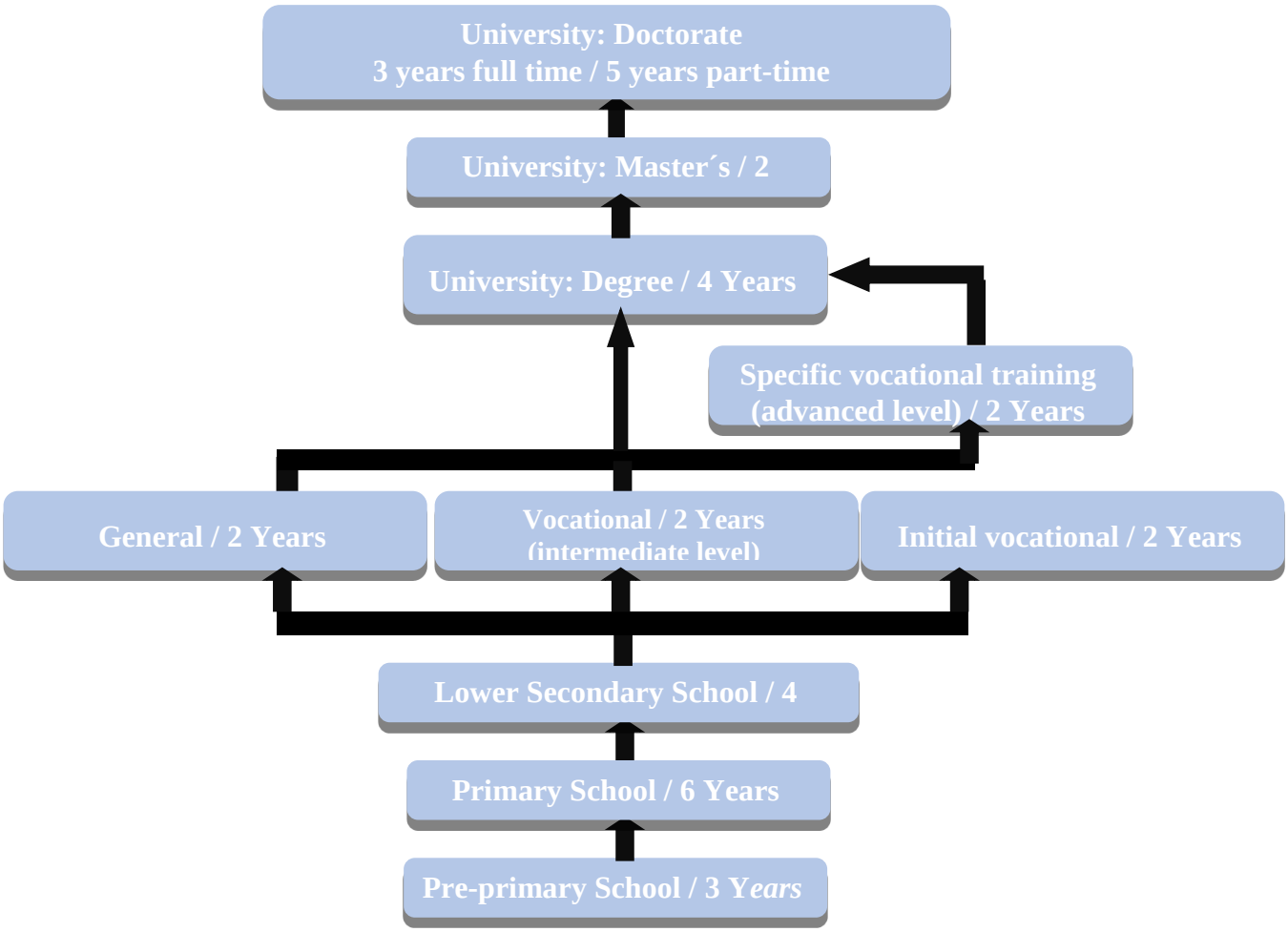


Figure 2.7.2.5: Structure of Spain's education system

Higher education is paid but the State finances a part of the tuition fees. There are also stated-subsidised and private schools, which are usually related to the Catholic Church and are paid at all stages.The structure of higher education in Spain is now aligned with the provisions laid out in the Bologna Process—an educational reform act that aims to facilitate student transfer at universities throughout the European Union. Under this new system, university courses now have "ECTS" credits, and students will normally take 60 of these credits each year. The degree structure at Spanish universities is now as follows:

Bachelor Program: A three-year program (180 credits)
Master's Degree: A two-year program (120 credits)

After completing the Bachelor' s degree under this new system students are not awarded a degree; they are instead promoted to the Master' s program for the final two years of studies. Certain courses of study do, however, allow students who are not interested in earning a Master-level degree to pursue a 4-year study program, leading to an undergraduate degree. Students can also pursue Doctorate-level or Ph.D. degrees, as well as more advanced degrees in fields, such as medicine, dentistry, pharmacy, e.tc., which typically span an additional 3-7 years depending on the area of study. See **Figure 2.7.1.1** about the education system in Spain, and **Figure 2.7.2.2** about the universities of Spain. As for MM, the **Figures 2.7.2.3 & 2.7.2.4** indicate the universities related to the mining and metallurgy sector[9] (Bachelor and Master).

About the Universities and the students participating in departments/schools, in which they have the opportunity to attend courses related to the MM and the number of participating students per University (per year or data for a certain period), see Student Statistics since 2015-2016 in the website: http://www.educacionyfp.gob.es/servicios-al-ciudadano/estadisticas/universitaria/estadisticas/alumnado/desde-2015.html

Skills: ability to draw up, sign and develop projects in the different areas of mining engineering, according to the knowledge acquired for measurements, stakeouts, plans and maps, calculations, assessments, risk analysis, surveys, studies and reports , work plans, environmental and social impact studies, restoration plans, quality control system, prevention system, analysis and assessment of the properties of metallic, ceramic, refractory, synthetic and other materials, soil characterization and rock massifs and other similar works.

Comprehension of technical and legal conditionings, that arise from the projects development, in the specific areas of mining engineering, geological-mining exploration and research, the use of all types of geological resources including water underground, underground workings, underground storage, treatment and benefit plants, power plants, mineral and steel plants, building materials

[9] Concerning description about Bachelor and Master's studies related to mining and metallurgy sector, see https://consejominas.org/?q=ingenieria-grados

plants, carbochemical, petrochemical and gas plants, waste treatment plants and effluents and explosives factories and the ability to use checked methods and accredited technologies, in order to achieve the greatest efficiency while respecting the environment and protecting the safety and health of workers and their users.

UNIVERSIDAD	CENTRO	TÍTULO	TIPO DE UNIV/ CENTRO	OFERTA DE PLAZAS 2018/2019	NOTA DE CORTE 2018/2019	NOTA MEDIA DE ADMISIÓN 2017/2018	RENDIM. MEDIO 2016/2017	CRÉDITOS NECESAR.	PRECIO DEL CRÉDITO 2018/2019
Universidad Politécnica de Cartagena	Escuela Técnica Superior de Ingeniería de Caminos, Canales y Puertos e Ingeniería de Minas	Grado en Ingeniería de Recursos Minerales y Energía	Pública / Propio	50	7,433	n/d	66 %	240	16,78 €
Universidad de Cantabria	Escuela Politécnica de Ingeniería de Minas y Energía	Grado en Ingeniería de los Recursos Energéticos	Pública / Propio	50	6,46	8,45	65 %	240	15,02 €
Universidad de Vigo	Escuela de Ingeniería de Minas y Energía	Grado en Ingeniería de los Recursos Mineros y Energéticos	Pública / Propio	50	6,36	6,92	54 %	240	13,93 €
Universidad de Oviedo	Escuela Politécnica de Mieres	Grado en Ingeniería de Recursos Mineros y Energéticos	Pública / Propio	30	5,14	5,85	59 %	240	16,40 €
Universidad de Cantabria	Escuela Politécnica de Ingeniería de Minas y Energía	Grado en Ingeniería de los Recursos Mineros	Pública / Propio	40	5	n/d	56 %	240	15,02 €
Universidad de Córdoba	Escuela Politécnica Superior de Bélmez	Grado en Ingeniería en Recursos Energéticos y Mineros	Pública / Propio	30	5	n/d	68 %	240	12,62 €
Universidad de Huelva	Escuela Técnica Superior de Ingeniería	Grado en Ingeniería en Explotación de Minas y Recursos Energéticos	Pública / Propio	65	5	n/d	64 %	240	12,62 €
Universidad de Jaén	Escuela Politécnica Superior (Linares)	Grado en Ingeniería de Recursos Energéticos	Pública / Propio	35	5	n/d	71 %	240	12,62 €
Universidad de Castilla-La Mancha	Escuela de Ingeniería Minera e Industrial de Almadén	Grado en Ingeniería de los Recursos Energéticos	Pública / Propio	-	-	-	71 %	240	18,87 €
Universidad Politécnica de Madrid	Escuela Técnica Superior de Ingenieros de Minas y Energía	Grado en Ingeniería de los Recursos Energéticos, Combustibles y Explosivos	Pública / Propio	150	-	-	78 %	240	24,55 €

Figure 2.7.2.3: Universities related to mining and metallurgy sector in Andalucia (Bachelor)[10]. Source: Reprinted from: https://www.educacion.gob.es/

[10] There is also, the Universidad Politécnica de Cataluña EPSEM Grado en Ingenieria Minera

University	Faculty	Program	Type	Foreign languages	Places available	Graduates in ave.	Credits needed	Price for a credit[11]
Universidad Autónoma de Barcelona	Faculty of Sciences	Master of mineral resources and geology	Public, Private		ND	ND	60	ND
Universidad de Barcelona	Faculty of Earth Sciences	Master of mineral resources and geology	Public, Private	YES	25	96 %	60	46,50 €
Universidad de Granada	Postgraduate School	Master of mineral and energy resources and geology	Public, Private	NO	40	93 %	60	ND
Universidad Huelva, Cordoba y Javen	Faculty of Experimental sciences	Master of geology and environmental issues of mineral resources	Public, Private	NO	15	86 %	60	13,68€
Universidad Internacional de Andalucia	Postgraduate School	Master of geology and environmental issues of mineral resources	Public, Private	NO	20	87 %	60	13,68€
Universidad Complutense de Madrid	Faculty of Geology	Master of exploration of hydrocarbons and mineral resources	Public, Private	NO	40	ND	60	45,02 €
Universidad de León	School for mining managers and engineers	Master of mining engineering and energy resources	Public, Private	N0	60	83 %	90	31,14 €

Figure 2.7.2.4: Universities related to the MM sector in Andalucia (Master)[1]. Source: Reprinted from: https://www.educacion.gob.es/

[11] CURSO 2018/2019

These are the centers in our Autonomous Region of Castilla y León:

- University of León: Higher and Technical School of Mining Engineers, in León.
- University of Salamanca: Faculty of Geological Sciences, in Salamanca
- Higher Polytechnic School, in Avila.

The specialties are as follows:

University of Leon

- Degree in Mining Engineering. Specialty Mining Exploitation.
- Degree in Mining Engineering. Specialty Mining Surveys and Surveys.
- Degree in Mining Engineering. Specialty Mining Electromechanical Installations.
- Degree in Mining Engineering. Specialty Energy Resources: Fuels and Energy.
- Degree in Engineering in Geomatics and Surveying (Ponferrada)

University of Salamanca

- Degree in Geology
- Degree in Geological Engineering

Higher Polytechnic School of Ávila

- Degree in Mining and Energy Technology Engineering
- Degree in Engineering in Geoinformation and Geomatics
- Degree in Geomatics Engineering and Surveying

2.7.2 Other types of training related to mining and metallurgy

Andalucia

Training through several partnerships related to the MM sector: Professional Colleges of Mining Engineers and Geologists, business and union organizations, mining and environmental administrations, Mining Schools, National Institute of Silicosis and Madariaga Official Laboratory.

Castilla y Leon

Indeed, there are **conferences**, **meetings** and different **events** connecting the different organizations and institutions, such as Professional Colleges of Mining Engineers and Geologists,

business and union organizations, mining and environmental administrations, Mining Schools, National Institute of Silicosis and Madariaga Official Laboratory.

2.7.3 Co-operation between academia & mining and metallurgy industry

Andalucia

There are many **research groups** from universities collaborating with companies in areas like metallurgy (University of Seville, Chemistry Faculty), hydrology and water treatment (University of Huelva), environment (University of Huelva), geology (University of Granada) e.tc.

Castilla y Leon

Beside the previous point, it is also important to refer the existence of **the Regional Mining Commission of Castilla y León**, which is an advisory collegiate entity of the Regional Administration of Castilla y León in matters related to mining, paying special attention to the impact on the economy, the socio-labor field and the territory of Castilla y León.

The Santa Bárbara Foundation (FSB) is a public entity of the Region of Castilla y León, attached to the Ministry for Economy and Finance, through the General Management of Energy and Mines, established for the initial purpose of collaborating with social welfare and the promotion of those cultural activities aimed at promoting the knowledge and development of the works inherent in mining of Castilla y León.

Currently, the foundational goals of this Foundation have been strengthened and diversified, becoming a consolidated entity in the field of educational and technological activities in sectors such as mining, energy, construction, job security and civil protection. The headquarters of the Foundation are located in the province of León, in the Bierzo region, between the municipal terms of Folgoso de la Ribera and Torre del Bierzo, in a center called “Escuela Laboral del Bierzo” (known as “Bierzo Mine-School”) (http://www.fsbarbara.com/).

2.7.4 Research centers, programs and events, and projects related to mining and metallurgy industry

Andalucia

The Spanish Geological Survey is a **Public Research Organization**, with an autonomous body, attached to the Ministry of Science, Innovation, and Universities. It was created under the name of "Commission for the Geological Charter of Madrid and General of the Kingdom", by Royal Decree of July 12, 1849. Later, in 1910, it was renamed the Geological Institute of Spain, and in 1927 it was reorganized and modernized the laboratories, it is installed in its current headquarters,

and it acquires the name of Geological and Mining Institute of Spain. The Institute is an autonomous body as of the promulgation of Law 6/1977, of January 4, on the Promotion of Mining and has the character of Public Research Organization (IPO) under Law 13/1986, of 14 April, Promotion and General Coordination of Scientific and Technical Research (Source: http://www.igme.es/QuienesSomos/elIGME.htm)

Castilla y Leon

Laboratorio Oficial Jose María de Madariaga (LOM) is a national reference Centre in the different areas of mining, explosive atmospheres, explosives and pyrotechnics in Spain. It was created by Government Presidency Order on November 27th, 1979, as a proposal to the Ministries of Industry, Energy, Universities, and Research. In addition to the activities of certification and testing in these areas, LOM is the scientific and technical expert body of the General Administration of the State. As an expert body, LOM provides the Directorate General of Energy Policy and Mines technical assistance and consultancy services, within the limits of the areas of competence. See http://www.lom.upm.es/

The **National Institute of Silicosis** (INS) was established in 1970 as a Social Security Health Institution, with only and specific characteristics, being declared Special Center of Social Security in 1974 (Ministry of Work Order, April 25th, 1974) and recognized as a National Reference Unit for Respiratory Diseases of Labor Origin in 1991, by the Interregional Commission of the National Health System. This national reference was endorsed by Law 31/1995 on November 8th, on Occupational Risk Prevention, second additional provision, as well as in the R.D. 39/1997, on January 17th, which approves the Regulation of Prevention Services. Also, on December 15th, 2006, it was accredited by the Ministry of Health as a national reference center for training the MIR of Occupational Medicine, in the area of competence. The activity of the I.N.S. is linked to this mission, focused on technical-medical prevention, teaching, the research and advice on silicosis, and other pneumoconioses as well as other inhalation pathologies. It also cooperates with other national and European Union bodies and entities in the field of occupational health, mining and related industries. The validity of the Occupational Risk Prevention Law in 1995, its scope of action is extended to other respiratory and inhalation diseases of labor origin other than pneumoconiosis. See http://www.ins.es/

Mining and Minerals Hall (MMH) is the world meeting that will gather the present and future knowledge of mining. Seville Conference and Exhibition Centre (FIBES) will be the meeting venue for professionals of the industry from all over the world in October 2019. An excellent opportunity for networking and sharing experience and knowledge regarding the latest improvements in mining with the common thread of innovation, sustainability, and social progress. MMH is promoted by the Andalusian Regional Government (Junta de Andalucía); the Association of Researching, Extracting, Mining-Metallurgic Transforming and Service Companies (Aminer); and Fibes. See https://mmhseville.com/en/home/

2.8 CASE STUDY: REGION OF ALENTEJO

2.8.1 Academic potential related to mining and metallurgy

Portugal is a parliamentary democracy with a president as head of state. The country is divided into 18 districts and two autonomous regions (the Madeira and Azores archipelagos) (Nuffic, 2016). The **Education Ministry** is responsible for basic and secondary education while the higher education in under the **Science, Technology and Higher Education Ministry**. Education is compulsory up to age 18.

Figure shows the education system in Portugal.

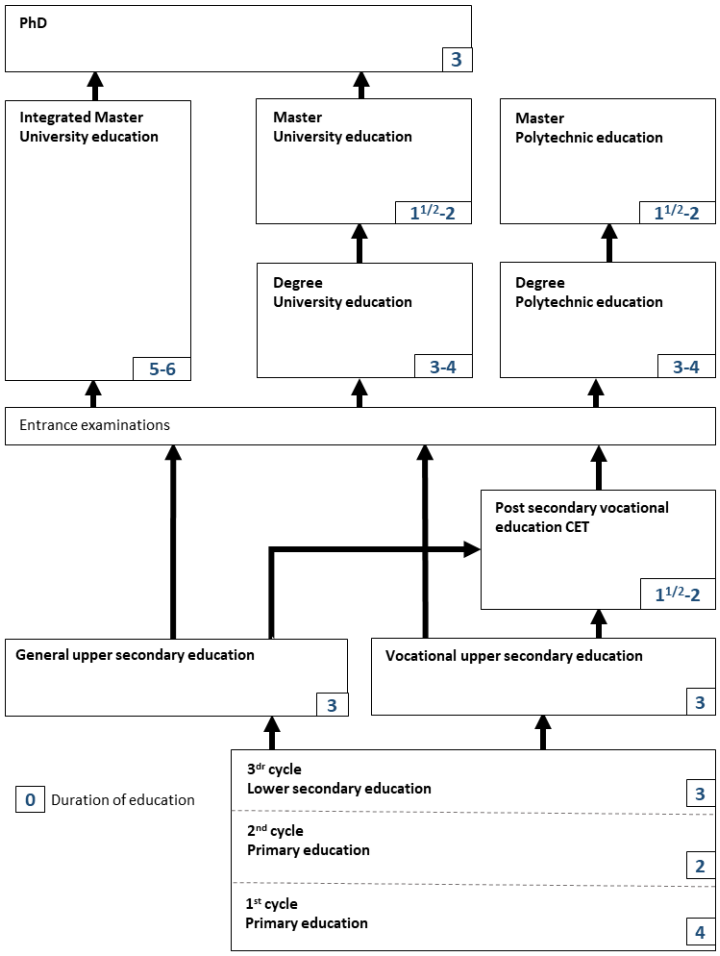


Figure 2.8.1.1: Education system in Portugal (adapted from Nuffic, 2016)

In the academic year of 2017/2018, 195,199 students enrolled in public higher education institutions in Portugal. According to **2.8.1.2** "Engineering, manufacturing and construction" and

"business administration and law" were the areas with the highest demand. Conversely, "Agriculture, forestry, fisheries and veterinary sciences" and "Information and communication technologies (ICTs) were the ones where less students enrolled.

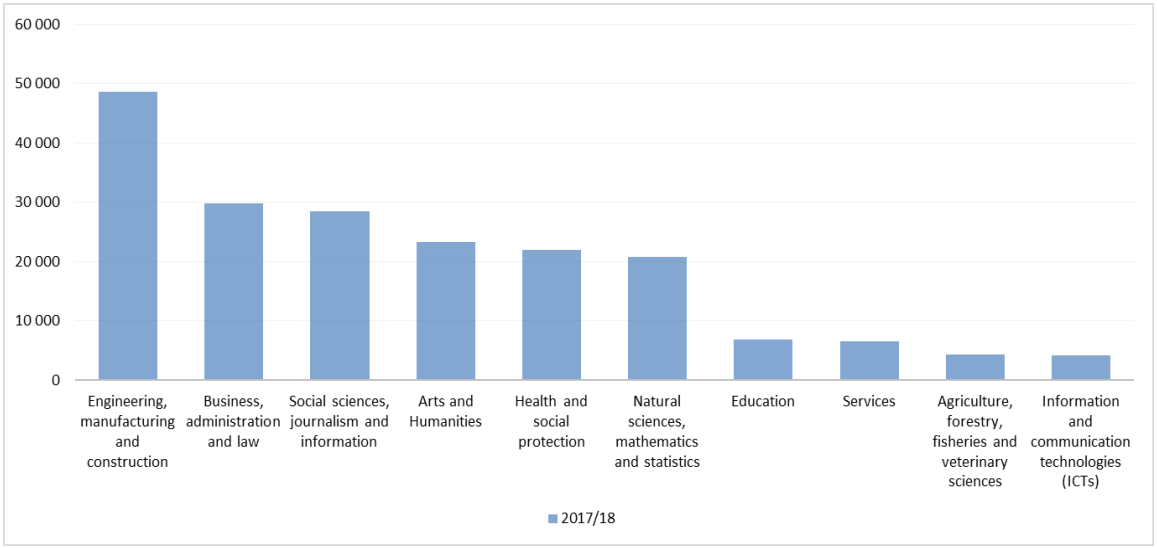


Figure 2.8.1.2: *Number of students enrolled in higher education establishments by area of education and training - 2017/18 (DGEEC, n.d.)*

In Portugal, the educational offered on the fields of Geology and Mining are located in six main cities: 1- Braga; 2-Oporto; 3- Aveiro; 4- Coimbra; 5-Lisbon and 6- Évora (

Figure 2.*3*.1.3). The several courses in public universities in Portugal connected with geology and mining have a reduced number of students and teachers (Ordem dos Engenheiros, 2012) (**Table 2.8.1.1**). Note that no courses were found connected to metallurgy. Table shows that the five public universities that offer the three levels of studies in geology/mining areas are University of Coimbra, Nova University of Lisbon, University of Lisbon, University of Porto and University of Évora, with the last one situated in the Alentejo region.

University of Évora, in Alenetejo region, includes a degree of three years (180 ECTS) in "Geology"; this training can be followed by any of the two years master's degrees offered, one in "Geological Engineering", and other in the "teaching" modality, lasting four semesters each. Also, at University of Évora there is a course which grants the degree in a similar disciplinary area, the course has the designation of "Earth and Atmosphere Sciences", which lasts three years (180 ECTS). There is a PhD program "Earth and Space Sciences" in University of Évora that aimed at original, autonomous research. This PhD include, among others, the fields of geophysical prospecting, mineral resources, genesis and behaviour of geological materials, geological materials and its influence on human societies[12].

[12] https://www.estudar.uevora.pt/Oferta/doutoramentos/curso/(codigo)/657

As for specific courses in mining, since the 19th century, Mining Engineering has been a domain of application of geological knowledge. In spite of the relative scarcity of our ferrous and non-ferrous mineral deposits, along with the university course of "Geology" taught in the Faculties of Sciences, a higher training in "Mining Engineering" in Lisbon and in Porto was consolidated. Today, Mining Engineering can be found in Coimbra, Lisbon and Porto. Both Faculty of Sciences and Technology in Coimbra and Técnico Lisbon offer in the 2nd cycle of higher studies of a Master degree in Geological and Mining Engineering of two years (120 ECTS). With a slightly different name, the Faculty of Engineering of the University of Porto has also a Master degree entitled Mining and Geo-Environmental Engineering lasting two years (120 ECTS). In this institution, there is also a PhD in Mining Engineering and Geo-Resources.

In the last 20 years, there have been changes in the offer by universities in the field Geology and Geological and Mining Engineering, which have accompanied transformations in the national and international labour markets (Freire, 2015). According to Freire et al. (2015) nowadays the curricula of geology courses is composed by a multiplicity of disciplines where the solid scientific nucleus of geology that includes in one hand the engineering related to its exploration and teacher training lines for the National System of Education.

Figure 2.3.1.3: Location of educational offer on Geology and Geological Engineering and Mining Engineering. Source: own work.

Nº	University	Faculty/School	Department	Course	Level
1	University of Minho	-	Earth Sciences	Geology	I
2	University of *Porto*	Faculty of Engineering	Mining Engineering	Mining Engineering and Geoenvironment	I, II
				Mining Engineering and Geo-Resources	III
3	University of Aveiro	-	Geosciences	Geological Engineering	I, II
				Geomaterials and Geological Resources	II
4	University of Coimbra	Faculty of Sciences and Technology	Geosciences	Geology	I, II, III
				Geological and Mining Engineering	II
				Geosciences	II
				Biology and Geology	II
5	Nova University of Lisbon	Faculty of Sciences and Technology	Earth Sciences	Geological Engineering	I, II, III
	University of Lisbon	Técnico Lisboa	Civil Engineering, Architecture and Georesources	Geological and Mining Engineers	I, II
				Petroleum Engineering	II
				Geo-resources	III
		Faculty of Sciences	Earth Sciences	Geology	I, II, III
				Economy geology	II
				Applied Geology	II
				Environment geology, Geological Risks and Spatial Planning	II
6	University of Évora	School of Science and Technology	-	Geology	I, II
				Geological Engineering	II
				Geosciences	II
				Earth and Space Sciences	III

Table 2.8.1.1: Courses connected to geology and mining in Portuguese public universities. Source: own work

In the Bachelor and Master in Geology, according to the same authors, about two-thirds of the subjects are geological sciences (including structural geology, crystallography, mineralogy, petrology, geochemistry, paleontology, stratigraphy, geomorphology, sedimentology, metalogenesis, hydrogeology, geology, geophysics, geological mapping and prospecting). This course has a small presence of mathematics, physics and chemistry. The Bachelor in Geological and Mining Engineering exhibit a curricular balance between geology and engineering subjects. Finally, the Bachelor and Master's in Geological and Mining Engineering reinforces the presence of engineering subjects, which occupy more than half of the course. **Table 2.8.1.3** shows the aims of Master's in Mining and Geological Engineering course available on the website of each of the three universities that offers the course.

The courses in Geology and Mining fields have different curricular composition by scientific area (**Table 2.8.1.2**).

	Geology	Mathematics	Physics	Chemistry	Informatics	Engineering	Others*
Bachelor in Geology (3 years)	67	9	6	6	6	-	3+3*
MSc in Geology	90	-	-	-	10	-	-
Bachelor in Geological and Mining Engineering (3 years)	23	35	8	2	5	25	2
MSc in Geological and Mining Engineering	15	7	-	-	-	53	15*
Bachelor in Geological Engineering (3 years)	36	16	6	3	3	33	3
MSc in Geological Engineering	33	-	-	-	-	33	14+20*
*Includes Economics, Management, Sociology and Pedagogy. The asterisk indicates the optional courses							

Table 2.8.1.2: Curricular composition of courses by scientific area (%)

Name of Institution	Objectives of the Master's in Mining and Geological Engineering course
University of Coimbra, Faculty of Sciences and Technology (FCTUC)	Provide professionals with an integrated perspective of System of Earth and its evolution; with the ability to design, execute or collaborate in projects of prospection, evaluation, exploration and improvement of geological resources; to collaborate on work in the area of civil engineering; to collaborate on geo-environmental requalification projects, to cooperate effectively with multidisciplinary teams; with comprehensive knowledge that allows them to redirect their training and work without significant loss of acquired skills; with respect for the environment and an ethical attitude that respects the principles of hygiene and safety at work.
University of Porto, Faculty of Engineering (FEUP)	Concepts of synthesis in exploration, process and environmental impact of Mines are discussed, while advanced knowledge on the characterization of rock masses and mineral processing is developed. Later on in the course advanced knowledge in management and mining technologies are offered.
University of Lisbon, Técnico Lisboa (IST)	The programme offers sound preparation in areas such as the exploration and valorisation of mineral, water, oil and gas resources and solid waste recycling (plastics, batteries and other urban and industrial waste). It also aims at offering sound training in the Geotechnical area.

Table 2.8.1.3: Fields of study included in mining engineering courses

Although the number of admissions in courses in the geology field increased with the expansion of Portuguese higher education until the beginning of the twenty-first century, the 2001/2002 academic year marks a notable decrease in the number of applications (Freire, 2015). Nevertheless, the results of the year 2018/2019 show that the fill rate for the courses offered by

the University of Lisbon, Técnico Lisboa and Nova University of Lisbon on Geology were 100%. Técnico Lisbon and China University of Mining and Technology, Beijing (CUMBT) even signed a double degree agreement for an International Master on Mining Engineering. The International Master on Mining Engineering aims at providing the modern tools and methodologies to face the new challenges of the mining engineering in the next decades: automation, industrial internet of things and data science – machine learning, artificial intelligence – applied in all mining chain since the geophysical exploration up to the production, geostatistics for resources and reserves uncertainty and risk evaluation, optimization methods for real time mining. Under this double degree the students will spend one year at Técnico Lisbon and another year in CUMTB. The first edition of the International Master on Mining Engineering will start in 2019/2020.

However, some authors consider there is an excessive number of courses related to mining considering the size of the Country and the weight of the Extractive Industry in the GDP (Ordem dos Engenheiros, 2012). In line with this opinion, also the official data on the vacancies available in the 1st cycle of the Portuguese Public Universities/Faculties offering geology and mining show that vacancies have been reduced. The vacancies on Geology fields of studies have been reduced in three institutions form 2016 until 2018: University of Évora, University of Lisbon - Faculty of Sciences and University of Porto. Note that the courses on Geological Engineering and Geological and Mining Engineering maintained their vacancies.

University	Courses 1st cycle	Vacancy		
		2018	2017	2016
University of Aveiro	Geology	20	20	20
University of Coimbra	Geology	33	33	33
University of Évora	Geology	10	10	20
University of Lisbon – Técnico Lisbon	Geological and Mining Engineering	20	20	20
University of Lisbon - Faculty of Sciences	Geology	84	90	90
Nova University of Lisbon	Geological Engineering	20	20	20
University of Porto	Mining Engineering and Geo-environment	33	35	35

Table 2.8.1.4: Number of vacancies in the Portuguese public universities/faculties offering geology and mining per course (DGEEC, 2018).

2.8.2 Other types of training related to mining and metallurgy

According to the research conducted to elaborate the present report in Alentejo there are **two institutions** that provide professional training: EPDM - Company of Drilling and Mining Development, S.A., and Litoral Alentejo Techonological School (ETAL).

The first belongs to the same business group as ALMINA - Minas do Alentejo, S.A. and it has included in its services vocational training on mining. According to their website, they promote tailored training according to specific needs of each company and associating the actions with the productive operations. They have carried out training/awareness actions covering 376 employees, and a volume of 37,608 hours of training in several areas:

- Quality, Environment, Safety and Emergency;
- Mining Equipment Operators;
- Operators of Surface Equipment;
- Explosives Operators;
- Computer science and new technologies;
- Behavioural area;
- Foreign languages.

The second school mentioned, ETAL also provides tailored training according to the needs of the companies. ETAL areas of expertise are focused in industrial technologies, namely:

- Automation and Industrial Instrumentation
- Industrial chemistry
- Laboratory Analysis
- Mechatronics, Mechanics and Electricity
- Hygiene and Safety at Work and Environment
- Computing

According to the review of profiles of people working in Somincor available on LinkedIn (March, 2019), Somincor employs high-qualified workers that occupy positions such as supervisor, managers or researchers mostly graduated in the main Portuguese Schools that offer geology and mining fields of study. Based on phone calls with former workers of Somincor, it was possible to perceive that knowledge of mining workers is transferred between workers. As Somincor employees people of the local communities nearby and therefore frequently more than one member of the family works in the company mine. Thus, old generations train new employees passing their experiential knowledge informally.

Training provided by Somincor/Lundin Mining is focused in health and safety (OHS). Somincor/Lundin Mining places a strong attention in OHS training as the company considers that good health and safety at work are inseparable from the economic efficiency and effectiveness of operations. To this end, Somincor provides all employees with the training and information they need to understand and respond effectively to the risk operations.

In 2018, Somincor launched a course of entrepreneurship and economic diversification that aimed to train, train and support business leaders with a view to their growth in a sustainable, diversified and competitive manner. The training of 95 hours included the modules of 1) Entrepreneurship, Innovation and Creativity, 2) Marketing, 3) Strategic Innovation and Business Development, 4) Business Plan, 5) Finance, 6) How to make a presentation, 7) Measurement of commercial performance and 8) Technologies and web applications. This program was promoted by Somincor and taught by Audax - Entrepreneurship and Innovation Center of ISCTE-IUL.

2.8.3 Co-operation between academia & mining and metallurgy industry

The universities have, over the years, established mutual collaboration, at various levels, with numerous companies, institutes and business associations. In fact, several of the master's and doctoral thesis held in the Portuguese universities have already had the possibility of being carried out in a business environment.

Universities also invite technicians of companies of the sector to conduct lectures, organize field trips to industrial units and working sites, and promote summer internships that consists on the collaboration between the student and companies.

Coimbra, Porto and Lisbon Universities provide consulting services at the request of external entities. In addition to the scientific and technical competencies of teaching staff and the researchers, university have laboratory resources, equipment for in situ testing and mobility capacity for field activities and studies namely[13]:

- Planning of Geophysical Prospecting campaigns;
- Collection, processing and interpretation of geophysical data;
- Laboratory analysis on soils, rocks and aggregates;
- Chemical analysis of trace elements in different materials (soils, waters, rocks, biological material, ores);
- Mineralogical analyses of panning concentrates;
- Field surveys and sampling for contamination characterization.

[13] https://www.uc.pt/en/fctuc/dct/servicosComunidade/areaLaboratorial

Table shows the companies that hosted students from Técnico Lisbon in Geology and Mining Engineering for the accomplishment of the Master thesis and the subject they worked on between 2008 and 2015.

Year	Title	Company
2008	Chronostratigraphy of the Gusev crater region (Mars) through the identification and characterization of impact	Almina - Minas do Alentejo S.A.
	Identification and characterization of polygonal surface of Mars	Mott MacDonald
	Geotechnical Characterization of Rejected Materials of Neves-Corvo Mine	GeoInveste-Stone Trading & Industry
	Generation and Evaluation of Prospects in Reservoirs Oilfields	GALP energia
2009	New formulations for propagation laws of vibrations in rock masses based on thermodynamic properties of explosives	Boliden Mineral AB - Suécia (Boliden)
	Development of Angola based on resources petroleum	Mckinsey & Company
2010	Potential for Underground Storage in Natural Gas Saline Cavities in Portugal	Almina
	Non-Metallic Geological Resources: Prospecting, Exploration, Exploration ('Industrial rocks, clays, sands, ornamental')	DGEG
	Scoping Parameters-Velocity Forecast Drilling	Schlumberger
	Treatment of geological information surveys and logging	The Boston Consulting Group
2011	Correlation between the roughness and the angle of friction in open discontinuity surfaces	The Janssen Pharmaceutical Companies of Johnson & Johnson
2013	Separation of WEEE plastics using separation gravitation and foam flotation	Somincor
2014	Resistance and deformability of the filling with time variation	Somincor
	Analysis of the damages inherent to the explosive dismantling at Neves-Corvo Mine	Somincor
	Problems of stabilization of oil wells: the critical issues onshore and offshore	Teixeira Duarte, S.A.
2015	Study of the influence of flocculation parameters on thickening of the wastes from the Neve-Corvo Mine	Somincor

Table 2.8.3.1: Master thesis title developed in business contexts (IST, 2019)

2.8.4 Employment rate after education

Regarding employment in the mining sector, official data in Portugal shows that, as expected, the number of supervisors and workers employed in the mining sector largely surpasses the number of managers, administrators and technicians in the same sector. According to **Figure 2.8.4.1** this difference is more accentuated after 2009.

Concerning the number of managers, administrative and technical human resources, it has been rising since 2003 to more than double for the subsector of metallic minerals (**Figure 2.8.4.2**).

Although, globally, it also increased for the non-metallic subsector it had slight decreases between 2004 and 2005, 2009 and 2010 and 2013 and 2014.

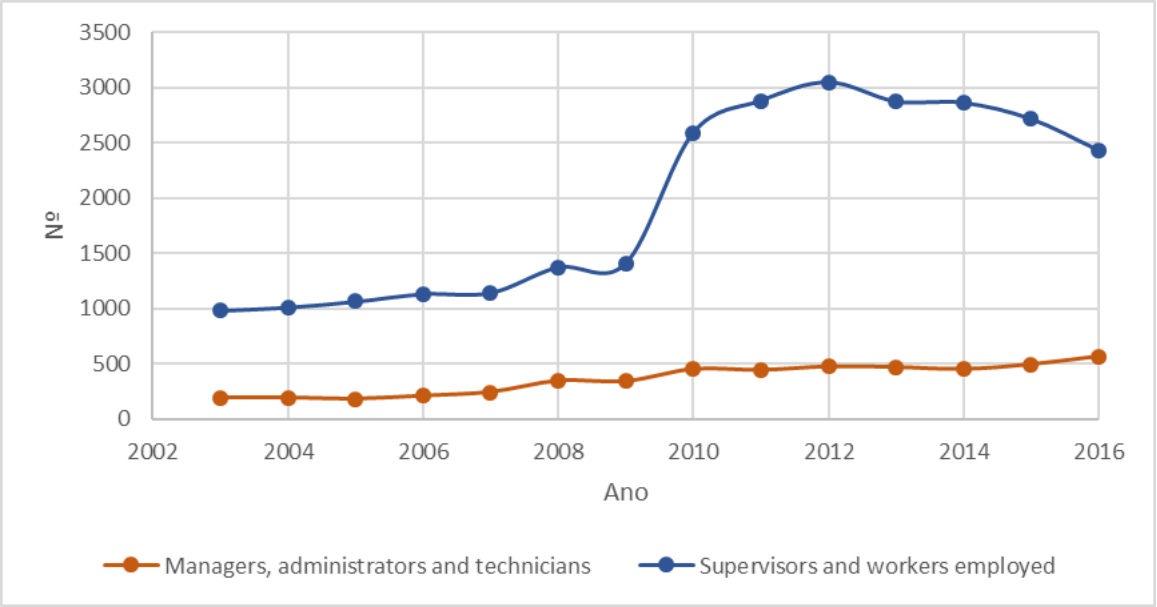


Figure 2.8.4.1: Evolution of the number of managers, administrators and technicians and the number of supervisors and workers employed in the mining sector in Portugal between 2002 and 2016 (DGEG)

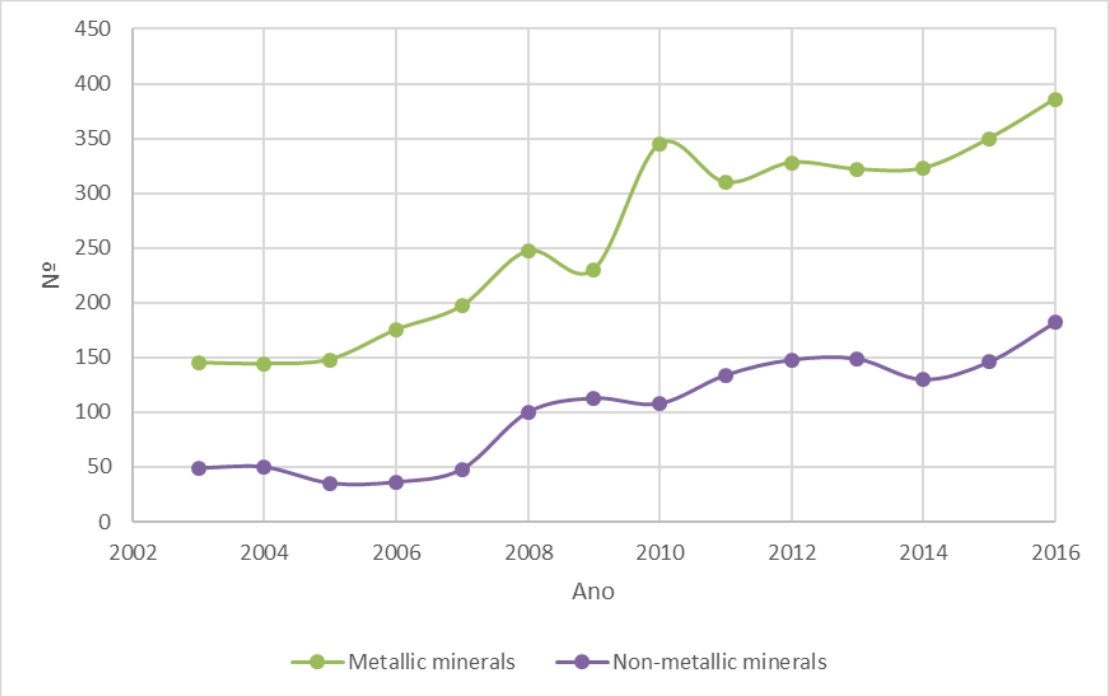


Figure 2.8.4.2: Evolution of the number of managers, administrators and technicians employed in the mining sector in Portugal between 2002 and 2016 (DGEG)

Regarding the supervisors and workers, for metallic mineral subsector the number of people employed increasing with moderation from 2003 until 2008 and slightly decreased between 2008 and 2009. From 2009 to 2010, there was a rapid increase. In 2012, it decreased again until 2016. As for the non-metallic sector, employment of supervisors and workers was subject to slight variations between 2003 until 2016 whereas it increased globally (**Figure 2.8.4.3**).

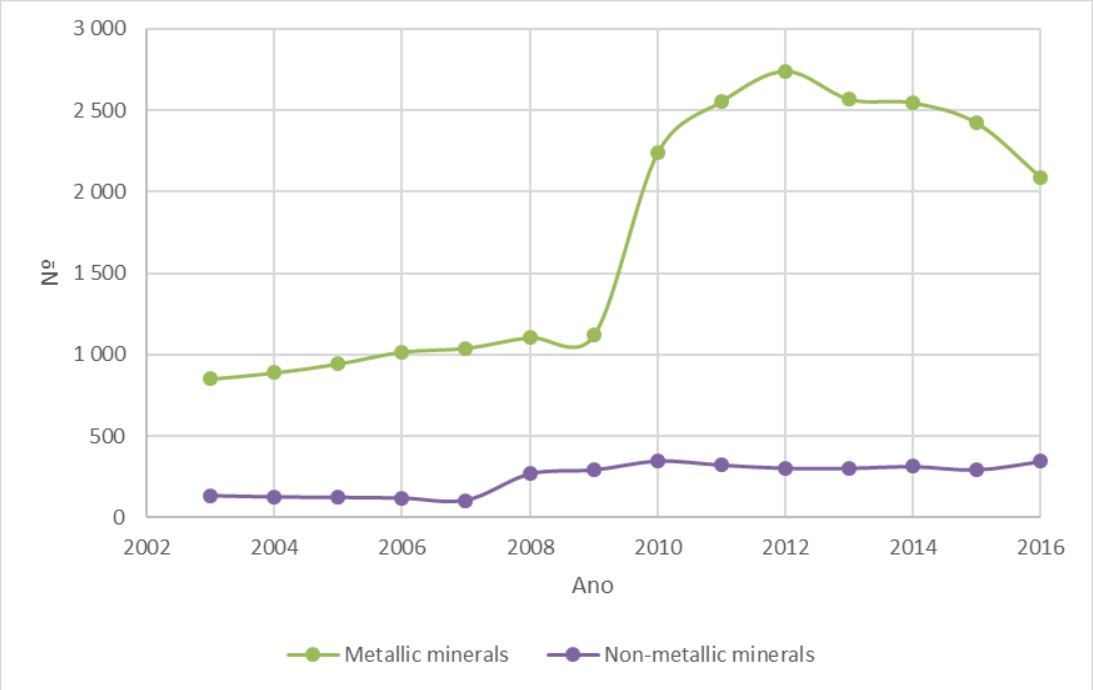


Figure 2.8.4.3: Evolution of the number of supervisors and workers employed in the mining sector in Portugal between 2002 and 2016 (DGEG)

Data available from the Department of Mining in Técnico Lisbon – University of Lisbon shows fields of employment students enrol after graduation (**Figure 2.8.4.4**). Job opportunities in Geological and Mining Engineering are very diverse including working in mines, petroleum or geoscience.

As for the Alentejo region, no data was available on the number of employment/ unemployment by sector. The employed population in Alentejo has been increasing but the employment rate was, in 2017, the lowest in the country (51.5%)[14]. The unemployment rate is higher than the national average, standing at 8.4 %, representing a decrease of 0.6 pp compared to the previous year (11%). As for the number of unemployed with higher education, this is a small percentage compared to total number of unemployed in Alentejo (**Figure 2.8.4.5**).

14 https://ec.europa.eu/eures/main.jsp?catId=437&acro=lmi&lang=pt&countryId=PT&regionId=PT1&nuts2Code=PT18&nuts3Code=null

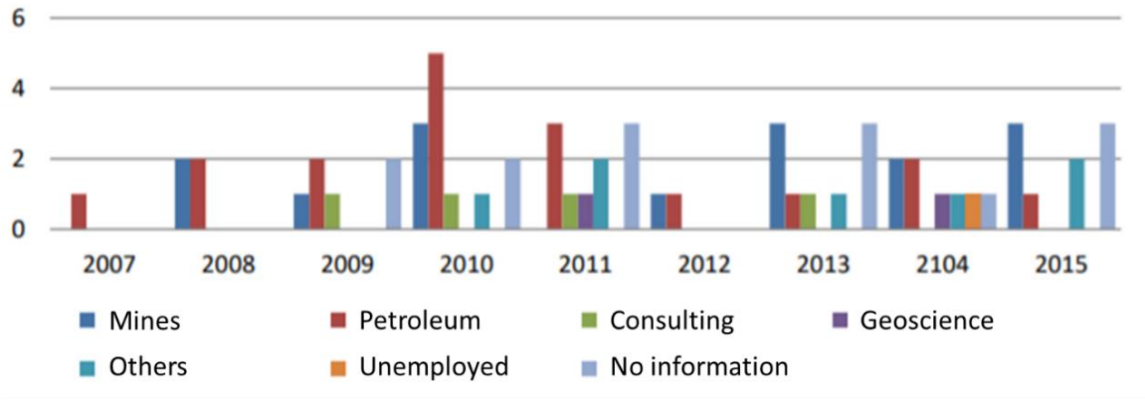


Figure 2.8.4.4: Fields of employment after graduation of Técnico Lisbon

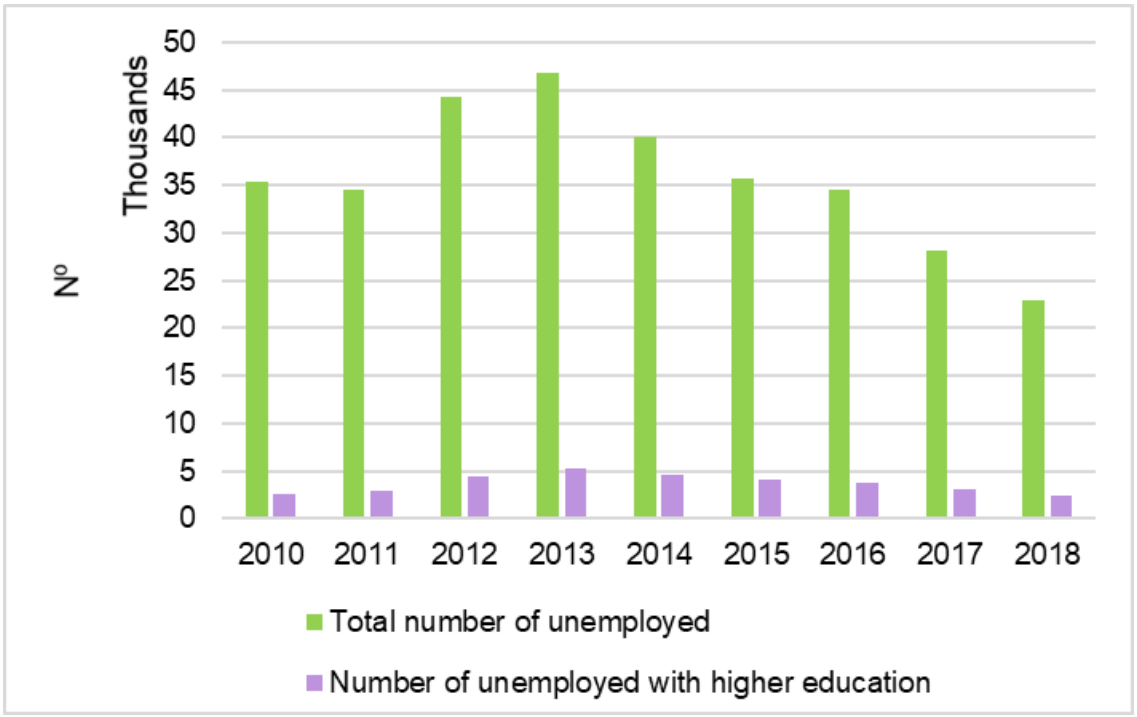


Figure 2.8.4.5: Number of unemployed and unemployed with higher education in Alentejo (PORDATA, 2019)

2.8.5 Research centers, programs and events, and projects related to mining and metallurgy industry

In respect to **research centres** as a means of improving knowledge in the sector, from the information available on-line it can be concluded that the state through is main Laboratory of Energy and Geology (LNEG) has been investing in promoting research development in the Alentejo region.

LNEG is a state laboratory that carries out research, demonstration, technical and technological assistance and laboratory works that support companies in the fields of energy and geology (LNEG, n.d.).

The activities of LNEG are structured in **three large groups**:

- R&TD projects, among others, within the framework of Community Support Frameworks and of the R & TD Framework Programs (Research and Technological Development);
- Provision of services and contracts with the business community and the State in their areas of competence;
- Direct support to the State in the areas of international representation in order to contribute to adequate science and technology and cross-sectoral policies.

In 2018, LNEG created a new centre in Alentejo CEGMA - Centre for Geological and Mining Studies of Alentejo. **CEGMA** is a research centre dedicated to the geological and mining resources of the southern region of the country, centered on the great potentiality of the Iberian Pyrite Range and the Ossa Morena Zone to host mineral resources of high economic value (LNEG, 2019).

The activity of CEGMA will facilitate the acquisition of new exploration investments, mostly foreign capital, by rapidly and efficiently providing the basic geoscientific information necessary for the correct planning and development of the research projects (LNEG, 2019).

CEGMA will effectively support mining industry (mining of Neves Corvo and Aljustrel, quarries in exploration) in its exploration area, facilitating research and georeferencing research. The Centre will function as the main infrastructure of the LNEG for the Alentejo region, also connecting Portalegre and the northern Algarve.

The data gathered in this chapter was withdrawal on internet websites, and reports available on-line. Institutions responsible for vocational training in the region were contacted by e-mail but at the date, no responses were obtained.

In general, the access to professional knowledge on the mining sector seems reduced, yet, according to Lundin Mining (2017) Somincor has not historically had any difficulties recruiting staff for the Neves-Corvo mine.

3. CULTURAL AND MINING HERITAGE

3.1 CASE STUDY: REGION OF STEREA ELLADA

3.1.1 Introduction

Sterea Ellada is a region of contrasts both in terms of geography and social and economic conditions with industrial and mining sectors co-existing with agricultural activities and a dynamic tourism industry due to the existence of significant archaeological sites such as Delphi, and famous ski resorts located in Mount Parnassos and Karpenissi.

3.1.2 Cultural significance

[The following data have been included in the document “Regional Operational Program for Sterea Ellada 2015 – 2019”.]

Given the great cultural heritage with particularly valuable cultural and archaeological sites, the sectors of culture and tourism could constitute the main pillars of development in the Region of Sterea Ellada, creating its "identity". Their protection, promotion and utilization in the context of sustainable development, and the particular value of the natural and cultural heritage of the Region, constitutes a crucial point and a factor of the Region's development.

In more detail, the Region includes a particularly important cultural reserve consisting of historical sites and monuments (e.g. Delphi, Eretria, Thiva, Orchomenos, castles of Amfissa and Lamia, fortress of Chalkida, the symbolic area of Thermopylae), religious monuments such as churches and monasteries, monuments of political folklore, cultural monuments such as museums and galleries, industrial and architectural heritage of great importance, as well as significant landscapes.

Figure 3.1.2.1: Archaeological Site and the Ancient Theater of Delphi, on the south-western slope of Mount Parnassus, source: en.wikipedia.org, www.greece-is.com

Figure: Ancient Theater of Orchomenos, in the peripheral unit of Viotia, source:

Figure 3.1.2.2: Monastery of Hosios Loukas, Agia Sophia of Roumeli, in the peripheral unit of Viotia. Source: greekorthodoxreligioustourism.blogspot.com

Figure 3.1.2.3: Medieval Castle of Amfissa, named "Orias", source: en.wikipedia.org

Two monuments of the Region have included in the UNESCO World Heritage List: the ancient site of Delphi in the peripheral unit of Fokida and the monastery of Hosios Loukas, Agia Sophia of Roumeli, in Viotia. According to an estimation of ELSTAT, the ancient site of Delphi has the 6th place in the list of archaeological sites in Greece, with more than 100,000 visitors per year (322,900 visitors).

According to Ministry for the Environment, Physical Planning and Public Works of Greece (abbreviated as ΥΠΕΧΩΔΕ), the peripheral unit of Fokida has the 3rd and 7th place, as regards to museums and archaeological sites, respectively. According to the same data, the peripheral unit of Viotia has the 10th place, as regards to museums.

The **Table 3.1.2.1** indicates the number of monuments of cultural heritage per peripheral unit and the total number for the Region of Sterea Ellada. The peripheral unit of Evia island includes the largest number of monuments.

Peripheral unit	Archaeological sites	Museums	Historical sites	Monuments of World cultural heritage	Total
Viotia	68	14	1	1	84
Evia	107	8	4	3	122
Evritania	7	5	2	4	18
Fthiotida	76	8	2	2	88
Fokida	28	7	1	6	42
Region of Sterea Ellada	286	42	10	16	354

Table 3.1.2.1: Number of monuments per peripheral unit. Source: own work on the basis of ROP for Sterea Ellada, 2015.

3.1.3 Mining heritage

[The following data have been included in the document "Regional Operational Program for Sterea Ellada 2015 – 2019".]

In the Region of Sterea Ellada identified deposits of mineral raw materials, such as Bauxites mainly in the mountains of Parnassus, Ghiona, Helicon and Oiti, Sideronicelite laterite have detected mainly in Central Evia, Viotia and Fthiotida. Lefkolithos or Magnesite in Central and Northern Euboea (Mantoudi), Lignites in Fthiotida and chromites in Domokos, with extractive and metallurgical activity.

The comparative advantage/strength of the Region is the exploitation of the most important mineral raw materials. In summary, Region has a leading role in the Mining Industry.

Examples of exploiting Mining heritage in Greece – Good practises

Vagonetto - Phocis Mining Park

The Region of Sterea Ellada counts 91 years of continuous mining activity on the production of Bauxite (Mount Parnassus and Ghiona), that has never been suspended; not even under the years of German occupation. Vagonetto is a region, in proximity to the Mountain of Ghiona. The story of Vagonetto begun in 1967 when the gallery known as Tunnel 850 launched its operation for the underground mining of bauxite in the Ghiona area. According to the mining practice, a tunnel's name indicates the number indicative of its elevation. After 5 years of continuous operations Tunnel 850 ceased its operations; the specific bauxite deposit was "exhausted" and thus, the gallery closed down (onparnassos.gr; www.vagonetto.gr).

Following 26 years of "silence," the gallery was transformed into a place of a visit so that the public could learn the history of bauxite. The construction of the park began in 1998, by S&B. The company following its sustainability policy and having the scientific background of the area, designed and deployed a -what proved to be- optimum plan for the transformation of the

obsolete gallery into an interactive museum, in honor of the old miners of Phocis (onparnassos.gr; www.vagonetto.gr).

As regards to the funding issues, the construction, maintenance, and operation of Vagonetto was realized with private funding, as mentioned, whereas the acquisition of the audio-guide digital system and the establishment of the Interactive Wing of Digital Technology were projects co-funded by EU (European Regional Development Fund), as well as Greece state. Phocis Mining Park welcomed the first visitors in 2003. Ever since, Vagonetto -actually the wagon that miners of the past used to transfer ore- remains a unique means of transportation through time and the history of bauxite mining for numerous contemporary travelers.

It can be noted that the outcome of a visit to Vagonetto is simple and ethical. Every visitor is informed about the necessity of mining operation in order to form their own opinion about it. This commences dialogue and productive communication. Further to the aspects of tourism and education, the restoration of the area by the reproduction of endemic, rare flora species and native plants was another solid benefit for the local community. The most important outcome was the Fokida Initiative, a non-profit Civil Company. It founded in December 2003, on the initiative of S&B and the Mayor of Amfissa, and with the participation of three more Municipalities, namely Gravia, Delphi and Lidoriki, and the Fokida Chamber of Industry and Commerce.

The results of these activities were two-sided for the company and the local community. For the company, the positive outcome of the specific activities which concerned the reclamation were the trust of their workers and the local people and the creation and conservation of a monument close related to the history of bauxite. In these examples of CSR practice, there were no serious drawbacks or complaints by the local community because the company was truly devoted to their environmental strategy This attitude had, as a result, the non-profit Civil Company, the Fokida Initiative. The purpose of the company is to support and promote the sustainable economic and cultural development of the area for the benefit of the local communities.

Finally, as regards to the touristic activity of Vagonetto, it welcomes approximately 10,000 visitors annually, offering a multi-faceted experience to families, educators, and students. The Ministry of Education included early Vagonetto in the list of approved educational destinations and thus 60% of the visitors, are students of all levels. Vagonetto reflects the facility's history as an integral part of local residents' life and labor in Phocis, in harmony with the area's numerous archeological sites including Delphi, a Unesco' s World Heritage Site as mentioned above etc.
In overall, the Phocis Mining Park – Vagonetto constitutes a unique interactive museum in Greece, dedicated to the bauxite history and mining heritage, aiming to be engaged with critical challenges that the 'traumatized' mining sector is called to address; lately more connected to communication and social acceptance rather than techno-economic aspects (onparnassos.gr; www.vagonetto.gr).

Figure 3.1.3.1: Vagonetto, Phocis mining park, source: arttravel.gr

Lavrion Technological and Cultural Park

Another "good practice" in the context of protecting, promoting and utilizing the mining heritage of Greece, is the Lavrion Technological and Cultural Park (LTCP). Lavrion, known as the area of silver and lead production, is a city out of the Region of Sterea Ellada, on one of the most southern parts of the Region of Attica. LTCP constitutes a unique monument of industrial architecture and archeology, connecting Lavreotiki mines with the local community (Skarpelis, N., 2007).

In a geology prospect, Lavrion (or Lavreotiki peninsula) belongs to the Attic – Cycladic Metamorphic Complex. The occurrences of massive sulfide Pb–Zn–Ag ores hosted in carbonates gave rise to the opening of Pb and Ag mines complex, dated in classical antiquity. According to estimations, over 3,500 t of silver and 1.4 Mt of lead had been produced during those centuries and the resources had a fundamental bearing on Athens' rise, as regards to economic, and also to cultural flourishing. After centuries of mining and metallurgical inactivity, the Pb and Ag mines become operative in the late 1890's and closed permanently in 1978 because of the exhaustion of economic mineralization (Conofagos, 1980; Photiades A. and Carras N., 2001; Skarpelis, N., 2007).

Lavrion then becomes one of the most important industrial centers in Greece suffering a severe degradation of the environment due to the intense mining and metallurgical activity. Eventually, the complex of Lavrion having faced several cycles of crisis ceased its operation during the late1980's sending up only with environmental issues and a clear economic prospect.

Between 1994 and 1997 a rehabilitation program was designed and deployed by National Technical University of Athens, transforming the old mine complex into the Lavrion Technological and Cultural Park (LTCP), a body of scientific research, education, business, and culture. The NTUA

Asset Management and Development Corporation (NTUA AMDC) undertook, under the Program “Competitiveness” funded by the Ministry of Development and the EU, the implementation of the project: "Soil Rehabilitation and supplemental infrastructure at LTCP" to conduct a vital environmental intervention on a heavily polluted site like LTCP.

The soil rehabilitation Project Report states clearly that no concentrations of heavy metals are detected. Moreover, LTCP has succeeded in linking scientific and technological research conducted in Athens, with the needs and interests of the business world, along with the realization of cultural events related to the promotion of the history and culture of the wider area of Lavreotiki.

Nowadays, the services provided by LTCP in its renovated facilities, support research, education, and technology. LTCP is the only Technology Park in Attica, which specializes in areas - keys of modern applied technology, such as information, electronics, telecommunications, robotics etc, restoring Lavrion back to its rightful leading position. In overall, the LTCP area constitutes a unique mining monument of industrial heritage and archeology.

Figure 3.1.3.2: Lavrion Technological Cultural Park (LTCP) founded at the site of the old French Society of Lavrion (Compagnie Francaise des Mines du Laurium) in 1995, at the initiative of the National Technical University of Athens. Source: www.ltp.ntua.gr

3.2 CASE STUDIES: REGIONS OF NORTH KARELIA AND LAPLAND

3.2.1 Cultural significance

North Karelia

North Karelia shares over 300 km of border line with Russia and there are 1.5 million border crossings in Niirala. The region has had the strongest Russian influence on the livelihoods, culture and history as the Karelian border has repeatedly been redrawn through the centuries between Sweden, Finland and Russia, most recently after the Second World War.

There are many museums most of which are small, providing exhibitions of culture and history of local municipalities or provinces or local arts-and-crafts. Lieksa's Pielinen Museum, is the second largest open air museum in Finland. It presents the development of local building styles over the last 300 years through a collection of about 70 wooden buildings. At many sites the visitors will find restaurants with typical Karelian menu. There are numerous Orthodox churches and chapels throughout Karelia and there is Otrhodox Cultural Center in Joensuu. The center has permanent exhibitions about the Orthodox ecclesiastical year and its sacremental artefacts. Each Orthodox church have its own festival ('praasniekka') on the name day of its patron daint. The House Museum of Murtovaara in Valtimo is protected and valuable part of cultural history. It gives a general view of the development of the peasant house from the 1700s to the present day.

Lapland

Lapland was first inhabited after the ice caps began to melt around 7000 years ago. The Sami people were among the first natives of the region and rock carvings from thousands of years ago show age old practices like reindeer herding which continue today. As a result, most of the cultural heritage sites of Lapland are related to Sami people and Stone Age establishments, but due to the nature of their nomadic culture there are not many sites to be seen. There are also sites related to different wars, such as the Järämä WWII Fortification Camp built by the Germans during the Continuation War and the Lapland War (1941–1945) in North-West Lapland. The camp is a kilometre-long section of the extensive fortified installation has been restored, with trenches, dugouts and gun-nests.

There are around 30 museums around the Region of Lapland, most of which are small, providing a glimpse of local culture and history of local municipalities or provinces or local arts-and-crafts. There are two Provincial museums Arcticum and the Provincial Museum of Tornio Valley. The Sámi Museum Siida is the national museum of the Sámi and a national special museum in Finland.

3.2.2 Mining heritage

Finnish Mining History

The mining industry has always been closely linked to Finland's state status and economic development. The mining has started in Finland already in Middle Ages, when Finland was part of the Swedish Empire, but the information on Finland's oldest mines in the Middle Ages is rather limited.

The earliest carbonate rock mines appear to have been in operation since the 11th century mainly in southwest Finland. The limestone mines were mainly mined by peasants in the earliest times and used for the churches, but also transported to Sweden for the crowns need. In 1551, the ore exclusive rights were declared for the Crown (Declaration of the Swedish Crown's ore exclusivity on March 27, 1551). During the 1550s, the crown was interested in the prospect of ore deposits in the Finnish area, and the iron fabrication was further developed. The first metal mines were probably established in Finland in 1500s, but there is very little written information and it is likely that copper was mined in Juva Remojärvi mine in SE Finland between 1525 and 1533. The others have been the Silver Mountain of Hyvinkää Kyttjän and the Silver Bag in 1556–1561, Matkajärvi Forssa in 1558 in South Finland and 1643 and the Ingesson mine and copper smelter in Mustasaari in 1561–1563 in West Finland. In addition, according to historical sources, the iron ore of Ylistaro Vitting in West Finland was already known in the 1560s.

For the first few centuries, the history of Finnish mining is mainly the history of ironworks, with the total number of 200 ironworks in the country. The ironworks were, at the time, a metal industry using either ore as a raw material, much of which was imported by ship from Sweden, mainly from the Utö mine in the Stockholm archipelago. In addition to the smelter, many of the ironworks also had manufactures of metal products. The workshops produced coarse iron forgings, such as iron nails, iron bars and shovels. The most advanced iron processing project was the state-owned rifle factory established at Oulu Castle in NW Finland in 1614. Finland's first regular Metallurgy plant Rautaruukki was operating in Siuntio Southern Finland between 1530 and 1558. However, the Finnish railway industry is thought to have begun in 1616, when the government established a blast furnace and a hammer in South Finland in Mustio. Rautaruukki (later Ruukki) was one of the longest operating ironworks in Finland and until 1630 it was the only large industrial plant producing iron products in Finland. Ruukki finally ceased operations in 1901.

The raw material, iron ore, was supplied to the ironworks from the Ojamo iron mine in Lohja, which started production in 1530, and can be regarded as the first metal mine in Finland. The Ojamo mine operated several times in the 17th century and finally the mining operations were completed by the mid-1860s. Following this, over 350 metal mines has been in operation before the Second World War. The scale of production in these mines was modest, although mining played an important role in the slowly developing society. Before the 1920s, the mines mainly produced iron ore for iron works in Southern Finland. Sulphide ore production was mostly from one mine, Orijärvi (Cu-Zn) in SW Finland. During the first 400 years (1530–1945), ore production

totalled 10.5 Mt, of which sulphide mines comprised 9.7 Mt (most of which was produced during the 1920s to 1930s) and iron mines 0.8 Mt (Puustinen 2003).

20th Century in Finland, the modern mining industry started to form along with the Outokumpu mine in Eastern Finland. The deposit was discovered in 1910 (Kuisma 1985) and gradually developed into the first major sulphide ore mine in the country. Small-scale production started in 1910, production gradually increased in the 1930s, and total ore output was almost 6 Mt between 1930 and 1945. During its lifetime, from 1910–1989, about 28 Mt of ore was mined and 1 Mt copper produced (Puustinen 2003). Nowadays, the companies Outokumpu Mining Ltd and Outotec Ltd, established along with the Outokumpu mine, are globally recognized mining and mine technology companies.

The Petsamo (Pechenga) nickel deposit was found in 1921, in the then NE part of Finland (Autere & Liede 1989). The development of a mine at Petsamo was complicated, but eventually, during 1936–1944, about 0.5 Mt of ore was mined, first as a Finnish - Canadian cooperation, and during WWII by Germany. The war between Finland and the Soviet Union ended in September 1944, and the Petsamo region was subsequently ceded to the Soviet Union.

Soon after the war, in the late 1940s, the Aijala (Cu) and Otanmäki (Fe-Ti-V) mines were opened. Otanmäki gradually developed into a globally significant vanadium mine responsible for about 10 % of the world's vanadium production during the 1960s and 1970s (Illi et al. 1985). Seven metal mines were opened in the 1950s, including Vihanti (Zn) and Kotalahti (Ni) mines. The most active mine development period thus far in Finnish mining history was from 1960–1980, when more than twenty metal mines started production, of which the most important were the still operating Kemi Cr and the soon to be closed Pyhäsalmi Zn-Cu mines. As a consequence, total metal ore output peaked in 1979 at slightly over 10 Mt. A few small mines were opened in the 1980s, but at the same time, major mines were closed, and total production gradually declined to about 3 Mt in the early 2000s (Puustinen 2003). The Kemi chromite deposit was found 1959 by a local layman (Alapieti et al. 2005). Open-pit chromite mining began in 1966 and ferrochrome production in 1967 at nearby Tornio, at the far northern end of the Gulf of Bothnia. Stainless steel production at Tornio commenced in 1976 (Outokumpu 2010).

Currently, we are living in a new era in Finnish mining history. Two major mines, Kittilä (Suurikuusikko) gold and Terrafame (formerly Talvivaara) nickel mines, were opened in 2008, and the Kevitsa Ni-Cu-PGE mine started its operation 2012. In addition to these major deposits, smaller projects have recently started.

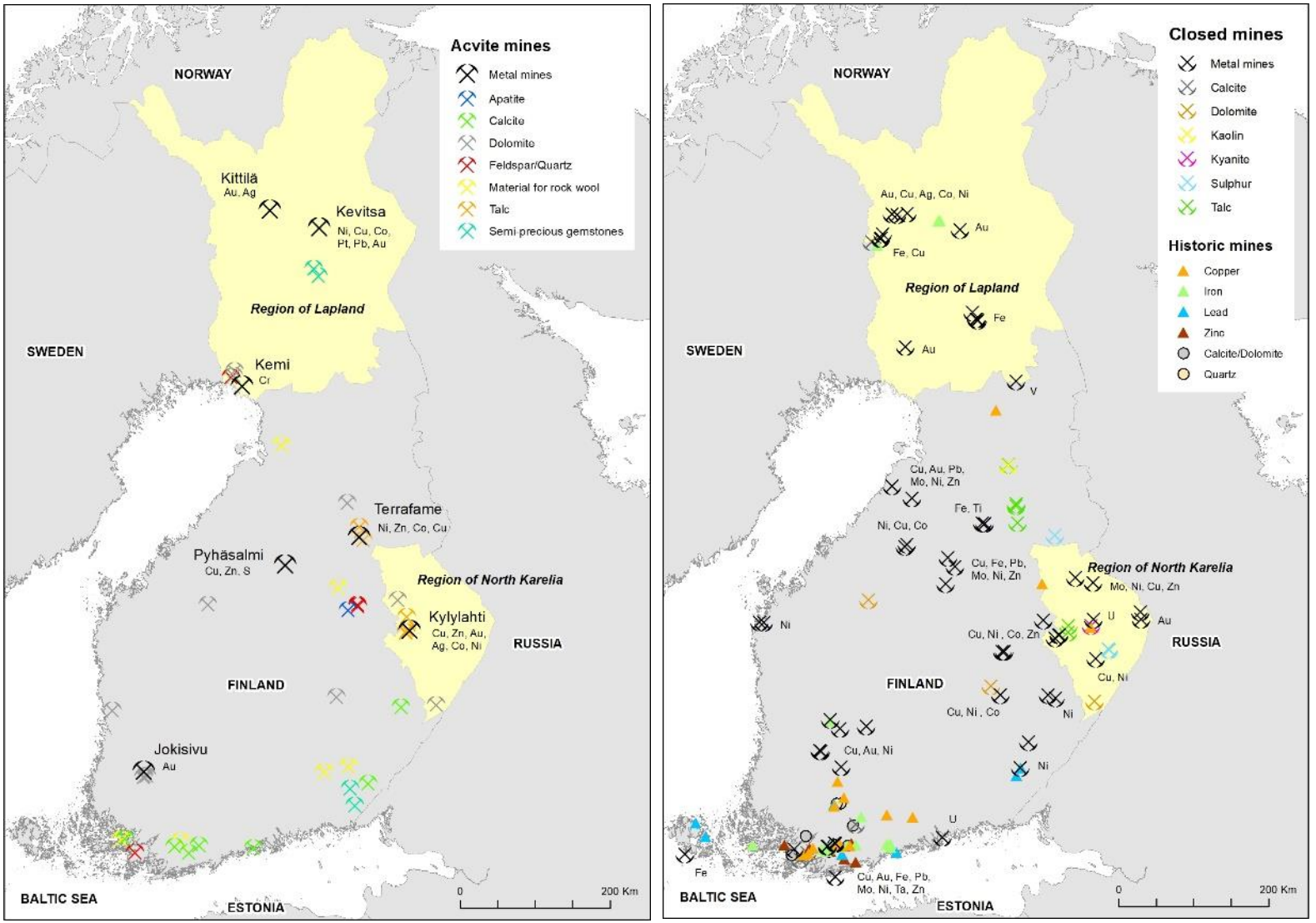
Mining and ironworks museums in Finland

The Tytyri Mine Museum is located in the city of Lohja in SW Finland. The exhibition is built up in the non-operating parts of the Tytyri limestone mine and comprises of tunnels 110 metres below the surface.

There are several exhibitions related to geology and mining operations in different museums and National Parks in Finland. Rokua Geopark is so far the sole Geopark with UNESCO Global

Geopark status in Finland. However, there are several Geopark project ongoing aiming to have the status in future. Every office of the Geological Survey of Finland has also a Geo exhibition with mining related sections.

Due to the number of the ironworks operated in Finland there are also numerous Ironworks museums and cultural sites around Finland. One of the most famous and most visited site is the Fiskars village in SW Finland. The Fiskars Village was awarded as Finland's best domestic travel destination in 2016 and received the European Commission's and Visit Finland's Culture EDEN in Finland award in 2018.



Figures 3.2.2.1 & 3.2.2.2: Map distribution for the location of active, closed and historic mines in Finland.

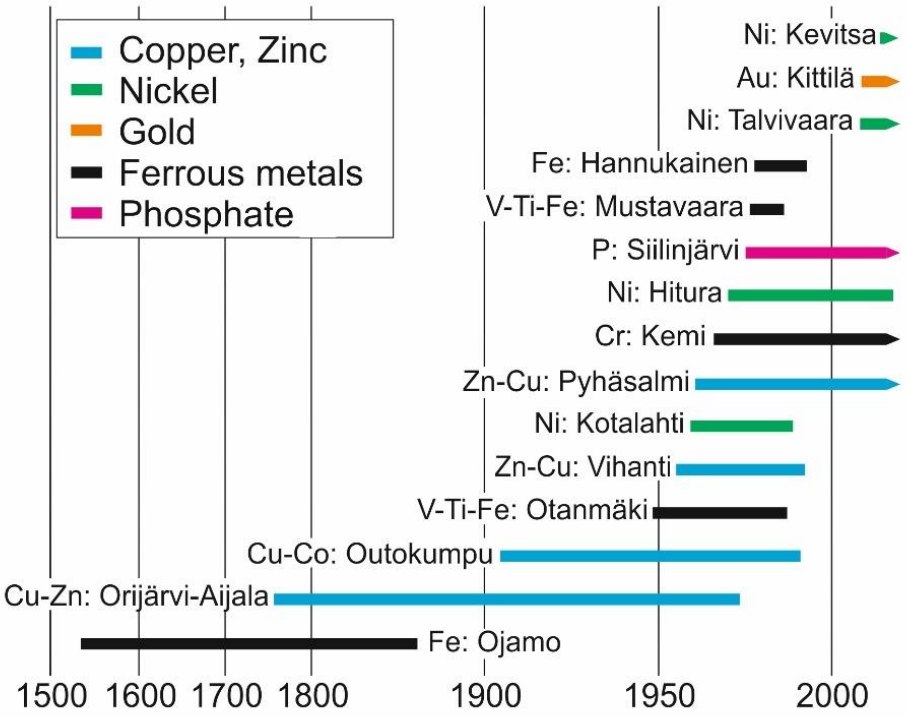


Figure 3.2.2.3: The timeline of the biggest mines operated ever in Finland. The lines ending with arrow are still in operation.

Mining history of North Karelia

In North Karelia the mining operations have concentrated mainly in **Outokumpu**, **Polvijärvi** and **Juuka**. The modern mining industry in Finland started to form along with the **Outokumpu mine** in North Karelia in 20th Century. The Outokumpu mine operated during 1913-1988 and produced a total of 50 Mt of sulphide ore at the average concentrations of 2.8 % Cu, 0.2 % Co (Loukola-Ruskeeniemi and Sorjonen-Ward 1997). There were altogether **four mines** in Outokumpu region: the Old Mine, Mökkivaara, Keretti, and Vuonos (Cu, Ni, Zn, Co). The main metal mined was copper. The other mines in North Karelia were **Hammaslahti** (Cu, Zn), **Mätäsvaara** (Mo), **Paukkajanvaara** (U), **Tainionvaara** (Ni), and **Otravaara** (S). The **Pampalo** gold mine started its operation in 2011 but the operation is now on hold. The **Kylylahti mine** (Zn, Cu, Ni, Co) opened in 2012 (**Figure 3.2.2.4**).

Nowadays, tourists can visit the **Outokumpu Old Mine** and **Mining Museum**, which was opened in 1982 in the former washing facilities and changing rooms once used by the miners (Kuusisto 1991). It presents the Finnish mining industry from the beginning of the 20th century to the

present day. The museum tunnels were opened to the public in 1985 to present mining work as authentically as possible. In addition, the museum includes underground mineral exhibition and theme park Kid´s mine for children. The main attractions at the museum are the museum tunnels, the "Treasures of the Earth" rock exhibition and the "End Products" exhibition, which presents how the mine's minerals are used in everyday objects. Historical mining vehicles are also on display, including the original fire truck, an explosion vehicle and an off-road vehicle that was used for finding ore deposits. In 2009, the museum tunnels and the museum were under a comprehensive renovation and the modernised museum and exhibitions reopened in July 2011. The Old Mine also offers facilities for weddings, banquets and meetings.

In the historical surroundings of the Old Mine, one can familiarize oneself with mining history through **guided tours** or with a map by oneself. There are signs with information on the history of the buildings (in Finnish and English). Close to the Old Mine area, there is a monument to Otto Trüstedt, discoverer of the Outokumpu ore. Opposite the City Hall there is also the "return from work" monument dedicated to the miners. The Mökkivaara open pit mine can be visited with a guide. The 96m high Keretti mine tower situated approximately two km from the museum can be ascended with a guide. The Pitkälahti harbor area can be visited without instruction. The harbor was used for shipping ore during the early periods of the mine.

The old mine has great accessibility, only the enrichment plant and the mine tower are not wheelchair accessible. The Keretti tower is only accessible by stairs. Local inhabitants get to enjoy events about mining history, some of which are free of charge. The Outokumpu Mining Museum has created a specialized tour for schoolchildren in grades 5 and 8, according to the school curriculum. The Old Mine area and buildings are owned by the city of Outokumpu. The city also owns the nature preserve of Särkiselkä. The Keretti tower as well as the adjacent golf course is privately owned. The Mökkivaara open pit is also privately owned.

Outokumpu Old Mine and Outokumpu Mining Museum are considered a nationally significant **architectural and cultural heritage site** (RKY 2009, The Finnish Heritage Agency). The Old Mine encompasses 28 ha, within which the most important mining industrial structures are located (including the enrichment plant, crushing plant, repair yard, power station, change house, different warehouses among others). The so called "bump" (or hill) of the Old Mine distinguishes itself as a landmark of central Outokumpu. The Outokumpu Mining Museum operates within the historical buildings of the area, as well as the underground tunnel. As a Specialist museum focusing on the Mining industry, the Outokumpu Mining Museum preserves mining history as well as material from the mining industry from the 1900s to this day. In the buildings there are also other exhibit halls which display for example art exhibits. The Kiisu theatre organizes theatre as well as other cultural events. The students of Dance in Outokumpu have productions in the area, not to mention underground. There is a booklet (in Finnish) about the Outokumpu areas architecture as well as the possibility for a guided tour.

Möhkö ironworks museum is located in Ilomantsi near the Russian border. The museum exhibits the local industrial history on the banks of Koitajoki River. The exhibitions are located in ironworks mansion Pytinki and there are also the ruins of blast furnace, massive waterwheel and

unique, restored canals. The Möhkönkoski rapids located close by are popular for recreational fishing and there is also arboretum - a tree species park.

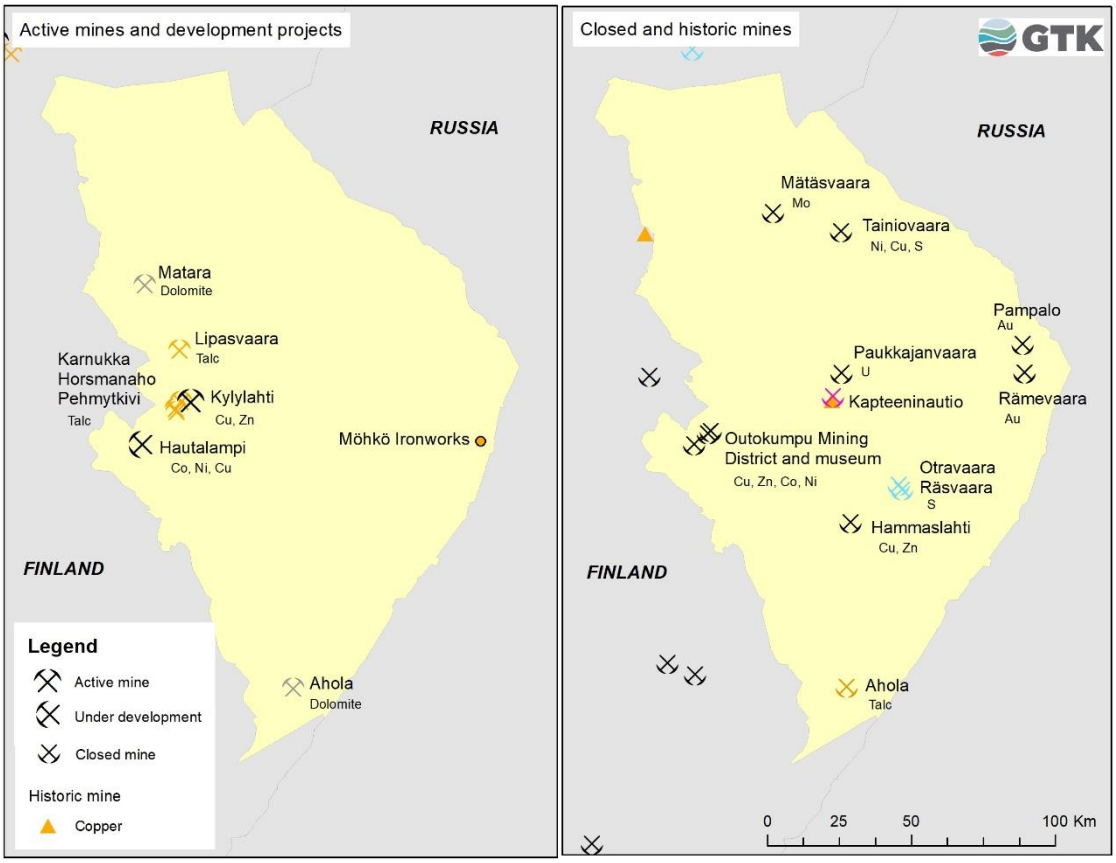


Figure 3.2.2.4: The location of active, closed, historic mines, mine development projects and mining museums in North Karelia.

Mining history of Lapland

Mining in Lapland started with the gold rush alongside of the Ivalojoki River in 1870 and since then thousands of kg of gold have been wrested from the rock and water over time in Lapland. River Ivalojoki's gold was discovered when an expedition sent by the Finnish Senate mapped out gold deposits in Lapland in the summer of 1868. Also, the largest Finnish nuggets have been found in its vicinity. Another significant place for gold panning in Lapland is the Lemmenjoki River, located in the Lemmenjoki National Park — one of the largest wildernesses in Europe. The gold diggers still continue gold panning in Ivalojoki River, in Lemmenjoki River, in Laanila site, in Tankavaara site and in Vuotso site in Lapland. Nowadays, the gold diggers are using more advanced techniques such as bulldozers for panning, but due to new mining law gold panning is

allowed only manually starting in 2021. There is a gold panning association of Lapland which aims to preserve the legal right for gold panning and carry on the heritage for the future generations.

There are few gold panning museums in Lapland. The Kultala “Golden Village” open air museum used to be the official headquarter governing gold prospecting during Russian times. Close by there is also popular Hammastunturi wilderness are and the 7.6 km long “Golden Trail”, which runs along old gold mines and claims. The Kultala Gold Village on the River Ivalojoki is among the nationally valuable cultural heritage areas. The main building in Kultala is always open to visitors and there is no entrance fee to the buildings. The closest inhabited place, the Sami village Njurgalahti in Inari, is about 30 km from the gold fields. From there, tourists are taken to the gold panning areas in the summer months. The Tankavaara gold mining village and museum is located in Urho Kekkonen National Park. Every summer, international championships in gold panning are held in Tankavaara. Both gold villages offer visitors gold panning experiences among other activities and accommodation in cottages as well as our campsite. The Tankavaara gold museum aims to have the site on the list of UNESCO World Heritage Sites. Some of the huts used by the gold diggers in past are functioning nowadays as a wilderness huts for hikers and skiers.

The Europe’s only active amethyst mine of Lampivaara is located in Lapland, Northern Finland. The visitors can dig their own gemstone, purple amethyst, during their visit to Amethyst Mine. The museum is located on the top of the Lampivaara fjell with captivating view of the surrounding nature. The Amethyst Mine is owned by a private company, The Mining Company Arctic Amethyst Ltd. Although, the mountain is full of amethyst the company is not in raw material business and the company is owned by about 2,700 individual persons and small enterprises. There are not international mining companies or big corporations among the owners.

More advanced mining started in Lapland in the end of 1950s when Kärväsvaara iron mine started its operations. Many of the mines focused on iron and gold and nowadays the biggest operating mines in Finland are located in Lapland (**Figure 3.2.2.5)**.

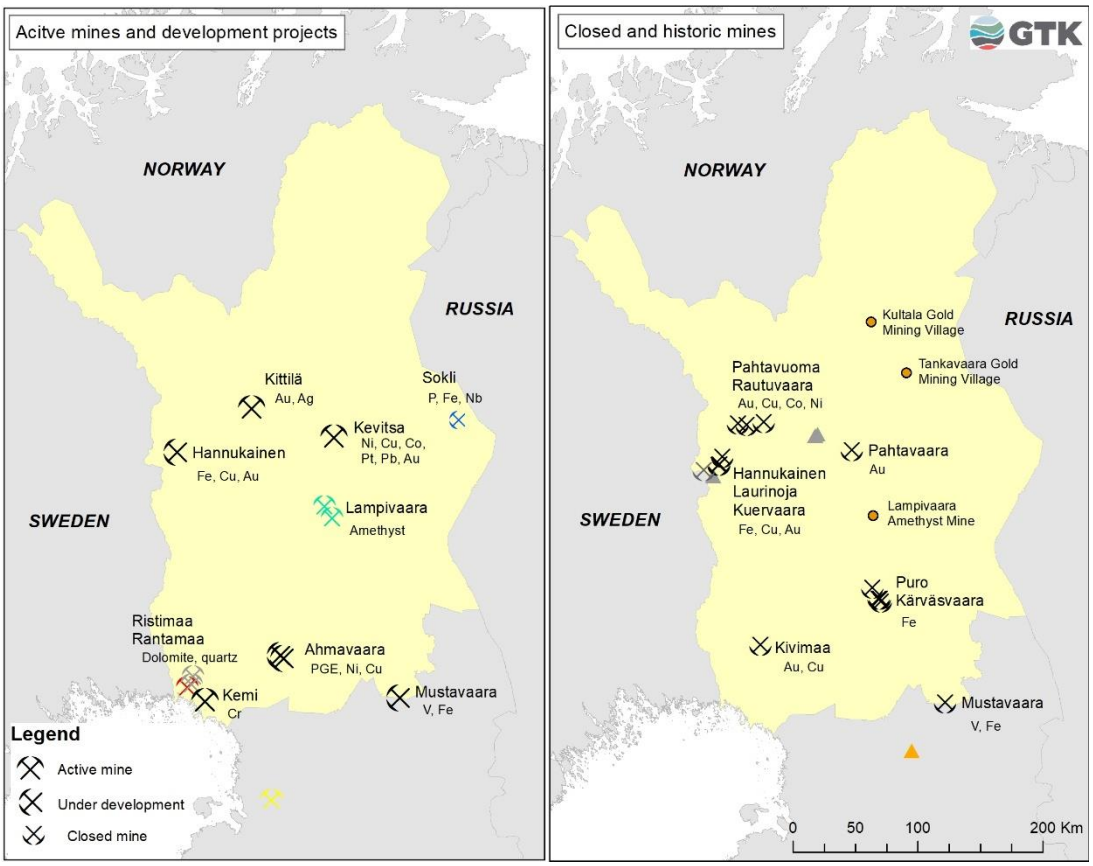


Figure 3.2.2.5: The location of the active, closed and historic mines, mine development projects and mining related museums in Lapland.

3.2.3 Regional GDP of tourist industry

North Karelia

- **Regional GDP of tourist industry:** 2,6 % (2014)
- **Regional GDP of tourist industry per capita:** 596e (2014)
- **Number and type of tourists:** 82% Finnish tourists, 60 % of the foreign tourists from Russia and the overnight stays of the Russians increased by 200% between 2007 and 2013. The turnover of the accommodation services increased by 6%.

There are about 1.5 M border crossings at Niirala's border crossing each year. Travelling is one of the region's leading industrial fields. The visitors come to North Karelia mainly to enjoy nature and sports (eg. National Parks, skiing, hiking) or culture and music events. There are three National Parks in North Karelia of which Koli National Park, is also regarded as the official Finnish National Landscape. It is one of the most famous attractions in Finland and maybe because of

its National value there were conflicts with a uranium mine projects few years back, which resulted in halting the project.

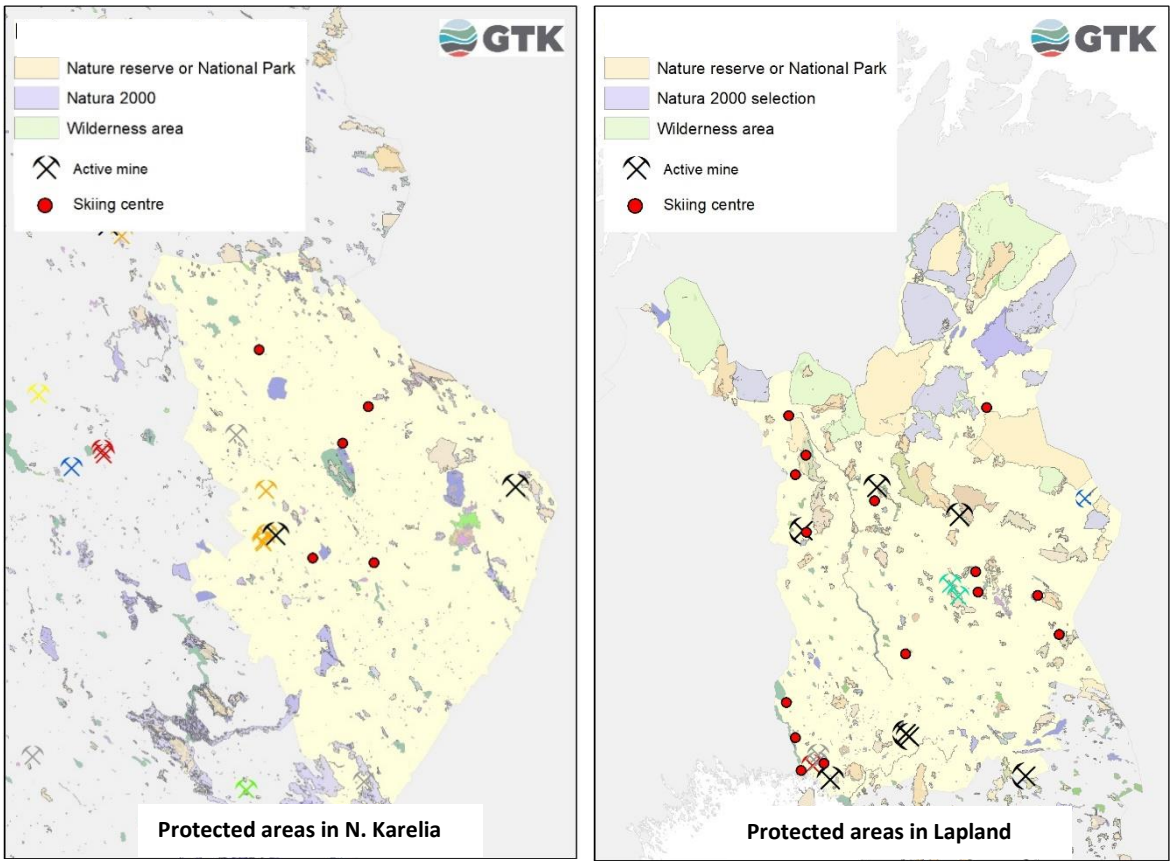


Figure 3.2.3.1. The location of different protection areas and active mines or development projects in North Karelia (left) and Lapland (right).

Lapland

- **Regional GDP of tourist industry:** 5,9 % (2014)
- **Regional GDP of tourist industry per capita:** 1,675e (2014)

Tourism is currently one of the fastest-growing industries in Lapland. In recent years, international travel in Lapland has grown faster than in the rest of the Nordic countries. According to Statistics Finland, international tourism grew by about 22% in 2017 and by 6% in 2018. The peak season of international tourism takes place during the winter and especially around the Christmas season, while the favorite months for domestic tourists in Lapland are March and April, and the fall season, especially September (RCL 2019).

The tourism sector consists of several different industries, such as accommodation, restaurants and program services. The development of this sector in Lapland has been on the upswing, as turnover in 2017 grew well by 15.5%, to 630 M €. All industries of the tourism sector have been growing in recent years. Growth has been the fastest in the program service sector, where turnover grew by up to 23% and the amount of staff by 10% in 2017 (RCL 2019).

The attraction of Lapland is based on the unique Arctic nature and there are seven National Parks and twelve natural parks in Lapland. There are several skiing resorts around Lapland which also offer other attractions such as dos or reindeer sledge riding, Northern Lights tours and visits to Sami villages. Strong growth in demand has been reflected, in particular, in the program service sector, and many tourist areas have an increasing need for innovative tourism service companies. The accommodation capacity in many destinations is practically in full use during the winter peak season, and there is a growing demand for themed high-quality accommodation (RCL 2019).

There are good and bad experiences in combining mining and tourism. In Kittilä, the Levi skiing center, the Kittilä mine and the municipality benefit from each other's, as the mine offers a year-round jobs, the tourism business accommodation and other services and the municipality the infrastructure and public services for the locals. On the other hand, the Hannukainen Mining project has had a lot of opposition to open the mine again in the vicinity of Ylläs skiing center and Pallas-Ylläs National Park in Kolari. Mostly the oppositions are contradicting interests of the tourism business, natural values and mining (RCL 2019).

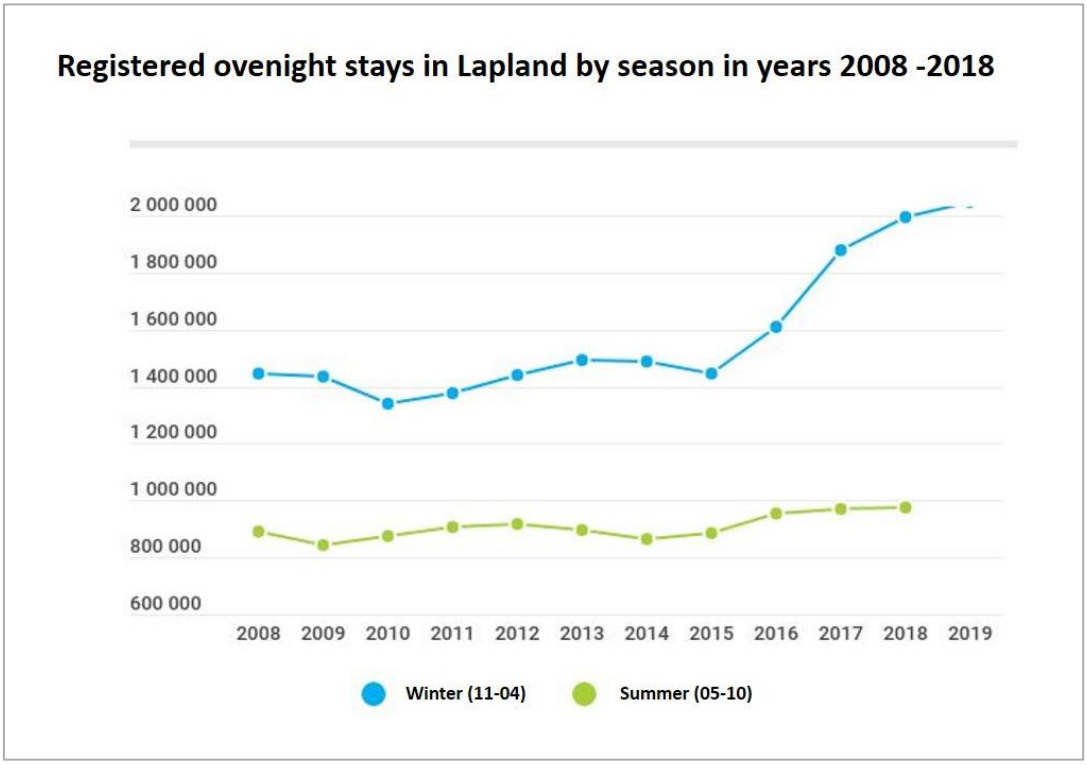


Figure 3.2.3.2: The overnight stays in Lapland in winter and summer months (source RCL 2019).

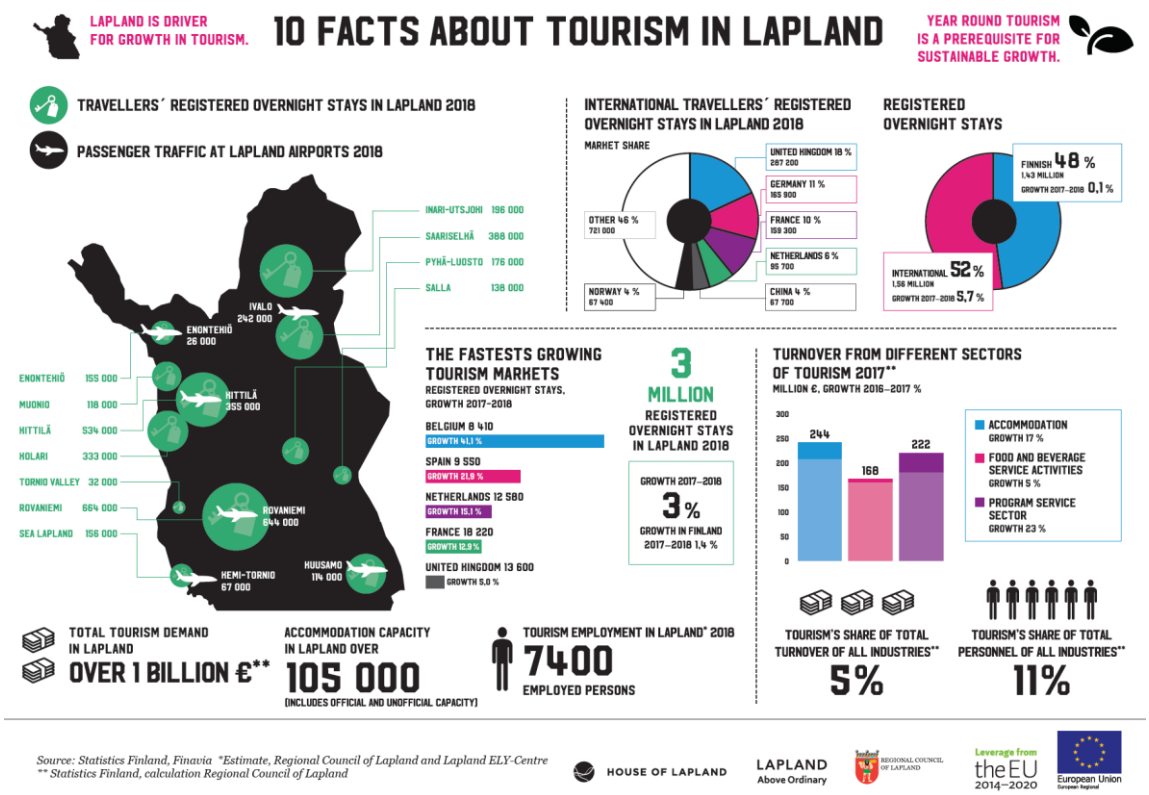


Figure 3.2.3.3: The overview of the tourism in Lapland (source RCL 2019).

3.3 CASE STUDY: REGION OF STYRIA

Figure 3.3.1 that follows, indicates the most important, active mines of Austria, while the encircled area corresponds to "Upper Styria". As can be seen on the map, the main, exploited

minerals/rocks, at the area of “Upper Styria”, are the gypsum, talc, magnesite, limestone, and other rocks (such as basalt, diabas e.tc.), while there are also ores of iron, that are exploited.

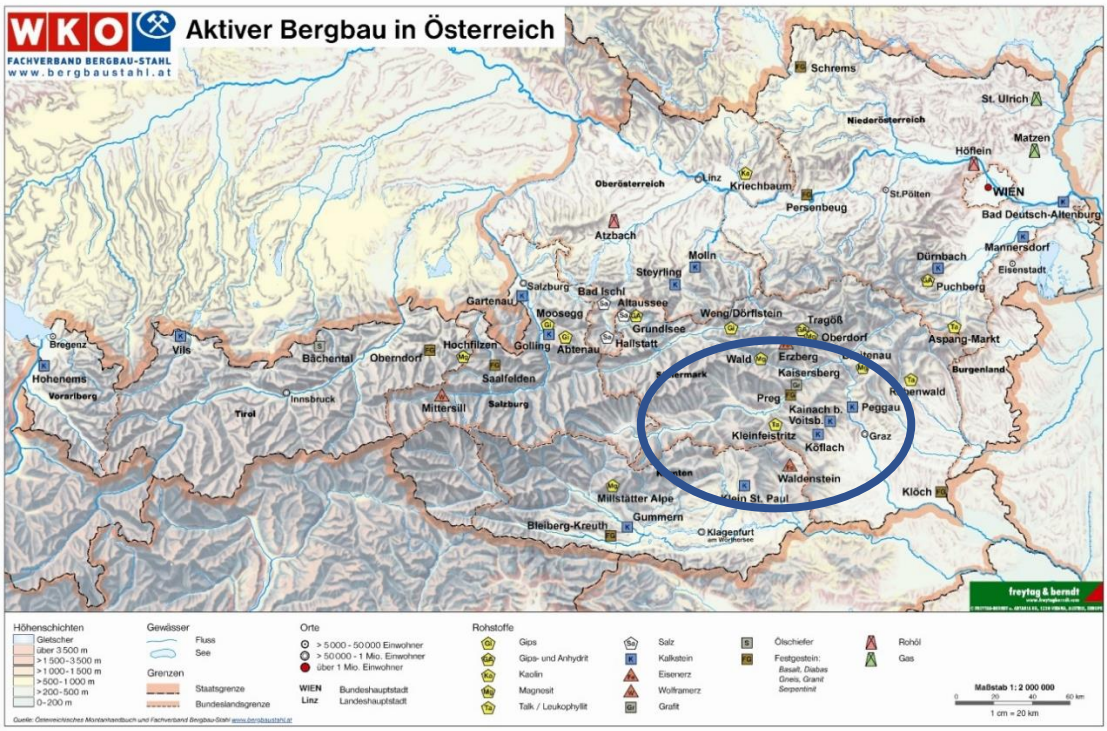


Figure 3.3.1: Active mines in Austria, with the Region of “Upper Styria” encircled.

3.3.1 Cultural significance

The **Styrian Iron Route** is Austria´s “cradle of industrialisation”. Starting point was the iron ore mine at the Erzberg (where – according to the legend – 712 A.D. iron ore was detected). The Erzberg (“Iron mountain”) is nowadays the landmark of the region. The open-cast mine with its spectacular silhouette is the regions´ well-known ambassador and the **only large iron ore mine** in Central Europe still operating. It is also a major **tourist site** (approx. 50,000 visitors per year – showmine & tours through open-cast mine showing modern mining in operation) (www.abenteuer-erzberg.at).

Industrial culture and heritage are visible throughout the region by many **mining monuments** and **remains**. Together with the **UNESCO awarded mining traditions** (intangible UNESCO heritage) they are still **important elements** of the region’s identity.

The **Styrian Iron Route** is a “**regional route**” in the ERIH (European Route of Industrial Heritage, www.erih.net) network, and the Erzberg is one of the approx. 100 European ERIH anchor points.

3.3.2 Mining heritage

It all began more than 13,00 years ago. According to the legend the region's **industrial history** started in 712 A.D. when iron ore was discovered some 30 km from the district capital Leoben at the Erzberg ("**Iron mountain**").

Over the centuries iron processing and iron-related handicraft developed – e.g. the region hosts the **last intact charcoal blast furnace** worldwide (the Radwerk IV in Vordernberg).

In this context the need of well-educated engineers grew, and in 1840 the mining university in Leoben was founded by Archduke Johann. It was firstly based on Vordernberg, but it moved quickly to Leoben and now it hosts more than 4,000 students from all continents and 80 countries.

Metal industry is still the base of the local economy in Leoben and the Upper Mur Valley 30 km east and west from Leoben. In the 50s the LD-process (Linz-Donawitz-process; engl.: basic oxygen process, BOP process) for steel production was developed in Leoben, and nowadays, 72 % of the world production of crude steel is produced by this process.

Hand in hand a typical industrial culture developed – and the region's Styrian Iron Route owns many **tangible** and **intangible cultural assets**. The customs of the miners and steel workers were recognized as intangible **UNESCO heritage** in 2018.

- **M&M museums and historical sites in the specific region – possible mining sites that could be attractive for tourists:**

  - **Erzberg** ("Iron mountain"): showmine and tours through open-cast mine – www.abenteuer-erzberg.at (anchorpoint in ERIH network – European Route of Industrial Heritage)
  - **Charcoal blast furnace museum Radwerk IV**: www.radwerk-vordernberg.at
  - **Copper showmine in Radmer**: www.kupferschaubergwerk.at
  - **Erzbergbahn / Erzberg railway**: European steepest narrow-gauge-railway (former steam engine railway for ore transport): www.erzbergbahn.at
  - Many other **old blast furnaces** and **monuments** + **M&M related museums**

List of the most important monuments: http://www.eisenstrasse.co.at/montanhistorisches-erbe/montanhistorische-monumente/

Museum association Styrian Iron Route: 13 museums: www.eisenstrassenmuseen.at

- **Mining museums in proximity to the Styrian Iron Route (in Upper Styria):**
  - **Showmine Oberzeiring** (silver)
  - **Mining museum Fohnsdorf** (coal) (former Europe´s deepest lignite mine - was shut-down in the 1970's)
  - **Showmines in Hallstatt & Altaussee** (salt)

- **Examples of exploiting Mining heritage in the country – Good practices:**
  - The very best Austrian example is **Erzberg** ("Adventure Erzberg") – a very good combination of mining in the past & present (from heritage to ongoing mining)
  - **Terra Mystica & Montana** www.terra-mystica.at/
  - **Schaubergwerk Hüttenberg** www.huettenberg.at
  - **Schwarzer Silberbergwerk** www.silberbergwerk.at
- **Spatial extent of areas with high naturalistic value in proximity to old mining areas by using maps or by a brief description.**
  - National park **Gesäuse** (parts of it belong to the "Styrian Iron route")
  - Nature Park "**Eisenwurzen**" (also UNESCO Geopark)

Most of the cultural valuable sites are **easily accessible** – either operating as a **touristic company** (e.g. "Adventure Erzberg") or are owned by **municipalities or non-profit associations**. Most of them have fixed opening times.

3.3.3 Regional GDP of tourist industry

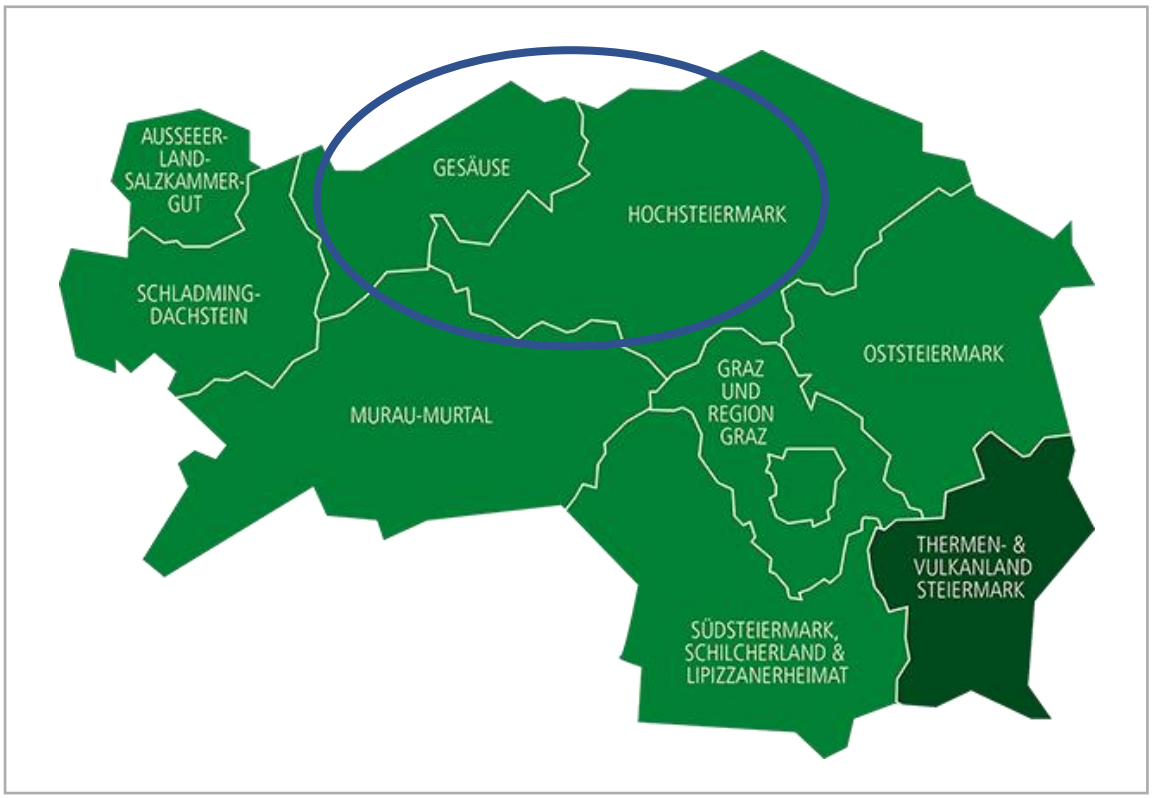


Figure 3.3.3.1: General touristic data of tourism region "Hochsteiermark" (= Eastern Upper Styria) (https://www.verwaltung.steiermark.at/cms/dokumente/12208857_117401915/6fdf847e/20190312_24_Hochsteiermark.pdf)

- **Regional GDP of tourist industry**

Turnover 2018 in touristic region "Hochsteiermark": 174 Mio € (State of Styria: 2,044 Mio €)

- **Regional GDP of tourist industry per capita**

157,159 inhabitants →1,107 €

Number and type of tourists

The overnight stays at the touristic region of "Hochsteiermark" for the year of 2018 correspond to 857,376 people, while for the State of Styria to 12,022,895. Regarding the number of visitors at the same region, the registered number is 356,097, while for the State of Styria, the same variable is 4,197,240.
The next Table represents the touristic peaks, for the region of "Hochsteiermark", and the State of "Styria", regarding the overnight stays, in the summer season.

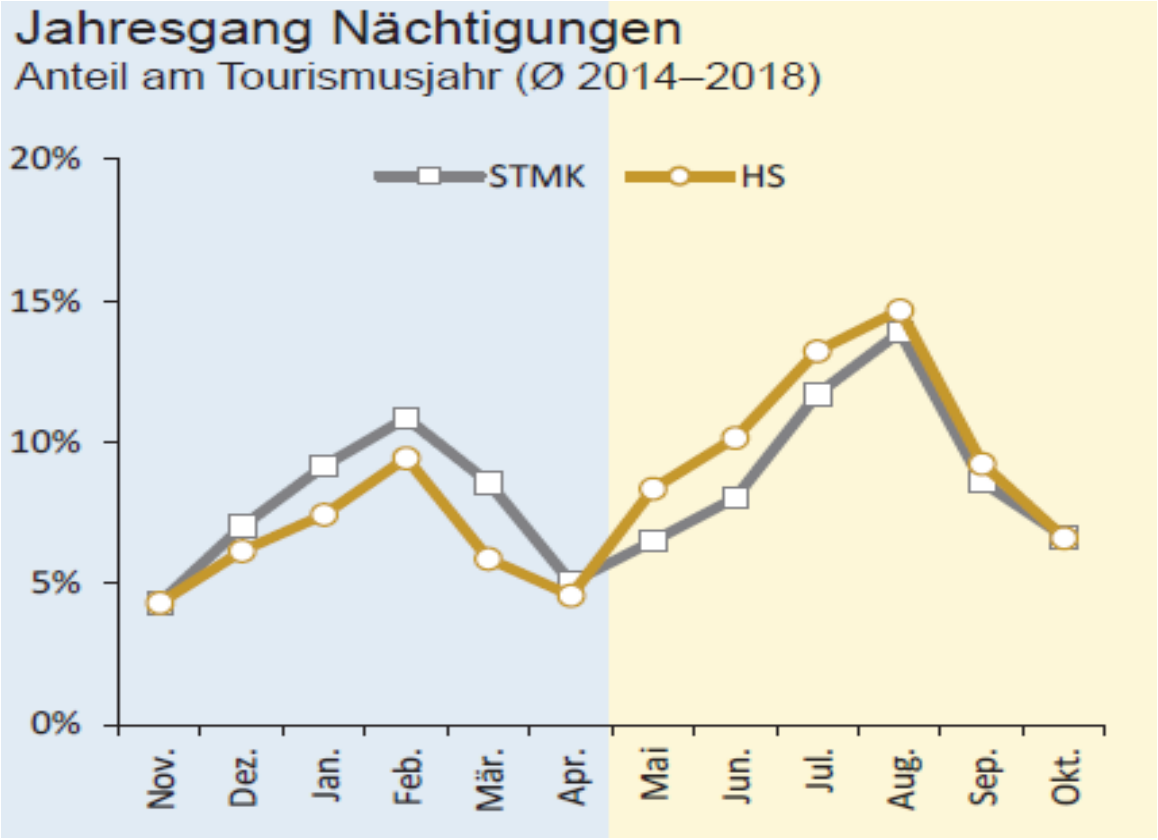


Table 3.3.3.1: Touristic peaks: HS: Region of "Hochsteiermark", STMK: State of "Styria" – peaks in February & July-August, 62% of overnight stays are in the summer season (May to Oct.)

Data related to the Mining heritage are **not available**. There are only visitor numbers of the major touristic mining heritage sites. In detail:

- **Erzberg** ("Iron mountain" – showmine and adventure tours): 55,108 visitors (2018); 2nd most important touristic attraction in region "Hochsteiermark"
- **Museum centre Leoben**: 5,768
- **Radwerk IV** (blast furncace museum): 1,784
- **Showmine Radmer**: 2,680

3.4 CASE STUDY: REGION OF SAXONY

- **Active mining permits** for ores and spates (as at 1 July 2015)
  - Orange: permissions **granted**
  - Red: **issued** licences

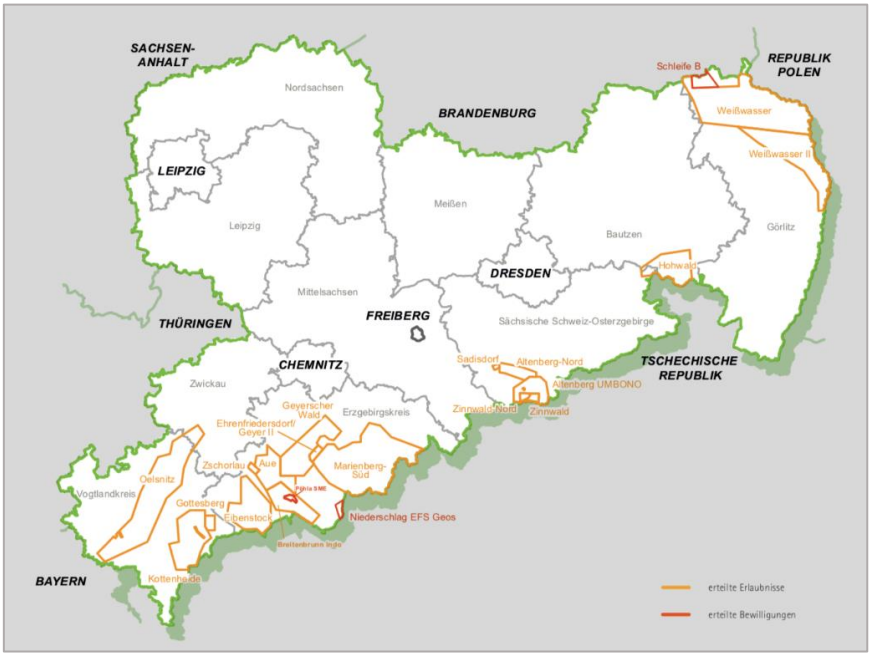


Figure 3.4.1: Active mining permits for ores and spates

- **Active** (aggregates and lignite) **mining operations** under mining supervision (as at December 2014)

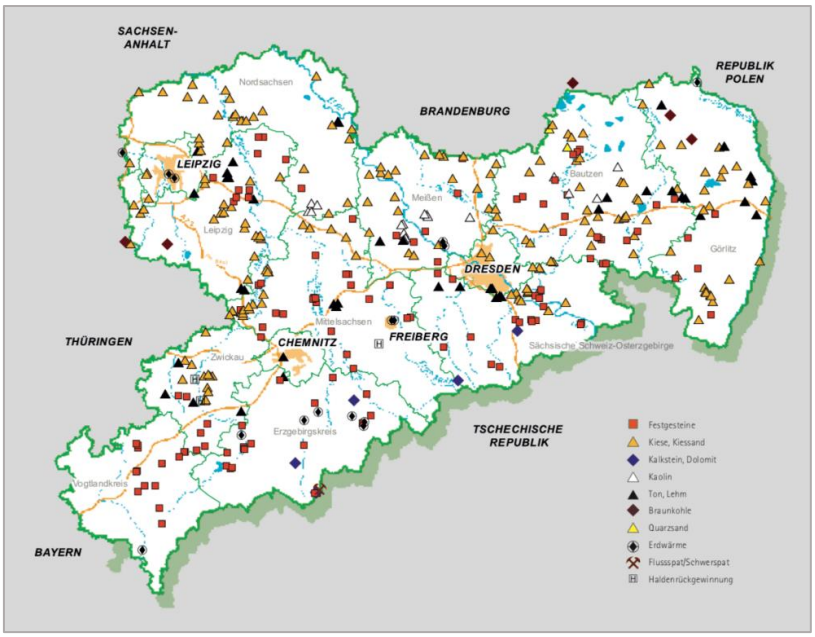


Figure 3.4.2: Active (aggregates and lignite) mining operations under mining supervision

- **Visitor mines** and other objects open for **inspection** (as of December 2014):
  - Symbols meanings are as follows:
    - Visitor mine
    - Mountain cellars, passageway systems of non-mining origin e.tc.
    - Visitor's cave
    - Others
  - At the end of the reporting year of 2014, there were **52 visitor mines** in Saxony, **8 underground caves** with walk-in passage systems, a visitor cave and **8 historical mining objects** managed by interest groups or associations. The 2 visitor mines ceased operations in the year under review.
  - The visitor mines in the Free State of Saxony, especially in and around the traditional historic mining towns of the Erzgebirge mountains, were also important tourist attractions in 2014. Together they counted **266,000 visitors**.
  - The operators of many mining facilities were busy further increasing the attractiveness of the facilities through maintenance and expansion measures. To this end, **75 full-time and part-time employees** are working in the visitor mines and other objects open for inspection. The work of the many voluntary helpers, who worked around 34,000 hours in the year under review, is essential for the presentation of the numerous mining exhibits.

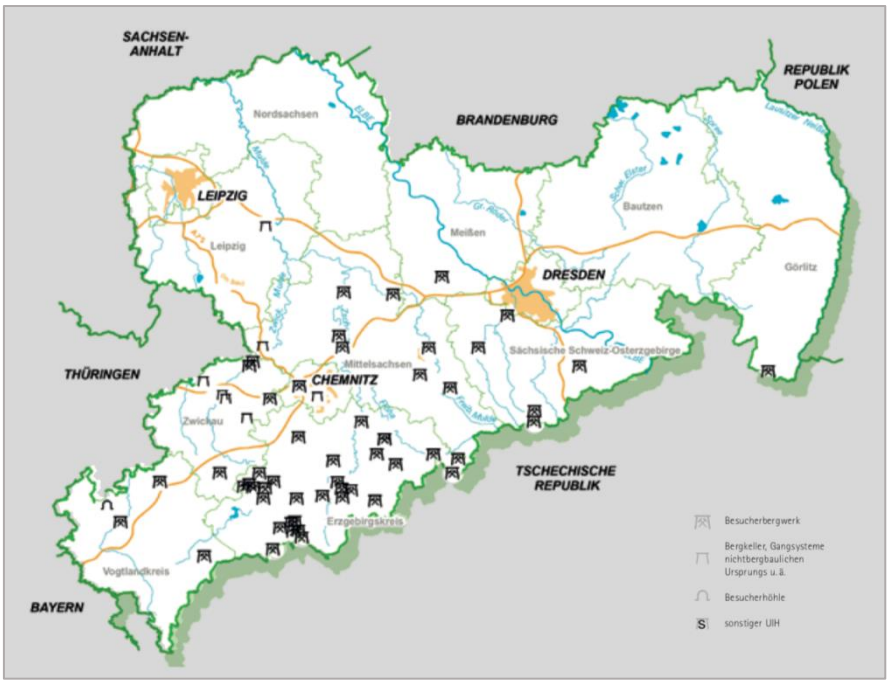


Figure 3.4.3: Visitor mines and other objects open for inspection.

- **Refurbishment plants/facilities** under mining supervision - **excluding** old mines (as of December 2014)

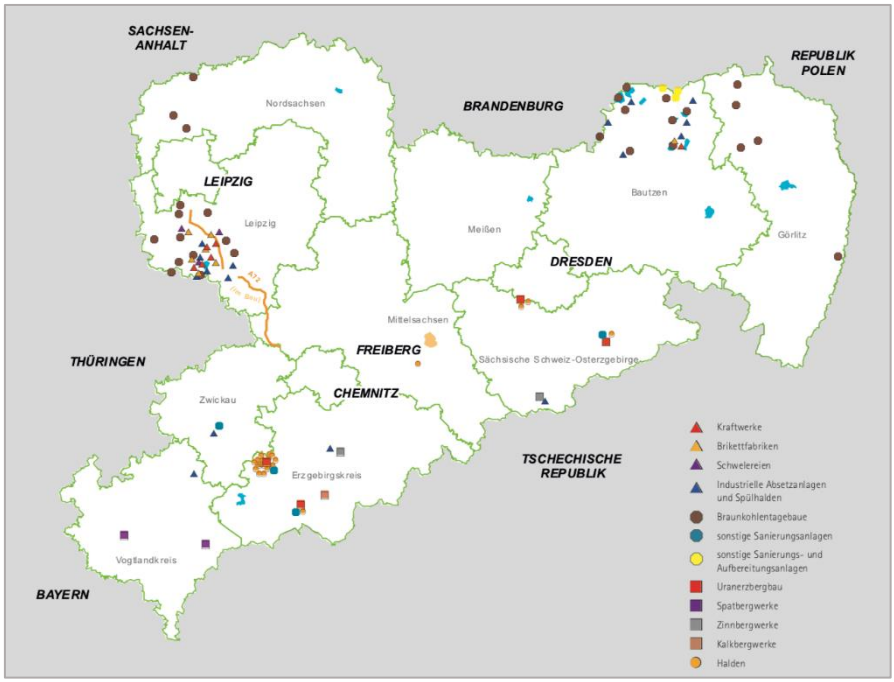


Figure 3.4.4: Refurbishment plants/facilities under mining supervision – excluding old mines

1. **Cavity map for Saxony:** http://www.bergbau.sachsen.de/8159.html

The areas of the cavity map are displayed up to a scale of 1:10 000 and the map is constantly updated.

- Areas with underground caves, according to § 8 der Sächsischen Hohlraumverordnung (Sächs.HohlrVO)
- Areas with mine workings under mining supervision

Background information for the cavity map

- The map "Areas with underground cavities" (Sächsische Hohlraumkarte) is part of the administrative regulation on cavity areas of the Saxon Upper Mining Authority. The map contains areas (1) in which underground cavities exist (cavity areas) and for the sake of completeness (2) also the areas with underground cavities which are subject to the Federal Mining Act (areas with mine workings under mining supervision)
- Areas with tailings piles or residual holes from which hazards for subsequent use emanate according to § 8 of the Saxon Void Ordinance (Sächs.HohlrVO): The designation of these areas is currently being prepared.

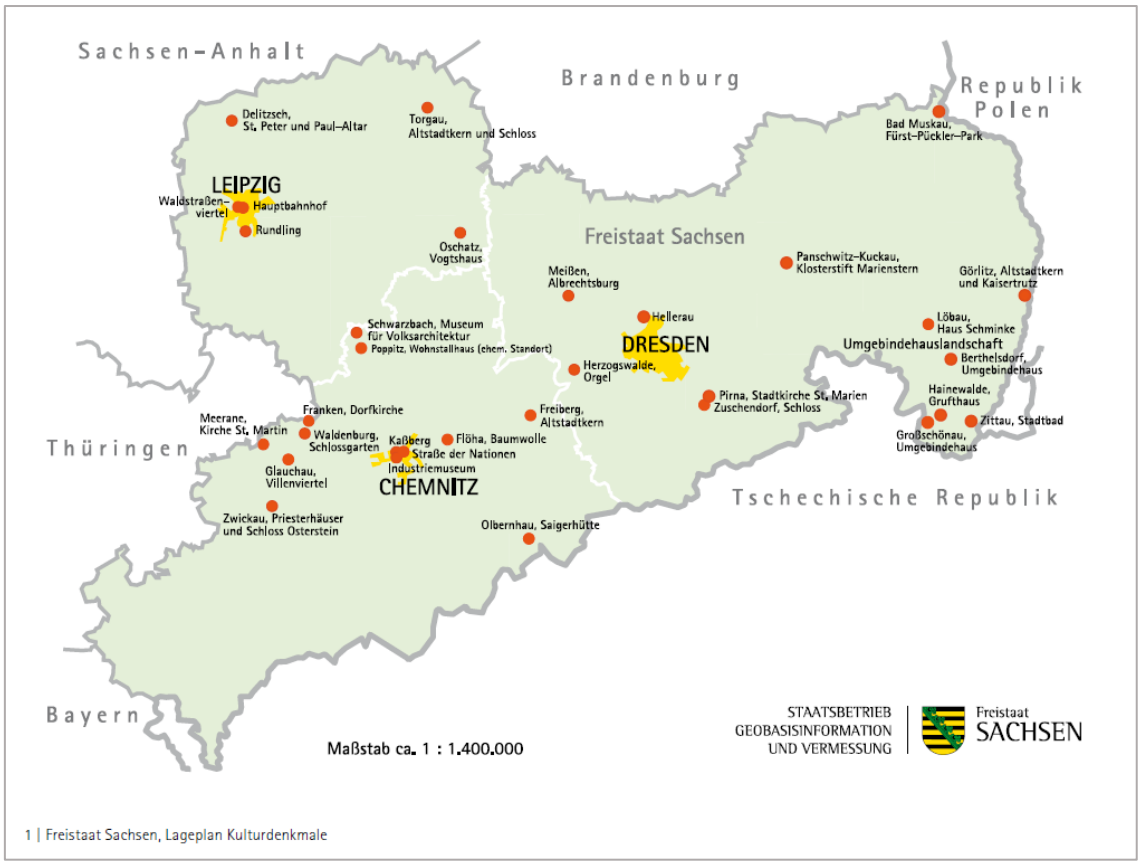
2. **Relevant active project: Prevention of risks associated with old mines (2014-2020)**

- In certain areas of the Free State of Saxony, the consequences of old mining operations pose risks to persons, companies and property. The prevention of risks in old mining serves to eliminate risky and development inhibiting legacies from old mining without legal successors.
- Measures for this purpose are surface and underground securing, safekeeping, final dismantling or the establishment of the long-term functionality of mining facilities.
- List of sub-projects and its locations
    - Refurbishment of lead and silver mines Stolln in Thum (2015 to 2018)
    - Rehabilitation of Seiffener Pingen mine workings in Seiffen (2015 to 2019)
    - Refurbishment Sankt-Johannes-Erbstolln, Erla-Crandorf (2016 to 2019)
    - Rehabilitation Tiefer Wolf Stolln in Siebenlehn (2016 to 2020)
    - Refurbishment of the deep Zwieseler Erbstolln in Berggießhübel (2016 to 2020)
    - Safekeeping of trust shaft and dismantling of buildings and facilities in Lugau (2017 to 2020)
    - Hedwig shaft custody in Oelsnitz/E. (2017 to 2020)
    - Safekeeping of Hilfe-Gottes-Schacht in Zwickau (2017 to 2020)
    - Safekeeping and renovation work on the Karl-Stein-Straße project in Dresden (2017 to 2020)
        - Remediation of Breitscheid-Schächte site in Hohndorf, Part A - Deconstruction of railway bridge (2018)
        - Refurbishment of Reibold shaft dump in Freital (2018 to 2020)
        - Renovation of Victoria Shaft dump in Lugau (2018 to 2020)
        - Rehabilitation of Friedensschacht site in Oelsnitz/E. (2018 to 2020)

- Planning of the receiving water connection Freiberger Grubenrevier via Roten Graben in Freiberger Mulde (2018 to 2020)
- Rehabilitation of shafts Explosives defeat Niederwürschnitz (2018 to 2021)
- Rehabilitation of Breitscheid shafts in Hohndorf, Part C - Rehabilitation of Halden II and III Breitscheid shafts (2018 to 2021)
- Rehabilitation of the Breitscheid shafts site in Hohndorf, Part D - Exploration of Breitscheid shafts I and III (2019 to 2020)
- Refurbishment of the Bockwaer Senke melt stream vault in Zwickau (2019 to 2020)
- Planning rehabilitation of Nickoley shafts in Zwickau (2019 to 2020)
- Planung Sanierung Standort Halden Brückenbergschächte in Zwickau (2019 to 2021)
- Rehabilitation of Griefner Stolln in Schneeberg (2019 to 2022)
- Rehabilitation of deep main gallery in Scheibenberg (2019 to 2022)
- Refurbishment of Kaisergruben site in Gersdorf (2019 to 2022)
- Redevelopment of Martin Hoop shaft in Mülsen (2019 to 2023)

3.4.1 Cultural significance

Saxony has a quite **important cultural significance** for Germany. Saxony is a **well-known** tourist destination. Dresden and Leipzig are two of Germany's most visited cities. Dresden is known as the Jewel Box, because of its baroque and rococo city centre. Areas along the border with the Czech Republic, such as the Lusatian Mountains, Ore Mountains, Saxon Switzerland, and Vogtland, attract significant visitors, largely Germans. Saxony has **well-preserved historic towns** such as Meissen, Freiberg, Pirna, Bautzen, and Görlitz. Other cultural assets of Saxony are the Meissen porcelain, which is the first European porcelain and the Erzgebirge woodcut art especially native to Seiffen. The festivals and customs of the Sorbs in Lusatia are nationally known and since 2014, registered as immaterial cultural heritage.
As such, throughout German history Saxony played an **important role** in shaping German culture. The controversial American and British bombing of Dresden in World War II towards the end of the war destroyed the entire city centre and lodged in the German cultural memory. Also, the movement which led to the re-unification of Germany started in Saxony. Local activists and residents staged demonstrations and demanded the removal of the non-democratic government. The following map (**Figure 3.4.1.1**) represents the spatial extent of these type of activities.



1 | Freistaat Sachsen, Lageplan Kulturdenkmale

Figure 3.4.1.1: Spatial extent of activities related to cultural heritage. Apart from the landscape of historical monuments, it was not possible to find a complete list of the data. Source: Staatsministerium des Innern: Denkmalschutz und Denkmalpflege im Freistaat Sachsen, p.2; https://publikationen.sachsen.de/bdb/artikel/11908

The following data are related to the number of monuments, historical sites, monuments of World cultural heritage etc.

1. M&M related **UNESCO World Heritage**
    a. **Mining Cultural Landscape Erzgebirge/Krušnohoří (designation in 2019)**: The Krušné hory Mountains region is heavily influenced by mining and ore processing in the past. More than 800 years of activities contribute to a unique landscape and customs on both sides of the border. The mining cultural landscape Montanregion Krušnohoří/Erzgebirge consists of five Czech cultural heritage places. Saxony has nominated 17 cultural heritage sites, including the historical mining towns of Freiberg, Annaberg-Buchholz, Marienberg and Schneeberg as well as other mountain landmarks including objects related to the connected industrial branches. The detailed information of the 22 sites can be found here.
2. **Other UNESCO World Heritages**

a. **Muskau Park** (German: Muskauer Park, officially: Fürst-Pückler-Park Bad Muskau; Polish: Park Mużakowski) is a landscape park in the Upper Lusatia region of Germany and Poland: It is the largest and one of the most famous English gardens in Central Europe, stretching along both sides of the German–Polish border on the Lusatian Neisse. The park was laid out from 1815 onwards at the behest of Prince Hermann von Pückler-Muskau (1785–1871), centered on his Schloss Muskau residence. In July 2004, Muskau Park was added to the list of UNESCO World Heritage Sites.
b. **The Dresden Elbe Valley** (former) is a cultural landscape and former World Heritage Site stretching along the Elbe river in Dresden, the state capital of Saxony, Germany: The valley, extending for some 20 kilometres (12 mi) and passing through the Dresden Basin, is one of two major cultural landscapes built up over the centuries along the Central European river Elbe, along with the Dessau-Wörlitz Garden Realm downstream. With respect to its scenic and architectural values, including the Dresden urban area as well as natural riverbanks and slopes, the Elbe Valley was entered on the World Heritage Site list of the UNESCO in 2004. However, in July 2006 it was designated a World Heritage in Danger and finally **delisted in June 2009**, in the course of the construction of the Waldschlösschen Bridge river crossing.

3.4.2 Mining heritage

The **origin of Saxony**[15] **mining** lies in the Middle Ages. Around 1168, after a sensational silver discovery, the area around Freiberg was settled and in 1186 the settlement was raised to the status of a town by Margrave Otto the Rich (Markgraf Otto den Reichen), which developed rapidly. Mining ensured the prosperity of the country in the following 700 years. A mining office in Freiberg has been mentioned since 1241. Since 1244 the first coin of the country is resident in Freiberg. In 1307 Freiberg's mining law, which had been applied for a long time, was written down and applied in large parts of Europe.

After the temporary **decline of silver** and **metal ore mining**, it was extended to the Erzgebirge district in the Altenberg, Schneeberg and Annaberg areas from the middle of the 15th century with new prosperity. In 1523, the arithmetic master Adam Ries became a mining official in Annaberg. In 1509 Duke Georg issued the "Annaberger Bergordnung", which was the authoritative basis of mining law in Central Europe until the 19th century.

The first mention of a master miner (Bergmeister) took place in 1241. Since the middle of the 16th century, the Oberbergamt was developed (the year of foundation 1542 is controversial). The Oberbergamt was the nucleus of the **first scientific university** for mining in the world, the Bergakademie Freiberg, founded in 1765. In the 19th century, the Oberbergamt also founded the **country's geological service**. Freiberg's ore mining ended in 1969, the last ore mines in

[15] History from Saxon Mining Office obtained on 05.07.2019: http://www.oba.sachsen.de/266.htm

Altenberg and Ehrenfriedersdorf closed in 1991. Since then ore mining has been history throughout Germany.

The **hard coal mining** in Zauckerode (Freital near Dresden), whose roots lie in the 16th century, developed further from the beginning of the 19th century to industrial dimensions, as did the hard coal mining from Zwickau to 1980 and Oelsnitz to 1971.

At the beginning of the 20th century, **lignite mining** in the Central German region (south of Leipzig) and in Lusatia also grew into large-scale operations, with the original underground mines being transferred to open-cast mining. In the GDR, lignite mining reached enormous dimensions, and the GDR became the largest lignite mining country in the world. Today, the privatised lignite mining industry in both regions is mainly used for crisis-proof and economic power generation.

Uranium mining, which began after 1946, also reached considerable dimensions in the GDR. The GDR was the **third largest uranium producer** in the world and the No. 1 in the Eastern bloc. Until 1990, mining took place in the Erzgebirge, in Dresden-Gittersee and in Königstein in the Elbsandsteingebirge. The abandoned uranium ore mining and the non-privatised part of the lignite mining are today among the **largest redevelopment** and **environmental projects** in Europe.

Due to the Saxon's geology, there are a lot of visitor mines, that are represented in the following **Figure 3.4.2.1.**

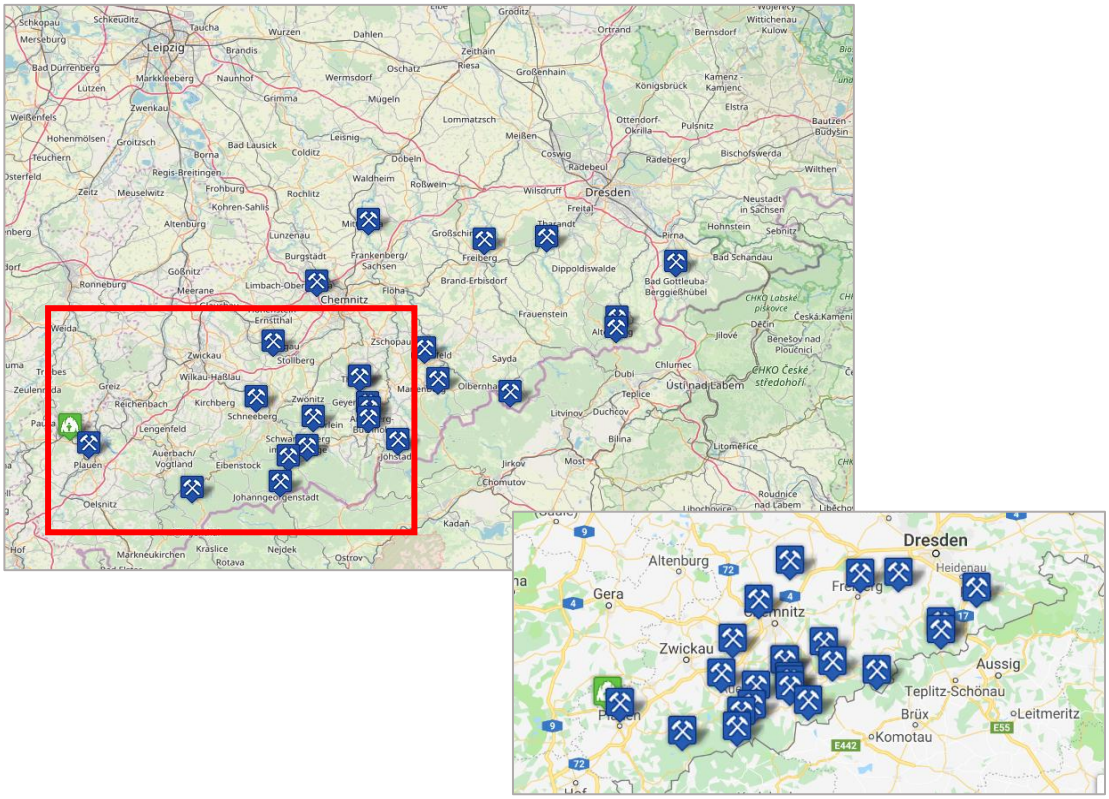


Figure 3.4.2.1: Spatial distribution for the M&M museums and historical sites in the specific region – possible mining sites that could be attractive for tourists. Source: https://www.sachsen-erkunden.de/sachsen-unter-tage-hoehlen-besucherbergwerke-und-schaubergwerke-im-freistaat/

In the region of Central Saxony, there are also many Christmas markets showing **old mining traditions,** such as Schwibbogen which was a metal candle holder for the Christmas shift (Mettenschicht) celebrated by miners and is now a popular Christmas decoration[16]. One of the most important mining traditions is the parade of miners. During Advent season, miners from difference mining regions dress in the historical garb of miners and carry the coat of arms of their mining regions to attend the parade taking place at various places in Saxony. This tradition is firmly rooted in Saxon region and no other German Federal state have larger parade than the one of the Erzgebirgs miners. Every Advent weekend the miners pass through the villages before they (almost) all come together on the 4th Advent weekend for the largest mountain parade.

A list with examples of exploiting Mining heritage in the country, as **good practices**, is the following:

1. Mining Cultural Landscape Erzgebirge/Krušnohoří: UNESCO World Heritage
2. Freiberg TerraMineralia – world largest public and academic mineral collection
3. Museum für mittelalterlichen Bergbau im Erzgebirge (MiBERZ)
4. Chemnitz Industrial Museum – permanent exhibition of mining and metallurgy industry (in development)

Regarding the **spatial extent of the areas** with **high naturalistic value** in close proximity to old mining areas by using maps or by a brief description, Saxony has selected 270 **Fauna-Flora-Habitat areas** (**FFH areas**), and 77 European **Special Protection Areas** (**SPAs**) as parts of the Europe-wide NATURA 2000 network of protected areas (Named Europäische Vogelschutzgebiete in the interactive map). Detailed information on each area is available here via a map application and search or here as the start webpage.
In general, there is **not too much overlaps**. The status of FFH/SPA areas do not interfere with carrying out the reclamation work. Only the reclamation work should be done in accordance to the **regulations of FFH/SPA areas**. In addition, old mines reclamation work is financially supported by the **Saxon government**. The map below (**Figure 3.4.2.2**) shows both the **visitor mines, FFH** and **SPA areas** and **birds protection areas** (in **green** and **black strips**).

[16]Erzgebirgsstube (n.d.) The history of the Schibbogen. Retrieved on 20.08.2019 from https://www.erzgebirgsstube.com/geschichte-der-lichterbogen

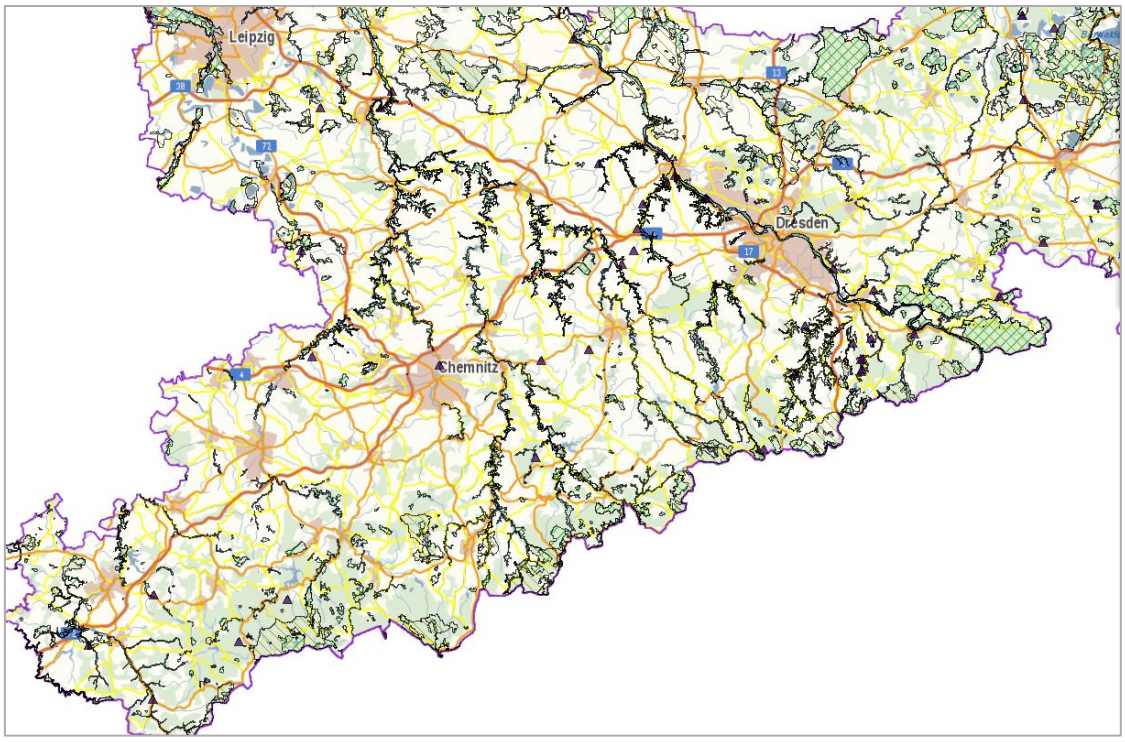


Figure 3.4.2.2: The map below shows the FFH and SPA areas and birds protection areas (in green and black strips).

As for the level of citizen information, regarding mining heritage and mining activities, in Saxony, particularly in the Erzgebirge region and regions with active mines (e.g. lignite), people are **highly aware** of the **mining heritage** and **mining activities**.

Finally, for the ownership regime of old mining heritage, most of the visitor mines are **private**. However, such as the visitor mine of the TUBAF, is **public owned** (university). Regarding the reclamation work for the old mines, on the basis of the SMWA Police Ordinance for the defence against dangers from underground cavities as well as heaps and residual holes (Saxon Cavity Ordinance - SächsHohlrVO), the Saxon Mining Office takes all necessary measures to restore public safety. This also includes the temporary restriction of rights of the affected landowners and other affected parties in order to protect them from the dangers.[17]

[17] The Saxon Mining Office (2015) The Mining in Saxony report 2015. Retreived on 20.08.2019 from https://www.oba.sachsen.de/download/2016_11_09_JB2015_Druckfassung.pdf

3.4.3 Regional GDP of tourist industry

As there is no availability of data for GDP, the table that follows, shows the economic indicator of GVA (**Table 3.4.3.1**). Regarding the number and type of tourists, the following table (**Table 3.4.3.2)** represents that type of data. The **Figure 3.4.3.1** represents the mining related regions: Erzgebirge, Oberlausitz and Sächsische Schweiz; together with the percentage of 28,5% of tourist activities.

Year	M €	Population (M)	Per Capita (€)
2005	1,034	4,274	242
2010	1,196	4,149	288
2015	1,452	4,085	355
2017	1,472*	4,081	361
2018	ND	ND	ND

***2016**

Table 3.4.3.1: Data for the economic indicator of GVA.

Year	Guests arrival	Overnight stays
2004	5,436,572	14,744,026
2010	6,267,540	16,317,139
2015	7,405,916	18,732,207
2017	7,864,001	19,513,123
2018	8,178,813	20,086,757

Table 3.4.3.2: Data for the number and type of tourists. Source: Landesamt für Statistik Sachsen, https://www.statistik.sachsen.de/download/050_W-Handel-Tour-DL/G_IV_1mt003.pdf

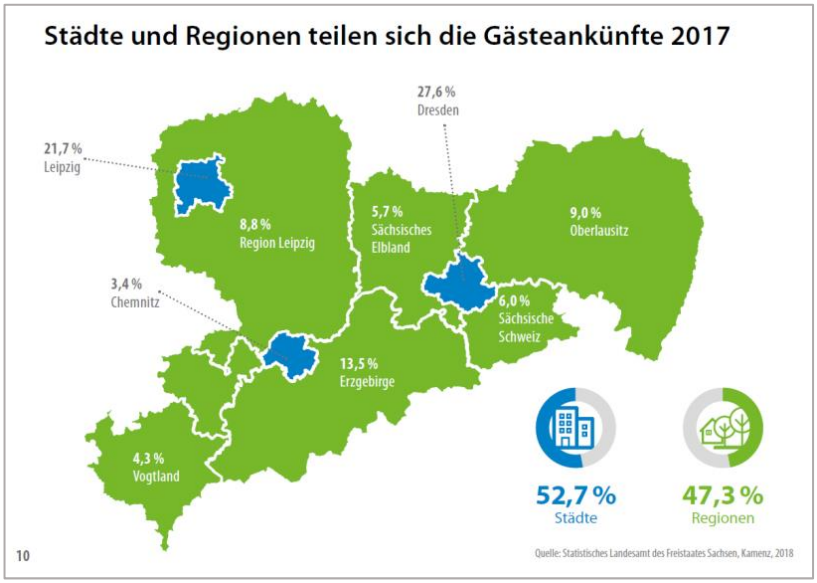


Figure 3.4.3.1: Source: Landestourismusverband Sachsen: Tourismus in Sachsen: Statistiken und Zahlen zum Wirtschaftsfaktor 2016/2017, p. 10.

3.5 CASE STUDY: REGION OF KOŠICE

3.5.1 Cultural significance

The Košice region has on its territory **11 cultural UNESCO monuments**, **7 natural UNESCO monuments** and **4 intangible UNESCO monuments**.

Figure 3.5.1.1: Location of UNESCO landmarks with in the Košice Region

Cultural UNESCO monuments:

The Spiš Castle - One of the largest castle complexes in the world (4 hectares). The oldest preserved written mention of the Castle comes from the year 1249. In the beginning it performed the function of a border fortress on the northern border of the early feudal Historic Hungarian Kingdom, later it became an aristocratic mansion. Over the centuries, the castle was in the hands of various noble families, and it was subject to power struggle. In the year 1780, the castle complex was destroyed by fire and the Spiš Castle gradually turned into ruins. Conservationists prevented its complete deterioration, when they began conservation work on the castle complex threatened by instability of the bedrock in the second half of the 20th century.

Žehra – Church of the Holy Spirit - Over the centuries, the church was modified several times up to its present-day shape. Architecturally, the late Romanesque and early Gothic styles blend

together in this building, and the interesting thing is that the Church of the Holy Spirit has been preserved to this day in an almost intact medieval form. In the church nave, the wooden cassette ceiling had existed at first, but centuries ago it burned out. After the fire, an interesting intervention was made, which completely changed the character of the interior – by adding a supporting octagonal pillar of the vault in the middle of the church, two naves were created. This architectural peculiarity is typical for several churches in the Spiš area and may be regarded unique in the world.

Levoča - It is a city with a distinctive signature of the greatest medieval artist of Slovakia – Master Pavol. Nearby the Spiš Castle, the city of Levoča lies, attracting the attention of almost any visitor by its atmosphere and uniqueness. The beautiful historical centre is encircled by the medieval city walls that have been preserved almost in their entirety; from among the original 15 bastions and towers, six have been preserved. The city walls are more than 2 kilometres long. Levoča was known especially as a free royal town with many privileges. The history also remembers this city as a centre of international trade, the capital of the Zipser Saxons Community, the Spiš County seat and the cultural and social centre of a wider neighbourhood. It is its abundant history which lies in the origin of the impressive authenticity of the present-day Levoča. We find in Levoča Europe's largest medieval square with rectangular shape with its sides in the ratio of 3:1. The square is surrounded by well preserved flashy townhouses, but its most prominent ornaments are the Town Hall, the Belfry, the Cage of Shame, and the biggest temple of the Spiš region – St. James Church.

Spišská Kapitula – The Spiš Chapter - The central building of the Chapter is St. Martin Cathedral, which had initially served as the first Provostal church in the Royal territory. Originally a Romanesque church, it was rebuilt in the 15th century in the Gothic style. By extending the original building, quite a large presbytery emerged, and the building doubled in height. There are eight altars at the church, the Altar of the Virgin Mary Coronation is over 500 years old. An unusually secular wall painting from the year 1317 is highly interesting – the scene of the Coronation of King Charles Robert, who is being blessed by the Virgin Mary holding little Jesus. The Cathedral forms a sort of a centre of the complex, whose boundaries are set by the city walls with three entrances, and its typical feature is a lane of the canonical houses. The lane forms the axis of the whole church town and is its only street.

Spišsképodhradie – Spišské Podhradie is now a small town of about 3800 inhabitants. In the past, however, it was one of the most developed towns of the Spiš region. The town was established as an extramural settlement. Although the first written mention of it comes from the year 1249, the site is much older. It benefited from its position beneath the Castle, its residents rendered all sorts of services to the Castle. The city ground plan reached its completion toward the end of the 15th century, when its form was given by the roads leading past the Castle Hill.

Ruská Bystrá - In the beautiful surroundings of the sub-Vihorlat forests, in the village of Ruská Bystrá, the easternmost representative of all the Slovak wooden churches included in the UNESCO List of the World Heritage is situated – the Greek Catholic Temple of the Transfer of the

Relics of St. Nicholas. The Church was built in the year 1730. It rises on an elevated place amidst the village and, as to its colour it stands out against the surrounding green background of massive trees.

Ladomirová - Above the wooden Greek-Catholic temple in the village of Ladomirová, the protective hand of St. Michael the Archangel is tending, to whom the temple is dedicated. In the year 1742, they built not just the church itself, but also a belfry, from which three mighty bells clang. The temple was built without using a single nail and belongs to the architecturally most valuable and most representative temples of the Eastern rite in Slovakia.

Bodružal - The St. Nicholas Greek Catholic temple in Bodružal is one of the oldest wooden churches of the Eastern rite in Slovakia, with its construction dated back in the year 1658. This is the log-cabin structure in the shape of three squares, which symbolize the Holy Trinity. In the two-part main tower, there are three bells, the oldest of which dates back from the year 1759. The Church is located on the hill above the village in a natural environment. The patron of the Church is Saint Nicholas, Bishop and thaumaturge, very popular for his philanthropy, who was Bishop in Asia Minor in about the year 300. At the back of the temple, we may also find a monument in honour of the 400 soldiers who fell in World War I and their remains are buried in the local cemetery. Bordužal is one of the few Slovak municipalities which were substantially affected by the military operations during both world wars.

Kežmarok - In the year 1717, Protestants of Kežmarok built a "new" Church of the Holy Trinity at the site of the first smaller wooden articular church within a record time of 3 months. The objects arose one after the other on the basis of the resolution of the Sopron Assembly of the year 1681, which allowed the construction of Protestant churches under precisely specified conditions. One of them included the material used, and so today we can admire in Kežmarok the majestic sacral building built of wood.

Hervartov - The Church of St. Francis of Assisi rises in the upper part of the village of Hervartov, on a gentle slope, embraced by high lime trees, enclosed by a stone "wall" covered by shingle. It is the only Roman-Catholic wooden church among the Eastern Slovak wooden churches included in the UNESCO List of the World Heritage. This is probably the oldest wooden church in Slovakia. It was built at the end of the 15th century and is the oldest wooden church in the Gothic style in this preserve. Its exterior has remained almost pristine even after more than half a millennium. The main altar was built between the years 1460 and 1480 and shows the Virgin Mary, St. Catherine of Alexandria, and St. Barbora. Some of the artefacts, such as originals of the side altar wings or the wooden case sanctuary from the early 16th century, are deposited in the National Museum in Budapest.

Bardejov - Near the border on Poland, there is a city with great individuality that would probably impress any visitor. The impressive city centre, for centuries preserved medieval monuments, but also the famous healing spa and the surrounding beautiful nature – these are the characteristics of Bardejov. The Bardejov City Hall Square is formed by a rectangle that defines the colourful burgher houses, built in the Gothic style. The system of Bardejov fortifications

ranks among the perfect ones in the whole of Europe. At the end of 14th century, Bardejov became a free royal town. Skills of the Bardejov merchants and the development of craft are documented by 64 craft specializations with over 50 guilds. Thanks to this fact, Bardejov rose to the peak of fame and wealth in the 14th and 15th centuries, and that era is considered a "golden one". The most valuable of Bardejov medieval buildings is the St. Egidius Basilica; its 11 Gothic wing altars rank it among European unique sites of this kind. Another of the observable landmarks of the square is the late Gothic City Hall, a building standing almost in the middle of the Town Hall Square from the year 1509 surrounded by rich burgher houses. Today it houses the exhibition of interesting items of the Šariš Museum, but it also serves as a venue for concerts. Distinctive architectural character has brought the city a number of victories in the online vote on the most beautiful city of Slovakia.

3.5.2 Mining heritage in Košice Self-Governing Region

Eastern Slovakia, in which belongs the Kosice region, is famous with medieval MM heritage. It represents the mining heritage from several points of view as **natural**, **geological**, **cultural** heritage.

Mining has been a part of human existence since the Paleolithic period – the Lower Stone Age. As early as that, there were groups of people dealing with collecting, and later on processing non-ore materials. At that time, they founded long distance trade with RM, such as obsidian, hornstone, and others. Copper and bronze trade exceeded the continental measures. The same can be said about transfer of the first metal-processing technologies. That is only one side of the coin – that of technology and trade. Subsequently there is a specific group of people creating a special category of population towards the society - miners.

As early as in the medieval age, miners were a specific group of inhabitants, which is documented e.g. by royal privileges granted to the mining towns. The miners were free, predominantly subordinated directly to the king. They joined together in guilds, created and followed the law of mining. They were at the birth or boom of natural sciences, e.g., geology, mineralogy, chemistry, geodesy, cartography, they initiated the occupational medicine and security, originated and developed several new technologies, e.g., metallurgy, the use of explosives, water management, drainage of the deepest and vast underground spaces, their lighting, and above all their achievements stands tall the beginning and further development of technical and higher education. The listing is not final. The liquidation and reclamation areas after mining, as well as the standardized technological procedures after the closure of mining activities in 20th century, simultaneously brought the liquidation of the unique mining works, technology equipment, machinery, abandonment of the former mining settlements with the following development of modern housing sites. All those solutions were considered correct in order to end hard work, unsuitable living conditions in the mining communities. In this manner we have lost “victoriously“ both: the unique technological and technical works created and used by the miners and a centuries social aspect of miners and mining communities.

Mining heritage in Slovak terminology forms a part of the category "technical monuments". But term mining heritage has a much wider meaning. Incorporates all: natural, historical, architectural, technological, technical, artistic, documentary, geomorphologic, and other aspects. Thus, mining heritage includes, in great part, the heritage of the miner as a human being within the mining communities that had invested their possessions and lives into specific mining conditions. Definition of mining heritage is complicated, because it should be associated with both: geological, geomorphologic, as well as natural heritage. Another time is mining heritage related to cultural heritage - historical, architectural, archaeological, industrial, technological, technical, and other attributes. Mining heritage can also cover territory, which have long depended on mining. In territorial terms, we may assign mining heritage in different categories. In general, the concept of heritage can be defined by **cultural, natural and mixed categories**. This is a case that covers the most areas where mining existed for a long time.

Medieval mining on the territory of East Slovakia

Deposits of precious and non-ferrous metals East Slovakia territory (Upper Hungarian mining towns), Central Slovakia (Lower Hungarian mining towns), and in Transylvania and district of Baia Mare (nowadays Romania), was „Goldmine" of Europe and the whole World, especially in the 13-18th centuries. There were periods when two thirds of the world's gold production and three quarters of world's silver production were provided by this region. From forty to sixty percentage of treasury revenue of the Kingdom of Hungary comes from mining and related incomes. Mining was in the hands of the treasury and nobility, but the latter was controlled by the royal court. The 14th century was a significant, „Eldorado" period of the region. Mentioned mining regions were significant until the middle of 19th century. Centers of Upper and Lower Hungarian mining towns were Gelnica and Banská Štiavnica. Mining activity in East Slovakia started in the 12th century and significantly developed with settlement of German miners after the Tartar Invasion (1241). Most important mining towns were Gelnica, Smolnik, Jasov, Rožňava, Spišska Nová Ves, Telkibánya and Rudabánya (last two named mining towns occur in Hungary). These seven mining towns, which were granted royal privileges, established Association of Upper-Hungarian Mining Towns. Legal relations and judiciary were determined in their meeting held on 26th and 27th December 1487 in Kosice. They all agreed to use the mining law of Gelnica, as the oldest and most important mining town in the region. The Chamber of these seven towns acted as Superior Court. Beyond these seven associated mining towns, other settlements also mined and exploited precious metals in Upper Hungary. After the Battle of Mohács 1526, the Association of the Upper Hungarian Mining Towns dissolved. Gelnica, Smolnik and Telkibánya got into the hands of the Szapolyai family and so the previously free royal mining towns simply became land of the landlord. Importance of mining in this region decreased. Upper-Hungarian mining towns sank temporary to market towns.

Short description of mining towns (members of Association of Upper Hungarian Mining Towns in the East Slovak territory)

Gelnica - was established by German colonists (guests) in the 12th century. The town's real development started after the Tartar Invasion, when German settlers arrived to replace the killed citizens. Gelnica soon became the center of the surrounding mining towns. In 1264 Hungarian king Béla IV. (Arpád) awarded town privileges for Gelnica. These privileges were extended by the king Charles Robert (Anjou) in 1317, by the king Louis the Great (Anjou) in 1359, and by the king Sigismund (Luxembourg) in 1435. Therefore, Gelnica was elevated to free royal town. The 15th century was the golden age for Gelnica, when a great number of silver and copper were mined there, later iron mining became dominant. In the end of the 19th century non-ferrous metal mines drained, only iron mines stayed determinant. Gelnica still has a developed iron mining.

Smolník - the first written record on gold mining in Smolnik was issued in 1243. German colonists founded the town settled in a narrow valley. The king Charles Robert rose Smolnik to free royal mining town. Especially silver, and partially gold mining was significant. From 1465 it belonged to Spiš Castle of the Szapolyai family. The family leased out their silver and copper mines and a blacksmithery. In the beginning of 16th century the mines were in the hand of the Dölens and Sauers families, who mined mainly silver. Later it was the property of the Thurzo family and the Csáky family. From 1671 Smolník belonged to the Royal Chamber. This time the town was known by its copper mines, and its industry based on the metalworks, hydroelectric power stations and blacksmithery. From the middle of the 18th century it also operated an own mint. In the 19th century mining activity gradually decreased.

Jasov - archeological finds shows that people lived in Jasov in the prehistoric age. After the Tartar Invasion German colonists arrived. In 1290 Jasov was granted several privileges (market right, and shooting right) and developed fast as a town. The population lived on agriculture and mining. In their mines iron, copper and lead were mined. There was a boom in its mining industry in the end of 18th century, even a blast-furnace was built here. Besides iron works several smithies, sawmills, brickwork and mills operated in Jasov.

Rožňava - was also founded by German guests in the 13th century. It was first mentioned as Rosnaubana in 1291. In 1340 Rožňava was granted town privileges. The Acta Geoturistica volume 3 (2012), number 2, 29-35 34 Roman Catholic diocese of Rožňava was founded in 1776. In their mines iron, copper and lead were mined. Iron industry made Rožňava one of the most important industrial region of the Hungarian Kingdom.

Spišská Nová Ves - German colonist were settled here in the 13th century, near the Slavic town - Iglov, where iron and copper were mined. Also, processing-industry have appeared. The town suffered from the invading Tartars, but the king Béla IV. resettled it. Spišska Nová Ves was granted market rights and was announced as official mining town by the king Louis the Great. In 1412 Spišská Nová Ves was pawned as loan security by the Hungarian king Sigismund to the Polish king Vladislaus II. Jagiello. The pawned towns were returned to the monarchy by empress

Maria Teresa in the year of 1772, and it became the capital of the "Province of 16 Spiš towns". This leading role ceased in 1876.

Mining museums

The mining museum in Rožňava - this museum specializing in the fields of mining, metallurgy and mineralogy has a history going back to the early 20th century, and later it was merged with the municipal museum in Rožňava. It is housed in a historically prominent factory building which used to be the centre of tanning and leather production. The museum possesses valuable collections covering the archeology, history, art history and history of technology connected with its main fields of specialization.

The mining museum in Gelnica - the history of the mining museum in Gelnica goes back to 1938, when its first exhibitions were opened to the public, at that time still in a former stable building. The basic collection of objects closely connected with the development of mining was gathered together by Leopold Gruss and Samuel Fabriczy from the local civic school. In fact, the tradition of collecting mining objects in Gelnica reaches back to the times of Maria Theresa. Since 1963 the museum has been housed in the historical town hall building, whose walls consist of stones taken from the ruins of Gelnica Castle.

The Spiš Museum in Spišská Nová Ves - since 1964 this museum has been housed in the medieval town hall building, the so-called Provincial House on the square in Spišská Nová Ves. The permanent exhibition offers visitors a cross-section of the nature and history of Spiš, with emphasis on the Slovak Paradise, Volovské hills, Hornád Basin and Levoča Hills, covering paleontology, archeology and mining.

The Slovak Technological Museum in Košice - one of the oldest museums in Slovakia, with a unique technological orientation, it has been based in Košice since 1948. Its collections come from the fields of astronomy, mining, electrotechnics, physics, photography and cinematography, land surveying, map-making, clock-making, metallurgy, chemistry, metal-working and machining, and also has some unique technical heritage under its administration, such as the water-powered hammer works in Medzev. Tickler's water-powered hammer works, a registrated technical heritage item, is one of the few preserved hammerworks from the original 109 in the 19th century. It was built in the late 19th century from stone and wood and served primarily for the production of agricultural tools.

Košice's golden Treasure - one of the rarest exhibitions of the East Slovakian Museum was discovered in 1935 in a copper container during excavation of the foundations for the building at no. 68 Main Street in Košice. the treasure-trove comprises 2,920 gold coins from the 15th to the 17th centuries, 3 gold medallions and a 214 cm long gold Renaissance chain. The treasure is unique, one of the largest such finds ever made of well preserved and undamaged coins, which come from a wide geographic range of 81 different mints in Europe.

The Slovak Technological Museum – the blacksmith's workshop in Moldava nad Bodvou - a roadside type of smithy from the mid-19th century, typical for small-town and village smith

production, is preserved with complete historical forge equipment. One part of the exhibition is the residential part for the smith's family, outbuildings with agricultural tools and the archeological finds of honorary citizen Gustáv Stibrányi.

Other heritage connected to mining history

Vlachovo – Karlova huta and the Andrássys' country residence this historical mining village was founded in the early 14th century, and by the 15th century it was already an important centre with flourishing iron-working production with its own hammer-works. in 1843 a blast furnace was built here, known as Karlova Huta (charles' smelter), which functioned until the end of the 19th century. another tourist attraction is the reconstructed country residence of the Andrássys, where they had their proper family seat. Today this residence houses the local museum, but in the grounds it is possible to find the renovated "ice room" which served the Andrássys for the storage of bagged game animals.

Also, the **village Poráč** is a very old upland mining village which is first mentioned in writing in the year 1247. At different times in the past, gold, silver, copper, iron ore and mercury were mined here.

Krásna Hôrka Castle - One of the almost completely preserved castles which has never suffered the ravages of war or post-war pillaging is Krásna Hôrka (Fair Knoll) Castle. Built in the early 13th century, the castle has undergone several reconstructions, and has changed ownership several times as well. One of the significant dynasties in the Middle Ages was the Bebek family, and it was Ferenc Bebek who initiated the most important reconstruction, to enable the castle to resist the dangerous Turkish incursions in the 16th century. After his death the family history becomes vague, and the castle ultimately came under imperial administration, as the monarchy was governed locally through ward captains. Significant among these was Peter I Andrássy, who initiated the almost 400-year long rule of the Andrássy dynasty in this area. At first, they did not make any notable changes to Bebek's original fortress, because they only held the status of hereditary ward captains and the castle was not their property, although they made efforts to acquire it. This situation changed though in 1642, when the grandson of Peter I Andrássy, Mátyás II, was granted hereditary ownership of the Krásna Hôrka estate by King Ferdinand III. Later in the 17th century the original castle was extended with the so-called middle and lower castles, used mainly for representative purposes. Another important figure in the dynasty was the governor Miklós I Andrássy, during whose rule the castle became the seat of the shire administration, and further representative and residential premises were added. Visitors to the castle are always intrigued by another unique feature – the glass sarcophagus of one-time lady of the castle Zsófia serédy, who died in the early 18th century and was entombed in the church crypt below the castle. The effects of the calciferous water dripping onto her and the dryness of the draught combined to keep her body preserved and practically intact. The castle, now a museum and since 1996 it has been administered by the Slovak national museum as part of the Betliar museum. Unfortunately, the castle was hit by a fire in 2012 and is under reconstruction since then.

Betliar Mansion - this former hunting lodge of the Andrássy family stands in romantic parkland in Betliar. The first building dates back to the early 15th century, but it acquired its current appearance in the last reconstruction at the end of the 19th century. This raised the original building by another floor, and the function of the mansion changed to serve purely hunting and representational purposes. The exceptionality of this stately home lies in the fact that it is one of just three in Slovakia left untouched by the ravages of World War II. The park stretching beyond the house is considered the largest historically and naturally landscaped park in Slovakia, and in 1978 it was registered in the World historical gardens list. Its area is a very respectable 81 hectares, and it contains water attractions and a collection of rare trees.

The Andrássy Family Mausoleum in Krásnohorské Podhradie - Count Dénes Andrássy had this mausoleum built in 1903 after the death of his wife Franziska, who in fact died and was temporarily buried in Munich. Her remains were transferred to the mausoleum on the second anniversary of her death. Count Andrássy himself died in sicily, but his bodily remains are also entombed in the mausoleum next to his wife's. This mausoleum is a unique piece of art nouveau heritage, and its building involved the participation of distinguished artists and architects from Munich. The interior is clad in rare types of marble imported from African as well as European sources. It is dominated by two sarcophagi made from Italian marble with likenesses of both spouses in relief decoration. Andrássy family was very famous and well known in Gemer region, because they significantly contributed to the development of mining in this area.

Drnava – small village also connected to Andrássy family. Mining and processing of metals had an important role in this village, since the estate belonged to the Bebek family, the then master of the castle Krásna Hôrka. After the extinction of the family in 1567, their possessions were owned by the Andrassy family. The most famous stages of the whole family, but also mining and metallurgy on their farms are the 19th century, when, thanks to mineral resources, became the richest tycoons of Central Europe. Andrassy family significantly contributed to the fact that around Rožňava produced the highest quality iron in Hungary and that Gemer was nicknamed the "Iron County of Hungary". The Ironworks in Drnava was considered a model iron works in Hungary in the 1830s. The high technical level of production is also evidenced by the fact that in 1844 they cast the main parts for the Széchenyi Chain Bridge (Lánchíd) in Budapest, which was built in 1842-1849 according to a project by English engineer William T. Clark. Ironworks was closed in 1915 and since then dilapidated.

Gothic and Iron Roads

It is also possible to get to know the Košice region by following the themed routes – the Gothic, Iron or Wine Roads. In their separate ways these reveal the history and heritage of the gothic period, the traditions of mining and metalworking, and the heritage hidden in vineyards and barrels.

The Gothic Road was the first tourist sight-seeing route in Slovakia. it is a complete circuit presenting the most interesting and most precious treasures of Spiš and Gemer, which in terms

of their importance far transcend the boundaries of this region and Slovakia itself, and are an inseparable part of European cultural life.

The Iron and Mining Road or Via Magna links up with the European Iron Road, and like the Gothic Road it uses the form of cultural tourism to familiarize visitors with the heritage of the mining and iron-making traditions of this region. The creation of this kind of thematic route is a consequence mainly of the historical status of this region, when it ranked among the most significant producers of iron in Greater Hungary. Examples of technical heritage to be found on this route are the old blast furnaces at Karlova Huta in Vlachovo and Etelka at Nižná Slaná. The most important stops on the Iron Road in the Spiš region are Smolník, Prakovce, Gelnica, Dobšiná and Stratená. This route is not only closely bound with Spiš and the Košice region, but Gemer and the area around Banská Bystrica also form significant parts of this historical quest.

Mining educational paths

Mining educational path Hnilčík - The village of Hnilčík has a rich mining history. In the local hills of deposits of iron and copper ore were found, that used to belong between the biggest and the most important in Slovakia. Mining localities as Bindt, Roztoky, Grétla or Gezwäng take pride of place between natural raw materials deposits and they are known by experts in all of Central Europe. Mines in Hlinčík were technologically the most developed in the second half of the 19th century and at the beginning of the 20th century. Nowadays the mining educational path consists of 3 parts. There is a permanent museum exposition in Jerohuta, in a wooden two-floor building that used to serve as school, then an underground mining exposition situated in Ľudmila gallery at the end of the local area of Roztoky and a system of educational mountain paths in the local areas of Roztoky, Bindt, Grétla-Cechy and the valley of Iron Creek.

Smolník – educational path of mining industry and mint - Smolník is the ancient mining village, which was also mentioned above. Charles Robert in 1327 promoted the village to an independent mining town. There they mined iron, copper and antimonite ore. The town enjoyed the greatest blossoming at the turn of the 14th and 15th century, when it served as royal mint. The establishment of mint, duration of its activity and its ending were conditioned also by the economic and political situation in the country, by market needs, but also by proximity of raw material resources. In the 18th century mining of copper used for minting in the local mint and for production of green and blue vitriol became even more intense. The importance of Smolník, its mining industry, but also the metallurgy crossed borders of the town and of Slovakia and they have a pride of place in Europe.

Natural monuments

Herľany geyser – national natural Landmark a cold-water artesian spring, unique in Europe, is located on the grounds of the former Herľany – Rankovce spa. It has been continually active since 1872, and its status as a world rarity is shown by the fact that it is situated in volcanic uplands which have long finished with their volcanic activity. The temperature of the spouting

water is at most 18°C. The eruptions, which are caused by carbon anhydride, are repeated every 36 to 38 hours. This hydrogeological phenomenon is set into a fountain and surrounded by a traditional park with rare trees and historical buildings.

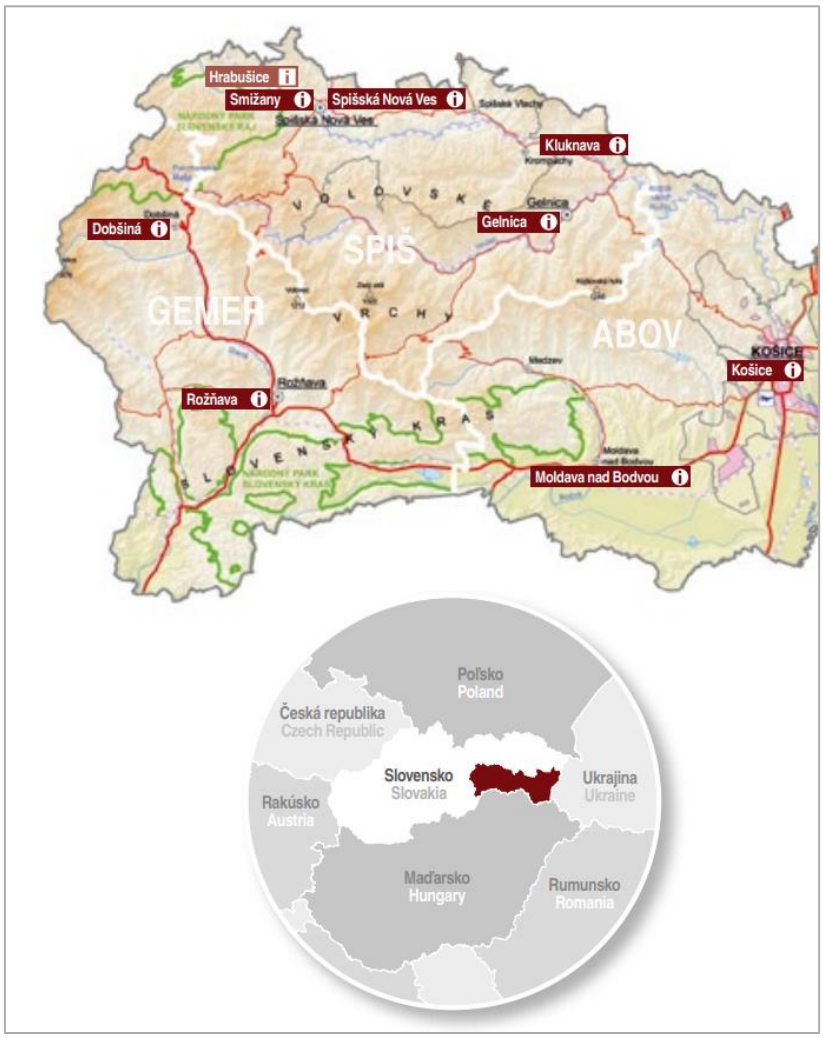


Fig. 3.5.2.1: The Region of Kosice with the most famous mining towns.

3.5.3 Regional GDP of tourist industry

- **Regional GDP of tourist industry:** the data from Košice self-governing region are not available
- **Regional GDP of tourist industry per capita:** the data from Košice self-governing region are not available
- **Number and type of tourists** are presented in the following tables

Year	Number of visitors	Number of overnight stays	Year-on-year development - visitors	Year-on-year development - overnight stays	Year-on-year difference - overnight stays by foreigners	Year-on-year difference - overnight locals	Number of visitors city Košice	The share of Košice city visitors to the region
2006	305,970	689,704						
2007	321,774	726,891	5.2%	5.4%	-3.4%	11.6%	137,072	42.60%
2008	356,946	825,024	10.9%	13.5%	7.1%	17.4%	141,758	39.71%
2009	291,115	662,006	-18.4%	-19.8%	-25.7%	-16.5%	115,550	39.69%
2010	281,205	618,308	-3.4%	-6.6%	-4.2%	-7.8%	135,188	48.07%
2011	289,435	620,403	2.9%	0.3%	6.9%	-3.0%	129,526	44.75%
2012	283,180	596,457	-2.2%	-3.9%	-1.9%	-4.9%	129,959	45.89%
2013	314,651	649,947	11.1%	9.0%	3.4%	12.2%	151,657	48.20%
2014	260,494	537,533	-17.2%	-17.3%	-18.1%	-16.9%	140,011	53.75%
2015	266,358	597,759	2.3%	11.2%	22.2%	5.4%	154,012	57.82%
2016	347,014	726,401	30.3%	21.5%	15.5%	25.2%	184,467	53.16%
2017	366,142	762,490	5.51%	5.0%	1.6%	6.8%	195,760	53.47%
2018	386,088	830,079	5.45%	8.9%	10.8%	7.8%	200,277	51.87%

Table 3.5.3.1: Numbers of visitors of destination Kosice self-governing region.

Order of visitors			Number of visitors			Number of overnight stays			Average number of nights		
			2018	2017	"+/-"	2018	2017	"+/-"	2018	2017	"+/-"
2018	**2017**										
(1)	(1)	**Slovakia**	250,658	242,917	3.2%	534,386	495,555	7.8%	2.13	2.04	4.5%
(2)	(2)	**Czechia**	32,090	28,469	12.7%	69,036	61,407	12.4%	2.15	2.16	-0.3%
(3)	(3)	**Poland**	18,205	15,098	20.6%	36,763	32,201	14.2%	2.02	2.13	-5.3%
(4)	(4)	**Hungary**	13,688	12,266	11.6%	30,235	23,498	28.7%	2.21	1.92	15.3%
(5)	(5)	**Germany**	12,410	9,543	30.0%	26,585	22,365	18.9%	2.14	2.34	-8.6%
(6)	(6)	**Ukraine**	9,645	8,185	17.8%	22,785	18,831	21.0%	2.36	2.30	2.7%
(7)	(8)	**Austria**	3,844	4,306	-10.7%	8,231	7,399	11.2%	2.14	1.72	24.6%
(8)	(7)	**Israel**	3,434	5,917	-42.0%	7,740	9,760	-20.7%	2.25	1.65	36.6%
(9)	(9)	**UK,**	3,409	3,848	-11.4%	7,199	9,472	-24.0%	2.11	2.46	-14.2%
(10)	(13)	**USA**	3,138	2,702	16.1%	6,899	7,189	-4.0%	2.20	2.66	-17.4%
(11)	(12)	**Italy**	3,012	2,848	5.8%	6,784	6,617	2.5%	2.25	2.32	-3.1%
(12)	(10)	**Romania**	2,565	3,257	-21.2%	6,463	6,492	-0.4%	2.52	1.99	26.4%
(13)	(11)	**Rusia**	2,533	2,994	-15.4%	5,297	6,196	-14.5%	2.09	2.07	1.0%
(14)	(14)	**France**	2,419	2,471	-2.1%	5,193	5,606	-7.4%	2.15	2.27	-5.4%

(15)	(15)	**Netherlands**	1,767	1,705	3.6%	3,928	4,089	-3.9%	2.22	2.40	-7.3%

Table 3.5.3.2: Top 15 countries in Košice region - ranked by number of visitors

3.6 CASE STUDY: REGION OF LOWER SILESIA

In Lower Silesia region, there are **841 deposits of rock raw minerals**. **334** of them are **active** (authorized concessions), **261** are **unexploited** (don't have a concession) and **246** are **abandoned**. These mines exploit a **lot of rocks**, e.g. **basalt**, **granite**, **sandstone** and **marble**. In general, most of mines located in **Jelenioniórski subregion** – **277**, but when it comes to **active mines** which are exploited, most of them are located in **Wrocławski subregion** – **99** of **334**. Spatial extent of rock raw minerals mines in Lower Silesia is illustrated in **Figures 3.6.1.-3.6.4**.

Additionally, in Lower Silesia region, there are **107 deposits** of other minerals. Almost half of them are active (about **41**), **34** are unexploited (don't have concession for mining) and **32** are abandoned. Most of mines are located in **Legnicko-Głogowski subregion**, where extraction of **copper ore** dominates. It's very characteristic for this region. Except of copper ores, in Lower Silesia there are important deposits of **brown coal, natural gas** and **curative waters**.

The RM base of Lower Silesia has **economic importance** for the development of the region, both because of the **nature** of the minerals and the **size** of their resources. However, **ore deposits** and **energy mineral deposits**, i.e. lignite, are strategic from the point of view of not only the regional economy but national, as well.

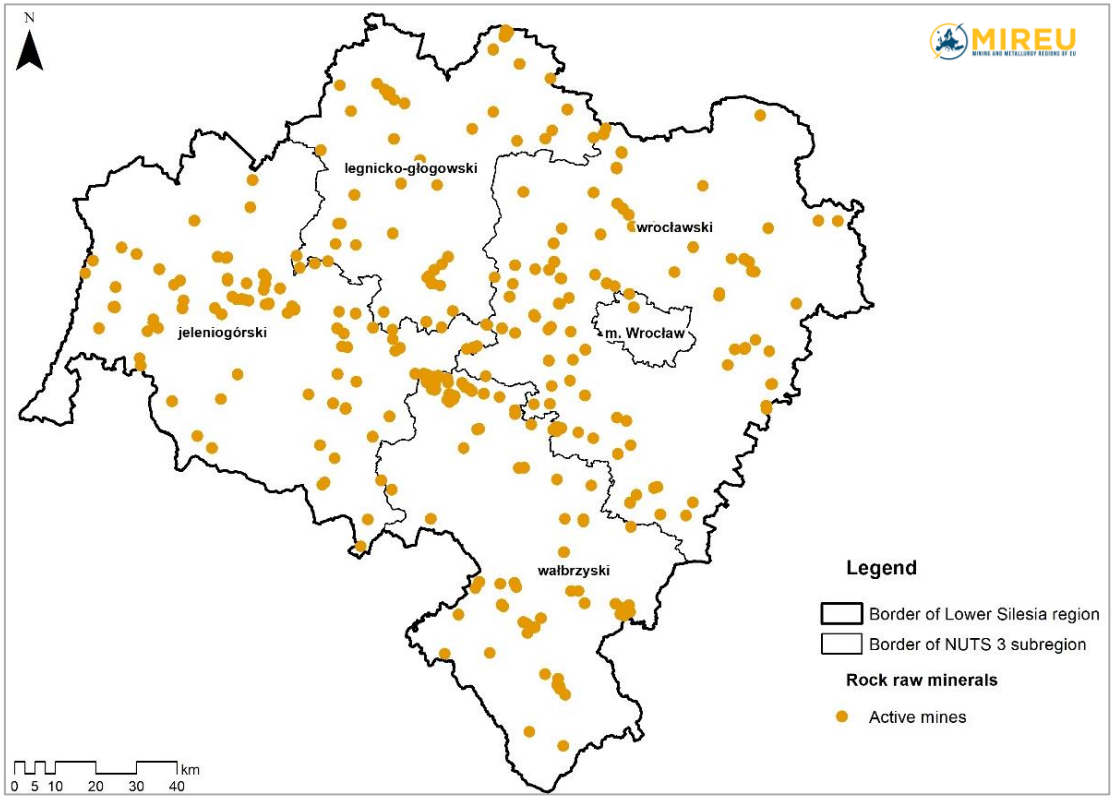


Figure 3.6.1: Active mines of minerals

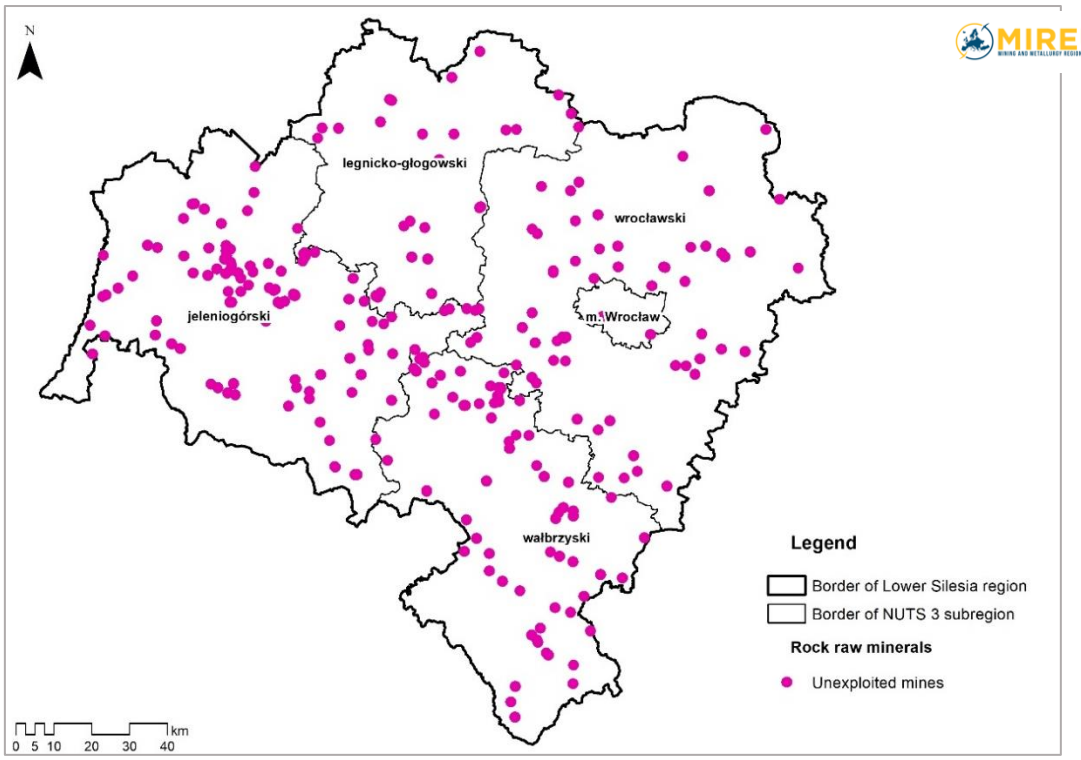


Figure 3.6.2: Unexploited deposits of minerals

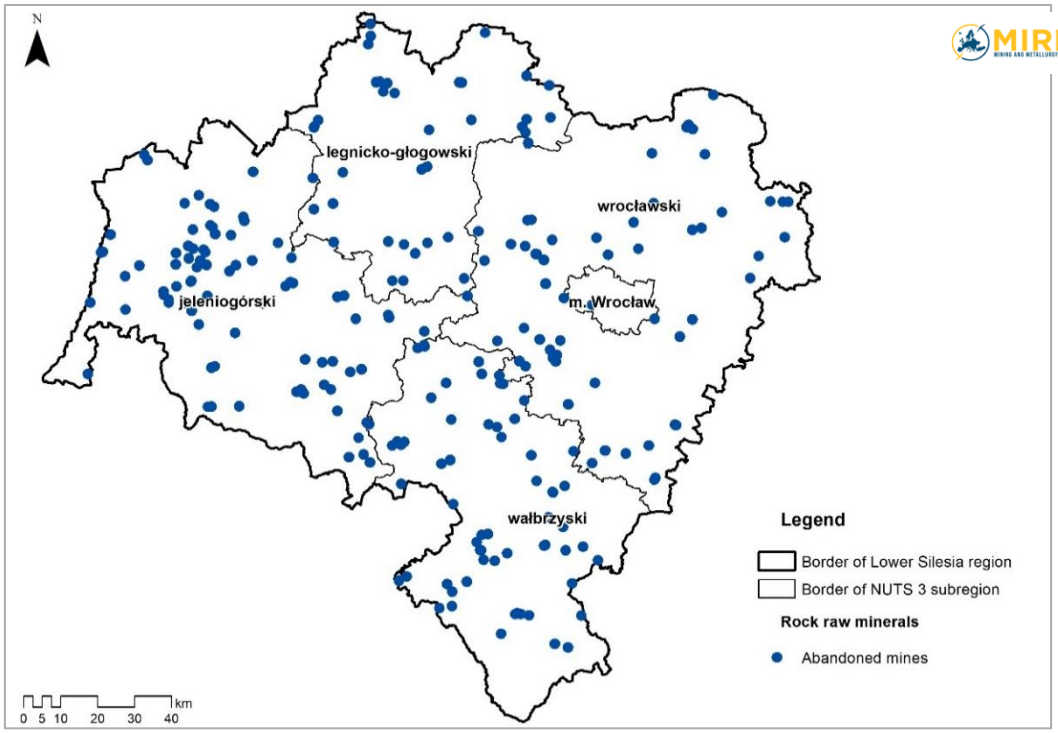


Figure 3.6.3: Abandoned mines of minerals

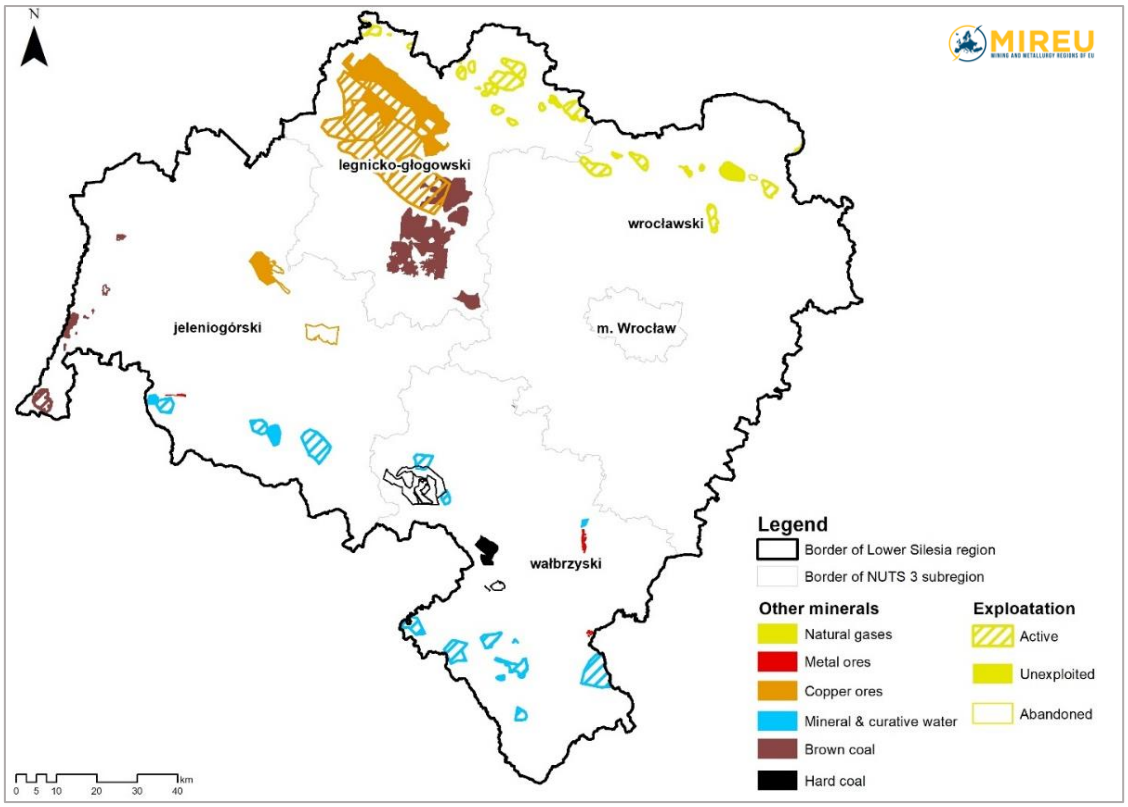


Figure 3.6.4: Mines of other minerals

Copper deposits (belonging to the KGHM Polska Miedź S.A.) are of the highest economic importance. They are located in the area of **Lubin, Polkowice, Głogów**, where the **volume** of resources is estimated as **4.5%** of the world's resources. copper deposit is accompanied by a whole range of **precious metals**: Ag, Au, As, Pb, Zn, Ni, V, Mo, Se, Rei platinum group, among which, the following are recovered: Ag, Au, Pb, Se, Ni in the form of sulphate, palladium and platinum sludge, metallic rhenium and ammonium perrhenate.
Lignite is the second most **important economic extractive resource**. In the area of Lower Silesia, there is a Turów deposit, which belongs to the PGE GiEK S.A. The Turów Brown Coal Mine – a large opencast mine in Bogatynia is connected (in terms of organisation and infrastructure) with Turów power plant (situated nearby). There are the **prospective deposits**: Radomierzyce deposit and Legnica-Ścinawa complex with documented **8 deposits**.

The rock RM base of the Lower Silesia is also heavily represented by various and different rock resources, e.g. **dimension and crushed stones** (over 90% of national resources of magmatic and metamorphic stones), **good quality sand and gravels** and **several minerals** unique for the country.

The **medicinal and thermal waters** of Lower Silesia constitute 95% of the documented balance of available resources in the country. These valuable medicinal waters are used by both the spa and bottling industry.

3.6.1 Cultural significance

Lower Silesia region is very **diverse** when it comes to **culture heritage**. There are a lot of monuments and places, which shows the cultural past and diversity of region. It includes 889 objects, which are listed in register of monuments, such as: castles, chapels, churches, parks, historical parts of cities, townhouses etc. Except of these monuments, there are three objects on **UNESCO's World Heritage List** that are: two churches in Świdnica and Jawor (2001) and Centennial Hall in Wrocław (2006). There are also 11 archeological sites located in the north side of region, dating back to the Stone Age and 26 culture parks, which are concentrated mainly in the south side of Lower Silesia region. It is worth to say that in region functions museum of paper making in Duszniki-Zdrój, Center of Science and Art "Old Mine" in Wałbrzych and lot of other interesting places, where people can see how work in mines functioned. Distribution of these objects is shown in **Figure 3.6.1.1.**

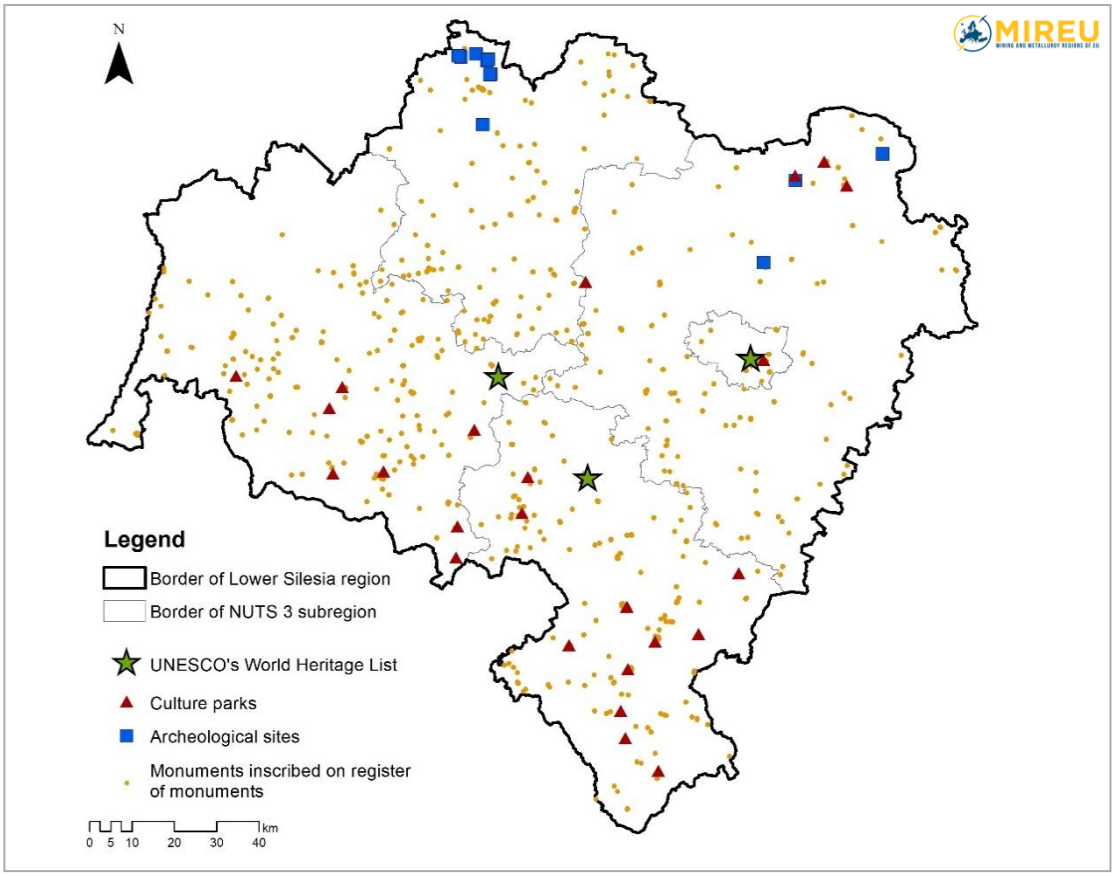


Figure 3.6.1.1: Spatial distribution of monuments

3.6.2 Mining heritage

Purposes of the development of former mining excavations are:

- **substantial improvement** of the environment and human safety resulting from the reclamation and protection of post-mining areas and facilities,
- **protection** of historically valuable sites of former mining works,
- increased **tourist value**.

Mining heritage is treated in **two ways**:

- shaping a **local identity** based on specific traditions and knowledge, aiming to revive monuments and places of former mining works,
- **economic resource** stimulating **local development planning**, inter alia based on tourism, inclusive, creative industries, expanding access to **cultural goods**.
- examples of the **development** of post-mining areas

The Lower Silesia region offers **numerous mining sites** attractive for tourists. When exploitation of mineral ended, these places were reorganized to tourist attractions, where people can find out more about mining and RM. These places represent examples of both **good practices** of **mining heritage** and attractive **tourist sites**.

- **Kletno Underground Tourist Route** in the old uranium mine – an underground tourist and educational route exhibits a number of attractive occurences of local minerals (fluorite, amethyst, quartz and others). The mine was in operation from 1948 to 1953. More information is available on website www.kletno.pl/the-uranium-mine-of-kletno/
- **Underground Tourist Route "Kowary"** – an underground route related to the geology of the Sudetes and mining techniques in the Uranium Exploratory Drift. Tourist route is open for exploring since 2000.
- **Nowa Ruda Underground Tourist Route "Coal Mine**" – an underground tourist route in Nowa Ruda with an underground railway. Coal Mine is divided in two parts – museum, where tourists can learn about the history of mining and underground part, where people can experience the real mining life on their own. The tourist route is open since 1996. You can find more information on www.kopalnia-muzeum.pl
- **Municipality of Mirsk - Geopark** – a tourist and educational route “In the footsteps of the old mining ore", the underground tourist route “St. John's Mine” - an example of comprehensive protection, protection and utilization for historical recreation of mining areas and tin mining ores.
- **Szklary Mine** of nickel chrysoprase and opal in Szklary – an underground route is available from 1st of May until 31st of September (**Figure 3.6.2.3**). Chrysoprase is very precious and unique jewelry mineral, which exists in Lower Silesia and Australia. More information can be found on website: www.kopalniaszklary.pl/english.html.

- **"Former Mine" Science and Art Centre** in Wałbrzych is the biggest post-industrial tourist attraction in Poland, located in the former bituminous coal mine – Hard Coal Mine "Julia" ("Thorez"). The 2014 revitalization of the biggest mine located in Wałbrzych, which at the height of its activity employed several thousand workers allowed for the creation of an exceptional object among tourist attractions in Poland. Currently, it covers the area of 4.5 hectares of historic post-industrial objects with authentic equipment, such as a machine park, which has been secured and made accessible for visitors. With the help of guides working in Stara Kopalnia (former miners who worked in KWK "Julia" in the past), all visitors can not only see the enormous scale of mine infrastructure, but also learn about the character of the dangerous and demanding work of a miner. In 2015, The Centre is open since 2014 (www.starakopalnia.pl/en).

Figure 3.6.2.4: Science and Art Centre in Wałbrzych.
Source: pl.tripadvisor.com

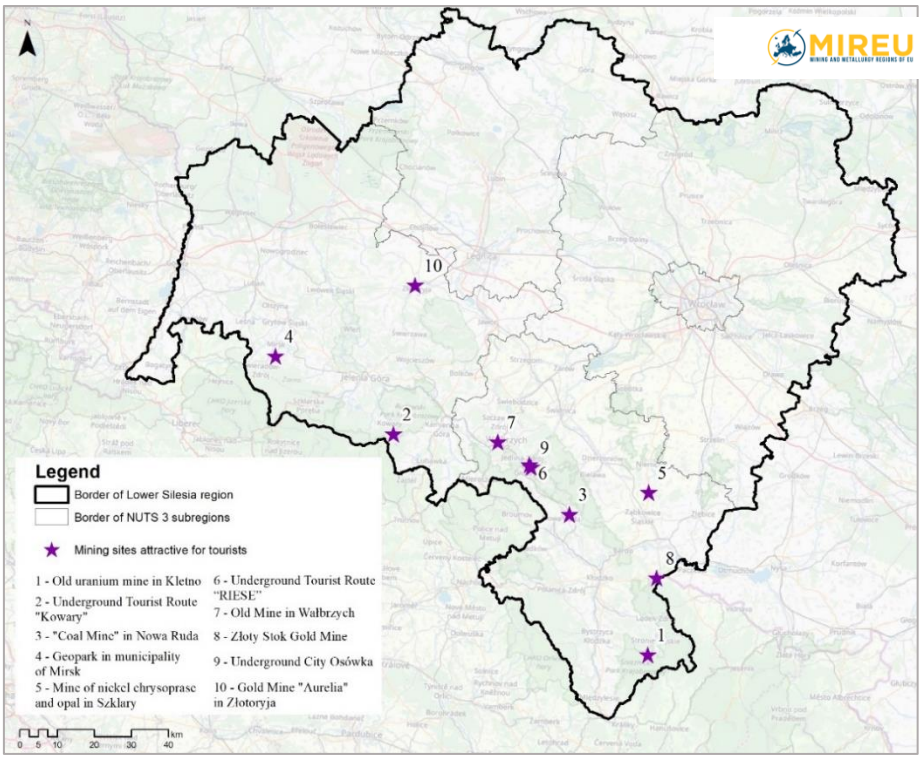
- **Złotoryja Gold Mine "Aurelia"** – an underground route is available from 1st of October until 20th of December.
- **Złoty Stok Gold Mine** – an underground Tourist Route "Gold Mine" and Medieval Technological Park were built on the basis of the oldest mining and metallurgical centre in Poland, finally closed in 1961. It is constantly expanding its tourism offer is related to the promotion of mining tradition and technology. In addition, in this mine exists only one underground waterfall in "Black drift". More information: www.kopalniazlota.pl/en
- **Underground Tourist Route "RIESE"** – not directly related to mining, a construction project of Nazi Germany in 1943-1945 period (World War II), consisting of seven

underground structures located in the Owl Mountains in Lower Silesia, previously Germany, now a territory of Poland. In Riese, tourist can visit a lot of objects, including complex of drifts where people have possibility to know some historical facts from period of World War II (www.sztolnie.pl/en).

- **Underground Tourist Route "Podziemne miasto Osówka"** (Underground City Osówka) – the underground Military Complex Osówka. There is the last and the most developed Hitler's headquarters during WWII.

On the map shown in **Figure 3.6.2.8**, all of described places attractive for tourists were marked. Most of them are located on the southern part of Lower Silesia region. Places of **old mines** are very attractive for visitors, but it can become even more attractive, when areas with **high natural value** are located in **close proximity**. The most important areas in terms form of protection in Poland are: **national parks, landscape parks, reserves** and **nature parks**.

Near the Gold Mine "Aurelia" is located reserve "Wilcza Góra", where we can find unique species of plants and rock basalt roses. Underground Tourist Route "Kowary" is located between Rudawski Landscape Park and Karkonoski National Park, what gives many possibilities to spending free time in this area. In these parks there are a lot of interesting species of animals and plants, including endemic species, like dzwonek karkonoski (Campanula bohemica). Also, other mines lie in close proximity to protected areas. These mines are: Old Mine in Wałbrzych, Underground Tourist Road "Riese" and Underground City Osówka, Coal Mine in Nowa Ruda (next to The Owl Mountains Landscape Park), Złoty Stok Old Mine and Old Uranium Mine in Kletno (next to Śnieżnicki Landscape Park). Most of the tourist sites located in former mines are privately owned. However, the larger ones are publicly owned, e.g. "Former Mine" Science and Art Centre in Wałbrzych.



Figue 3.6.2.8: Spatial extent of mines attractive for tourists.

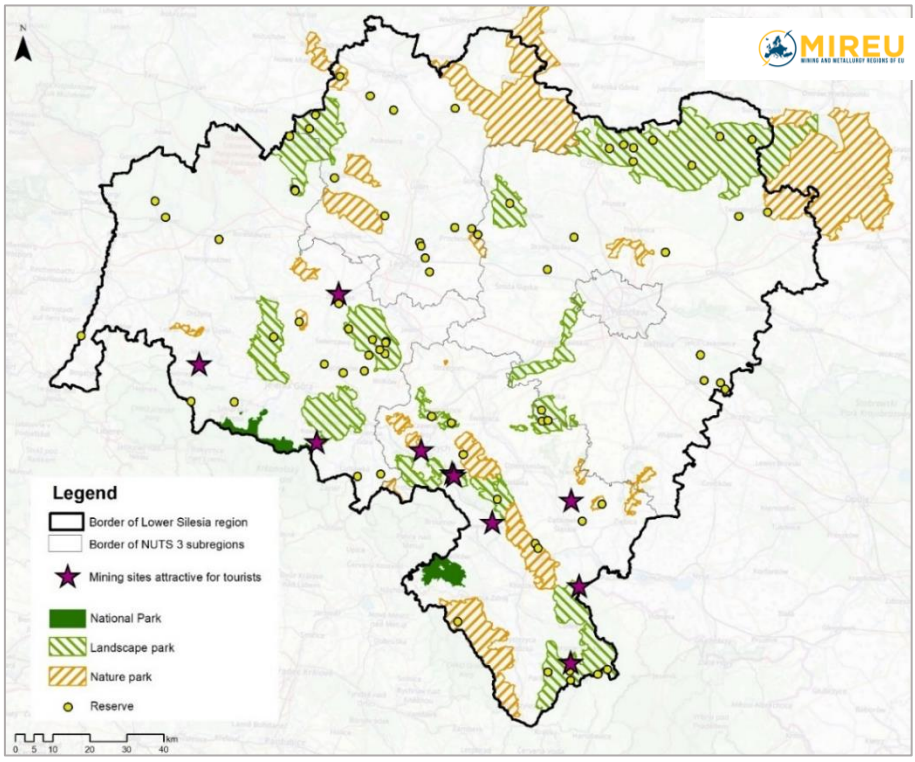


Figure 3.6 2.9: Spatial extent of protected areas

3.6.3 Regional GDP of tourist industry

When it comes to value of GDP of tourist industry, this kind of data unfortunately are not available for the voivodeship level of administration - Lower Silesia region. The main Statistics Office in Poland does not provide such data implicitly.

It is known, that in all country of Poland, Polish tourists spent 27,7 billion PLN (10,5% more than in 2017) and foreign tourists spent 34,5 billion PLN on their stays (5,4% more than in 2017). This value includes costs relevant to journey. According to Eurostat database, GDP of tourist industry in all country of Poland amounted to 2,4% of whole GDP in 2017.

In the Lower Silesia region, the number of tourists increases year by year. In 2018 the number of tourists who have used the accommodation amounted to 3 654 787. It is about 10,8% of all this kind of tourists in Poland in 2018. This value includes 696 726 foreigners (9,8% of all foreign tourists in Poland) who decided on overnight stays. In Lower Silesia, foreign tourists represent 19,06% of all visitors.

In general, amount of tourists in whole country increases by 6% anually. The most tourists visit our region in summer – especially in July and August. These months are very warm and it encourages visitors to come here for a couple of days. The least amount of tourists is noticed in April and November. The most popular destinations are: Wrocław – capital city of Lower Silesia, Karkonosze (Giant Mountains) with the most popular cities: Karpacz and Szklarska Poręba and the highest summit in region – Śnieżka (1603 m a.s.l.), The Kłodzko Basin, Stołowe Mountains and Góry Sowie (Owl Mountains).

3.7 CASE STUDIES: REGIONS OF ANDALUCIA AND CASTILLA Y LEÓN

Andalucia

The **Mining Andalusian Portal** is the thematic website of the Junta de Andalucía, created under the Management Plan of Andalusia's Mineral Resources (PORMIAN). The principal objective of the website is to disseminate and facilitate access to knowledge about the Andalusian mining sector, in order to be managed efficiently. The website includes the geological mapping of Andalusia, through the usage of information systems. As a result, it provides a broad base of knowledge for geological and mining sector in Andalusia. The website offers citizens a multitude of content that will allow them to expedite the process with the Andalusian mining administration, among which stand out: the mining work plans, the accident reports, and the consultations to the Mining Registry of Andalusia. (Source: http://svrdmz038.ceice.junta-andalucia.es/economiainnovacioncienciayempleo/pam/AcercaDelPortal.action?request_locale=en)

Andalusia has a great potential for natural resources. Its biological, geological and landscape diversity makes this community considered to be one of the **richest** and most **unspoiled** regions of Europe, therefore, the potential use of this Andalusian mineral resources should be **rational**, **efficient**, **diversified** and within the guidelines set by sustainable development. Incorporating all of the variables, it is important to be taken into account in all the mining and processing procedures of mineral raw materials. Regarding that, the **Mining Strategy of Andalusia** reflects the new situation in the region, and the strategy is under development. According to that, the metal mining industry has an **increasing role** in the economy of Andalusia, thanks to the increasing in **demand** in recent years and, consequently, the increased **material prices** and **technological advances** that enable older farms to become profitable. (Source: http://svrdmz038.ceice.junta-andalucia.es/economiainnovacioncienciayempleo/pam/EMA2020.action)

Castilla y Leon

In the **Strategy of Mineral Resources of Castilla y León** 2017-2020 a set of maps have been incorporated that can be consulted to your information demand. This Strategy can be downloaded at the following link: https://energia.jcyl.es/web/jcyl/Energia/es/Plantilla100/1284750663713/_/_/_

3.7.1 Cultural significance

Andalucia

The **cultural significance** of Andalusia is recognized around the world, mainly because of the high activity during the prehistory time, with important evidences of Neolithic, and Bronze age appearing in the Region (Argar Culture, Almeria, and Los Millares, Jaén).

The affection of different and diversified cultures resulted in the richness of the cultural heritage and the built of the cultural identity at the Region of Andalucia. Romans, Muslims and the rich middle age gave the base for the cultural heritage of the Region. Pieces of evidence of historical and cultural facts amount more than 576 cultural monuments and 404 museums.

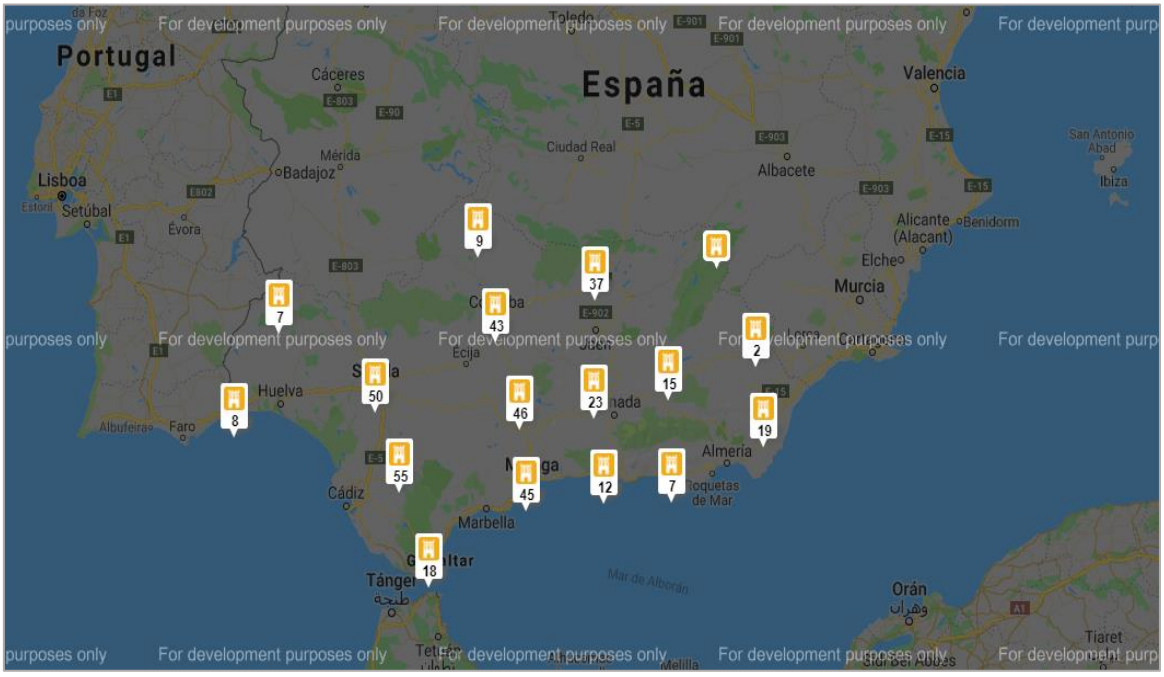


Figure 3.7.1.1: Map of the distribution of museums.
Source: http://www.andalucia.org/es/turismo-cultural/museos-de-andalucia/

Region	Number of sites
Andalucia	11
Aragon	6
Asturias	10
Cantabria	2
Castilla – La Mancha	6
Castilla y Leon	10
Cataluna	10
Comunidad Valenciana	4
Extremadura	6
Galicia	2
Islas Baleares	1
Islas Canarias	3
Madrid	2
Murcia	3
Pais Vasco	6
Total	82

Table 3.7.1.1: Number of monuments, historical sites, monuments of World cultural heritage. Source: Reprinted from http://www.sedpgym.es/descargas/AMARE-ORCHE_MINAS_MUSEO.pdf

Castilla y Leon

The cultural heritage of Castilla y León comprises property and real estate of **artistic, historical, architectural, paleontological, archaeological, ethnological, scientific or technical interest**. Also, documentary, bibliographic and linguistic heritage, as well as activities and intangible heritage of popular and traditional culture.

The most relevant goods are declared of cultural interest or included in the inventory of cultural goods. The Region of Castilla y León has recognized more than 1,800 goods of cultural interest, more than 1000 of them are monuments, more than 500 as castles, plus 130 historical ensembles, more than 100 as archaeological sites, and 12 cathedrals. There are also eight **World Heritage sites** and two assets included in the **UNESCO Intangible Cultural Heritage List**.

The main tasks that regional administration must promote for the observance of competences are the guarantee of the conservation of this cultural heritage, a basic aspect of the identity of Castilla y León and its historical and cultural importance, together with the promotion of their research and enrichment and the promotion and guardianship of access of the citizens to these assets.

This information is taken from the website of the Junta de Castilla y León and it covers the following aspects. Concept of cultural heritage, protected goods, cultural spaces, World

Heritage, Intangible Cultural Heritage, Specific Heritage, Accessibility: Monuments for everyone and Catalogue and geographical view of cultural assets of Castilla y León (https://patrimoniocultural.jcyl.es/web/jcyl/PatrimonioCultural/es/Plantilla100/1284389003066/_/_/_).

3.7.2 Mining heritage

Andalucia

Regarding the **mining heritage**, there are historical evidence of mining activities from Paleolithic age, crisol and metal furnaces, excavations and mineral extraction in Almería y Huelva and a prolific inventory of romans mining evidence around the region

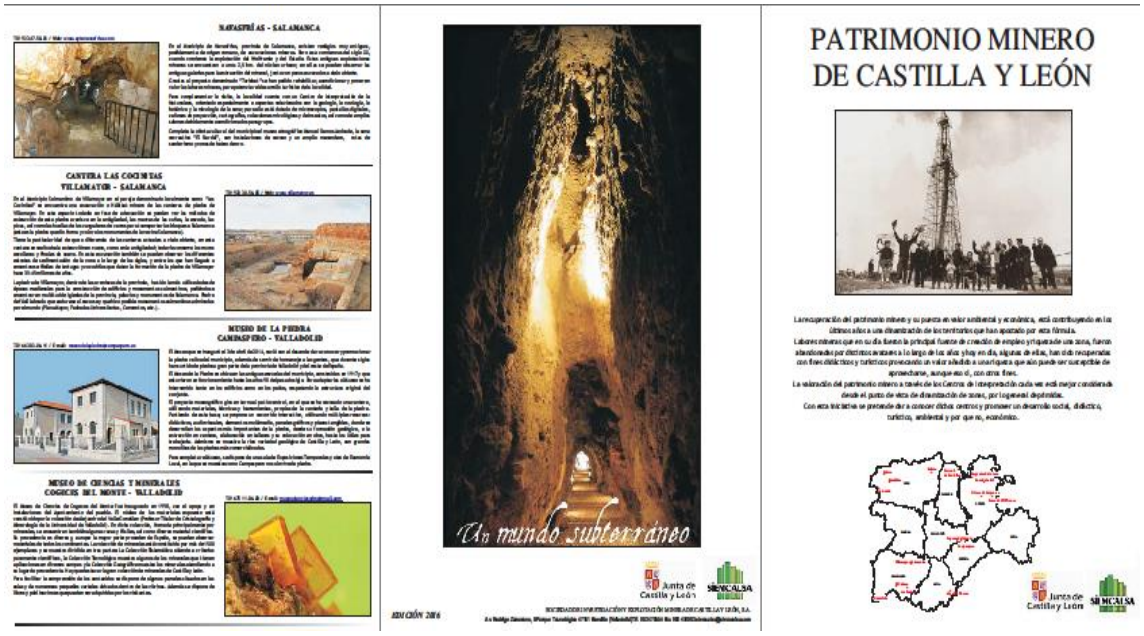
The greatest growing of mining industry was at the end of XIX century, when important mining companies from Great Britain, France, Germany or Belgium, arrived in Spain and Andalusia to start the industrial exploitation of metallic minerals. The territory of Andalucia is sown with historical mining remnants, mainly in the mineral districts of: **Iberian Pyrite Belt** (Huelva and Seville), **Linares-La Carolina** (Jaén), **Sierra Almagrera-Sierra Alamilla** (Almería), **Peñarroya-Pueblo Nuevo y Guadiato**(Córdoba).

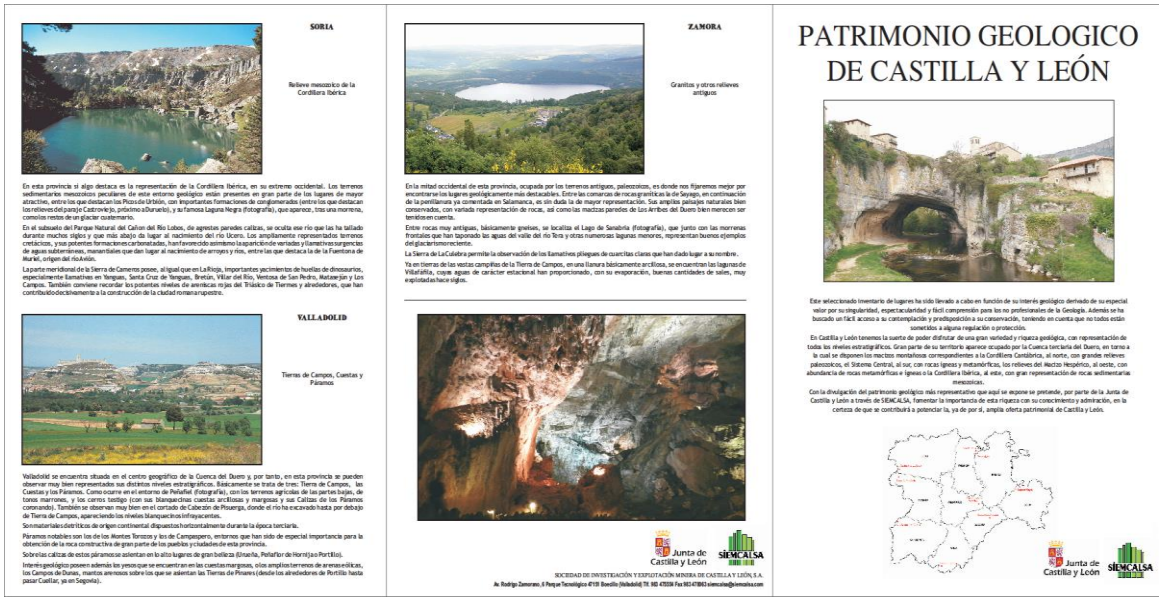
Nowadays, **different entities** constitute the mining heritage, with the most important being the following:

- Parque Minero de Rio Tinto: Rio Tinto mine, Peña de Hierro mine, Rio Tinto-Huelva mining railway, Rio Tinto Ernest Lluch mining Musseum. It is managed by Fundación Rio Tinto: https://parquemineroderiotinto.es/
- Bien de Interés Cultural BIC (Goods of Cultural Interest) Tharsis-La Zarza.
- Bien de Interés Cultural BIC (Goods of Cultural Interest) Minas de Rio Tinto.
- Centre for Mining Landscape Interpretation. Linares (Jáen). https://www.linaresturismo.es/museos/museo/centro-de-interpretacion-del-paisaje-minero/
- Museo Minero de La Carolina (Jaén) http://www.andalucia.org/es/turismo-cultural/visitas/jaen/museos/museo-de-la-carolina/#main-info
- Museo Geológico y Minero de Peñarroya: http://www.andalucia.org/es/turismo-cultural/visitas/cordoba/museos/museo-geologico-y-minero-de-penarroya-pueblonuevo/
- Museo geológico y minero Casa de los Volcanes, Rodalquilar (Almería): http://www.elcolordelcabo.es/casavolcanes/casavolcanes.htm
- Asociación Herrerías. Minas de Herrerias, Puebla de Guzmán, Huelva: https://www.asociacionherrerias.com/e

Castilla y Leon

The following brochures are considered interesting for attaching here in addition to what has been indicated in the aforementioned, Mineral Resources Strategy of Castilla y León.





Figures 3.7.2.1 & 3.7.2.2: Brochures for the Region of Castilla y León.

3.7.3 Regional GDP of tourist industry

Andalucia

- **Regional GDP of the tourism industry**: 12%
- **Number and type of tourists**: 30 M/yr

(Source: https://datosmacro.expansion.com/pib/espana-comunidades-autonomas/andalucia)

Castilla y León

- **Regional GDP of the tourism industry:** 6,000 M €/60,000 M €=10%
- **Regional GDP of the tourism industry per capita:** 6,000 M €/2.4 Mpax= 2,500 €/pax
- **Number and type of tourists:** 8.2 M pax (1.9 M pax international + 6.3 M pax national), for the year of 2017

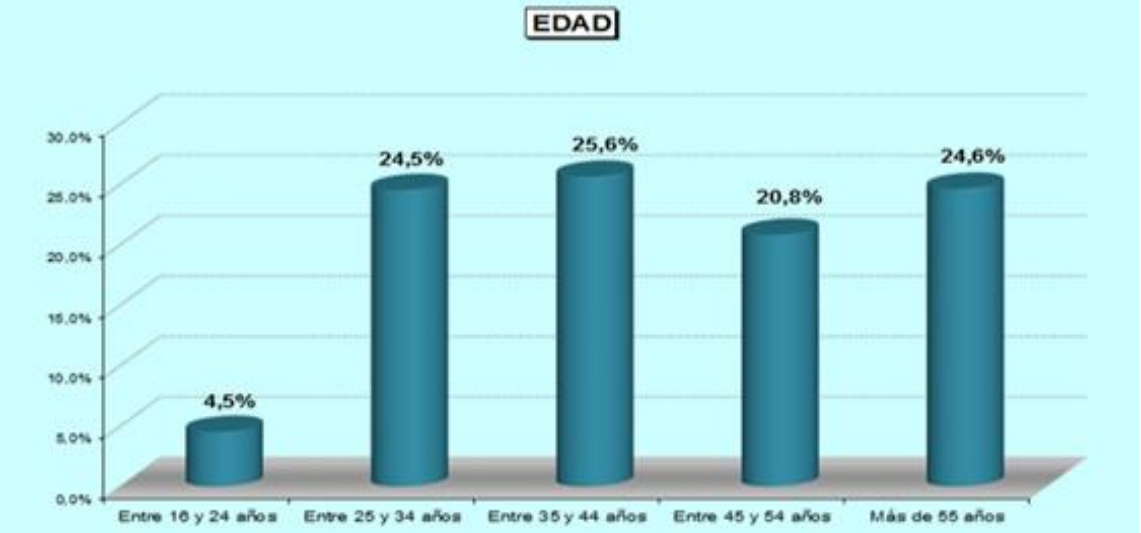


Figure 3.7.3.1: Graph of visitors by age, for 2018.

3.8 CASE STUDY: REGION OF ALENTEJO

3.8.1 Cultural significance

Alentejo region presents a **great diversity of cultural heritage**, both material and immaterial, namely related to the historical heritage (urban-monumental), the religious heritage built and the ethnographic and popular art heritage. This is a key factor of the development strategy of the territory (CCDR Alentejo, 2015).

Considering the **cultural heritage**, the region comprise cultural assets (classified under art. 15 of Law 107/2001, of 8 September, which classifies cultural real estate) of which 222 National Monuments, 422 Monuments of Public Interest and 76 Monuments of Municipal Interest, distributed by NUT III (**Table 3.8.1.1,Figure 3.8.1.1**). It has also two properties inscribed on UNESCO's World Heritage List that are the Évora Historical Centre (1986) and the Fortifications and the whole of the city of Elvas (2012). This cultural heritage is mainly distributed through archaeological heritage, civil architecture, military / defense architecture, mixed architecture and religious architecture.

NUT	Total	National Monuments	Property of Public Interest	Property of Municipal Interest
Alentejo Litoral	53	7	40	6
Alto Alentejo	200	62	112	26
Alentejo Central	258	107	136	15
Baixo Alentejo	126	24	84	18
Leziria do Tejo	83	22	50	11
Alentejo	**720**	**222**	**422**	**76**
Portugal	4.308	816	2 847	737
Alentejo/Portugal	16,7	27,2	14,8	10,3

Table 3.8.1.1: Classified cultural heritage in Alentejo region (DRC Alentejo in CCDR Alentejo, 2015)

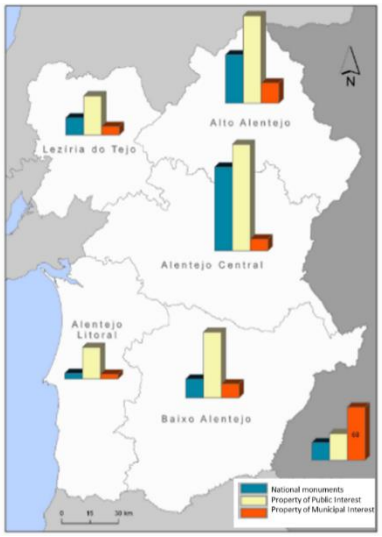


Figure 3.8.1.1: Cultural heritage distribution in Alentejo region (CCDR Alentejo, 2015)

Industrial heritage constitutes one of the most important material, social and cultural patrimony of the Alentejo region (CCDR Alentejo, 2015). In Alentejo, the industrial heritage is associated with mining towns and archaeological sites that constitute elements of the ancestral mining profile of the Alentejo region. According to CCDR Alentejo (2015) the valorization of these sites must link the operating chain of mining from the exploration to the shipment and export of ore and research and environmental sectors.

3.8.2 Mining heritage

In Alentejo region, there are **43 abandoned mines** (EDM & DGEG, 2011), 10 mines with concessions authorized (active), 4 mines with its concession in advertising, and 2 mines with concession areas requested (**Figure 3.8.2.1**). These mines exploit **different materials** such as metals (Cu, Zn, Fe, S, Pb, Ag, Au, Sn, Mn, Co, and associated minerals), kaolin, quartz and feldspar (DGEG, 2019). The largest active mines in the region are **Neves-Corvo** and **Aljustrel**.

Regarding the quarries **(Figure 3.8.2.2**), in Alentejo region there are around 150 of active quarries (DGEG, n.d.) and about **140 quarries** identified as **"Abandoned"** (DGEG, unpublished). This last number does not contemplate quarries in Lezíria do Tejo, because the quarry inventory had into account older administrative boundaries that didn't include Lezíria do Tejo as part of Alentejo region, and so, it is expected to be **more than** 140 abandoned quarries in Alentejo region. The active quarries exploit mostly for ornamental stones (marble and granite), common sand and common clay (DGEG, n.d.).

The **geology** of Alentejo region is **diverse** and the metals exploited throughout history have been lead, gold, silver, copper, zinc, manganese, tin, sulfur, uranium and even coal (GeoPortal LNEG, 2014). Despite the metal content in this region, quarries of marble, limestone and granite are also very important in the economy and culture of the region and have potential for cultural heritage.

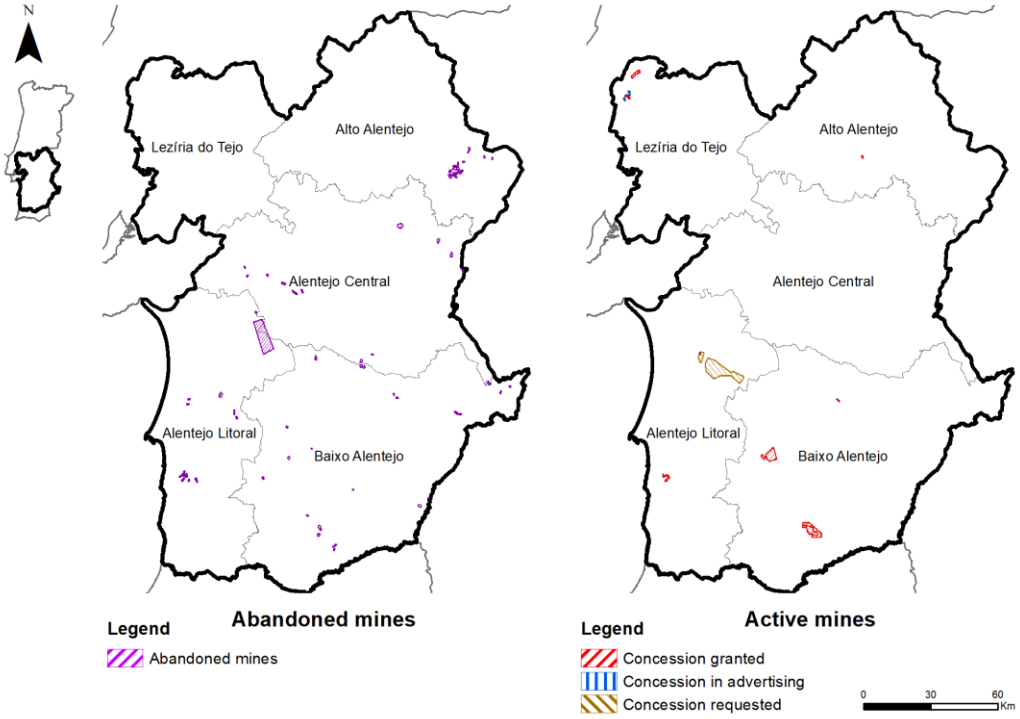
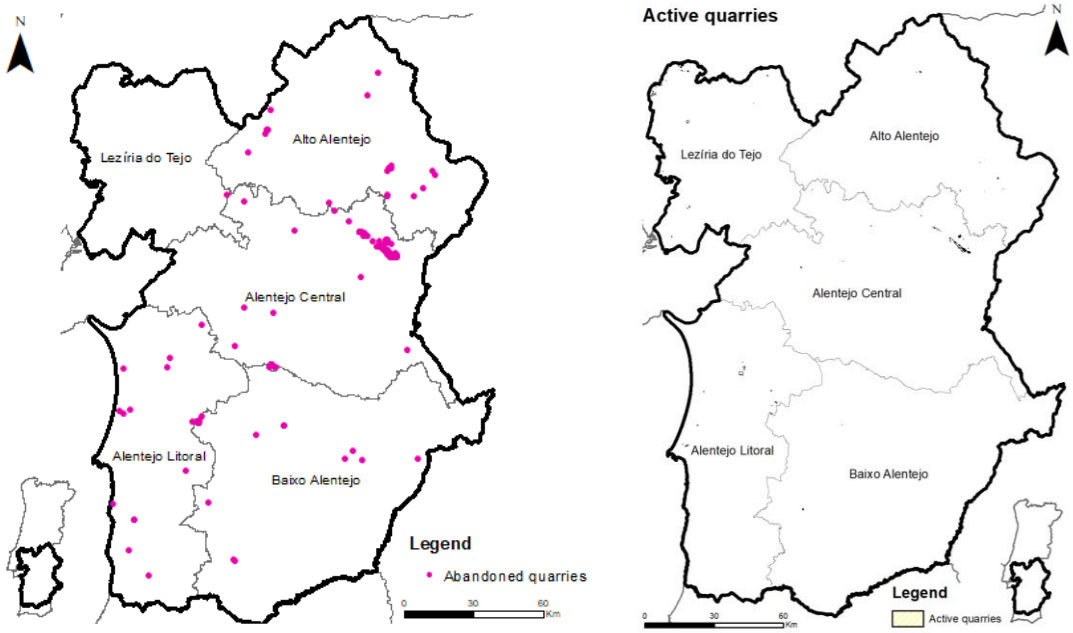


Figure 3.8.2.1: Abandoned (left) and active mines (right) in Alentejo region (DGEG, n.d.)



Error! Reference source not found. **3.8.2.2**: Abandoned (left) and active quarries (right) (DGEG, .d.)

In Alentejo region there are several metallogenetic provinces, being one of them considered as **world class metallogenetic province**, the **Iberian Pyrite Belt** (IPB) (Luz et al., 2019). The IPB is the main geological site for mining industry and is where the best examples of cultural mining exploitation exist. Moreover, in other Alentejo provinces there are archaeological sites, where traces of ancient mine activities or abandoned mineral explorations can be found (DGEG, n.d.; DGPC, n.d.). The mining history in Alentejo region goes back to the Pre-roman Period in most part of the region, being São Domingos, Aljustrel and Lousal the locations with longer history in mineral exploitation, with traces of that activity from 5,000 year ago (Oliveria et al., 2013).

The Industrial Revolution and external investment (mainly British, French and Belgian) gave a boost in the economy of Alentejo region and many small mineral explorations started to exploit metals by that time. Without the concern in getting up the product in the chain value and due to the volatility of the external markets, the region met several episodes of economic crises (Quintas & Pereira, 2016). Nowadays, it has potential for mineral exploration, and it has **two major mines in activity** (Aljustrel and Neves Corvo) (Luz et al., 2019).

After the Industrial Revolution, a new technology was brought to the region and some of it constitutes mining heritage, for example the *malacates,* which are tower like structures with a metallic cabin used to carry people, ore, materials, and mules, and its name was given in the IPB context (DGEG & EDM, n.d). Other contemporary mining structures/buildings considered heritage are treatment stations, metallurgical chimneys, mining processing plants, mining towns, wells, and mine galleries (Matos, J.; Pereira, Z.; Oliveira, J., 2010). The main places regarding Mining Heritage, in Alentejo region, are identified in **Figure 3.8.2.3** and **Table 3.8.2.1**.

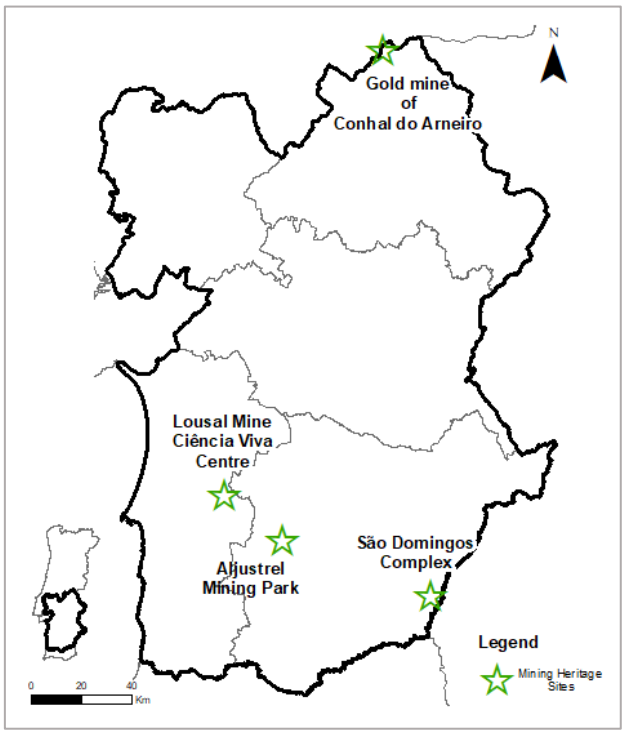


Figure 3.8.2.3: Location of the main identified and recovered sites of mining heritage (DGEG & EDM, n.d.)

Name	Historic periods	Period of project implementation	Main ore exploited	Places/items recovered	Ownership regime
São Domingos Complex	Pre-roman, roman, modern	Three regional projects from December 2009 to April 2015	Cu, Au, Ag	· Miner's house · São Domingos's Mine Documentation Centre · Restoration and preservation of archaeological remains and implementation of pedestrian circuits	Public-private nonprofit institution "Fundação Serrão Martins" (Town Hall of Mértola and La Sabida company)
Lousal Mine – Ciência Viva Centre	Modern	RELOUSAL project since 1996	Cu	· Mining museum · Mining facilities (Electric Plan, mining neighborhood, elementary school, market, etc.)	The lands belong to the private company of SAPEC. Yet, the nonprofit Ciência Viva Association Manages the site through public and private funds (National Agency for Scientific and Technological Culture).
Aljustrel Mining Park	Pre-roman, roman, modern, and it is still an active mine	It is still in recovery by three projects (from January 2017 to April 2020)	Cu, Ag, Mn, Zn	· Archive installation and Mining Centre · Urban requalification of the mining neighborhoods	Public (Aljustrel Town Hall)
Gold Mine of Conhal do Arneiro	Pre-roman and Roman	Preservation in the aim of Naturtejo GeoPark	Au	Walking routes and promotion	Public (Town Hall of Nisa and Institute for Nature Conservation and Forests)

Table 3.8.2.1: List of the main mining heritage identified and recovered for tourism and educational purpose. Based on several authors.

São Domingos Complex comprises several mining facilities, including railways and the harbour in Pomarão, and is classified as Public Interest Set Heritage. National and municipal roads make the accessibility to this site.

Lousal Mine – Ciência Viva Centre (Lousal CCV) was one of the first places to start this kind of approach for abandoned mines and today is a place where public can be educated for the mining industry and specially its legacy. The access to this site is made through motorways, national and local roads. The access by train is also possible but only for groups of at least 10 people (Comboios de Portugal, n.d).

As for **Aljustrel Mining Park** it has both mining heritage assets that are still under recovery, but it is still an active mine today, exploited by the Portuguese company Almina. The goal of this, still in progress, project is to combine research, technology, qualification, tourism, environment, culture and heritage (Aguiar, 2018). The access to Aljustrel Mine is made by motorway and national road. A railway that nowadays is inactive once served this village.

Finally, **Gold Mine of Conhal do Arneiro** is an archaeological, site near Nisa, marked by the presence of millions of pebbles left by a very peculiar mining technique used for Romans. Associated to this site there is another one, the Buraca da Faiopa, also explored by the romans for iron (Geopark Naturtejo, personal communication, 12 August 2019). Here, the access is especially by car through local roads, but a part of the journey has to be by foot.

In Portugal there are two main touristic routes regarding mining heritage:

- Guide of the Portuguese Geological and Mines Sites (DGEG & EDM, n.d.), that covers all national territory and includes quarrying related heritage (http://www.roteirodeminas.pt/home.aspx?cpp=1);
- Pyrite route (LNEG, 2015), which regards only a part of the Alentejo region, the IPB. It was created in the aim of ATLANTERRA project by LNEG, the Portuguese Geological Survey (https://www.lneg.pt/divulgacao/noticias-institucionais/349).

The purpose of these routes is to inform the population about this places and legacy and to give the opportunity to visit them.

Table 3.8.2.2 presents others potential locations for mining heritage included in the routes mentioned above and one more site, the Briquette Plan of Espadanal Coal Mine in Rio Maior. The **Espadanal Coal Mine** is an old mine that exploited the lignites of the upper Pliocene during the first half of 20th century, but due to its low quality and the start of the oil industry and its products, the mine closed in 1969 (Rocha, 2010). As part of this mine complex, the Briquette Plan was built and today is considered cultural heritage, although it has not been classified or recovered as such.

Beyond the mining heritage located in Alentejo region the Guide of Portuguese Geological and Mines sites identifies **other examples of mining heritage exploitation** in the country: “Terva Valley Archaeological Park (PARK), “Tresminas Roman Mining Compound”, “Barroso Ecomuseum Interpretive Centre of the Borralha Mines”, and “Castromil Mines”. All of them located in the north part of the country.

Name	Main historic periods of exploitation	Main ore exploited
Briquette Plan of Espadanal Coal Mine	Contemporary	Coal
Caveira Mine	Roman and Contemporary	Mn, Cu
Cercal Mine	Contemporary	Mn
Chança Mine		Cu
Campo Branco area	Pre-roman, roman and contemporary	Mn, Ba, Cu, Pb

Table 3.8.2.2: Other abandoned mining sites with no intervention. Based on several authors[18]

Beyond the mining heritage located in Alentejo region the Guide of Portuguese Geological and Mines sites identifies **other examples of mining heritage exploitation** in the country: "Terva Valley Archaeological Park (PARK), "Tresminas Roman Mining Compound", "Barroso Ecomuseum Interpretive Centre of the Borralha Mines", and "Castromil Mines". All of them located in the north part of the country.

In Alentejo region there are several **national protected areas**, Special Protection Areas (SPA) and Sites of Community Importance (SCI) as shown in the **Figure 3.8.2.8**. Some of them overlap with part of São Domingos Complex, namely the Natural Park of Guadiana Valley and the SPA Vale do Guadiana. In this area, a new project to create an UNESCO Geopark has been proposed (Câmara Municipal de Mértola, 2019). The site of the Gold Mine of Conhal do Arneiro is located in the small Natural Monument of Portas de Ródão, in the SCI of São Mamede and in Naturtejo Geopark. As forthe Aljustrel Mining Park it is located close to the border of SPA of Castro Verde.

In Portugal, the State conferred Empresa de Desenvolvimento Mineiro (EDM), S.A., the **concession** for the **environmental remediation** of **abandoned mines** (Decree-Law No. 198-A/2001). According to EDM, in 2011, there were seven mines which were targeted to be environmentally recovered (EDM & DGEG, 2011), yet, according to public digital data from the Directorate-General for Energy and Geology (DGEG), in 2019, there are 11 abandoned mines which have concluded its environmental recover process or are in a conclusion stage (DGEG, n.d.). The recovery consisted in the application of several techniques depending on the type and mining place of the contamination (EDM & DGEG, 2011):

- in waste dumps and tailings ponds, the covering, sealing and drainage techniques, depending on its geometry and specific location, were applied;
- in the open pit of São Domingos, a hydro-geologic study demonstrated that the acidic water was confined to the mining area, being necessary to protect its outline with a fence and create a pedestrian circuit with educational content;
- in run-off and mine waters, the technique chosen consisted in diverting the clean waters and creating basins for containing and passive treatment of the contaminated water;
- monitoring and control of the air quality, the soils and sediments and the aquatic environment

[18] Rocha (2010), LNEG (n.d.) and DGPC (n.d)

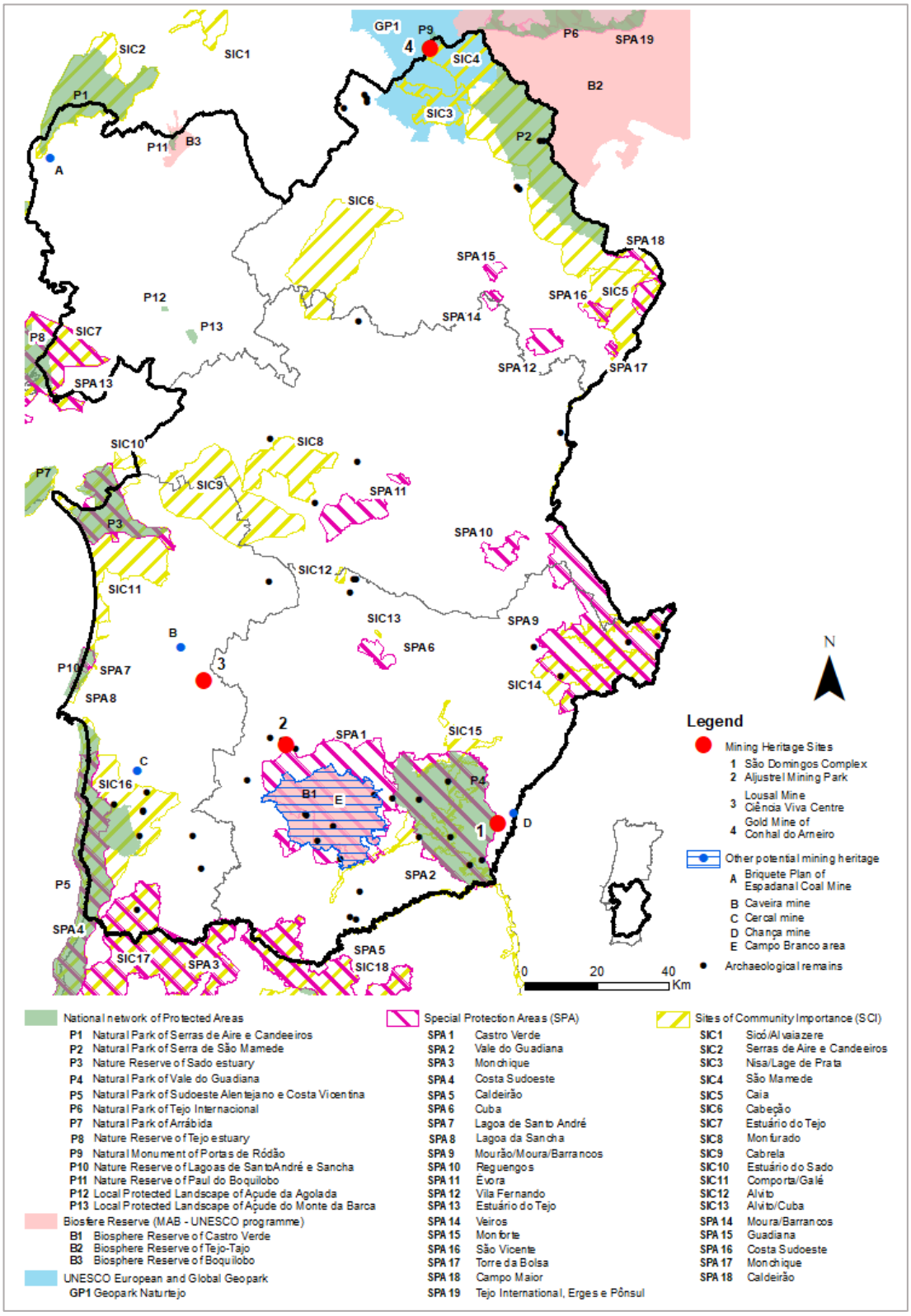


Figure 3.8.2.8: Proximity to areas with naturalistic value (ICNF, n.d.)

3.8.3 Regional GDP of tourist industry

For the Alentejo region, the information available regarding regional GDP and tourist industry are: the **regional GDP** of Alentejo (all economic activities, including tourism); the **Gross Value Added** (GVA) of the economic activity "Accommodation and food activities", which can give an approach of the economic importance of tourist industry, in the region; the number of guests and overnight stays in hotel establishments; and the number of visitors of general museums.

The regional Gross Domestic Product (GDP) in Alentejo has been increasing since 2014, as it has its proportion regarding the national GDP (**Table 3.8.1.1**). The GVA for "Accommodation and food activities", in Alentejo region, is about 6.4% of the national GVA of the same activity, but taking into account the global Portuguese GVA, in Alentejo region the "Accommodation and food activities" represents about 0.35% of total national GVA (**Table 3.8.1.2**).

Year	% of national GDP	GDP value (10^6)	GDP per capita	GDP in PPS EU28 (10^6)	GDP in PPS (EU28=100)
2014[1]	6.4%	165,206.8 €	15,000 €	19.2 €	76.8%
2015	6.6%	171,591.1 €	16,400 €	21.0 €	76.9%
2016	6.5%	177,969.5 €	16,800 €	21.0 €	77.4%
2017pro[2]	6.5%	185,725.4 €	17,800 €	21.7 €	76.8%

[1] The time series starts in 2014, because the administrative division has changed in 2013 and it could affect the value for Alentejo region.

[2] provisional statistics

Table 3.8.1.1: Regional GDP in Alentejo region: % of the national GDP; regional GDP in currency, per capita, Purchasing Power Standarts (PPS) in European Union and comparative PPS in EU (INE, n.d.)

Year	% of national "Accommodation and food activities"	% of total national GVA
2014	6.4%	0.34%
2015	6.4%	0.35%
2016	6.3%	0.36%

Table 3.8.1.2: GVA in Alentejo region regarding "Accomodation and food activities" (INE, n.d.)

In the last years, the number of tourists in Alentejo region has increased in hotel establishments, reaching 1,470,950 tourists in 2018 (Figure .8.3.1). More than 60% of the tourists are residents (national tourists), although foreign tourist has been increasing slightly (**Figure 3.8.3.2**).

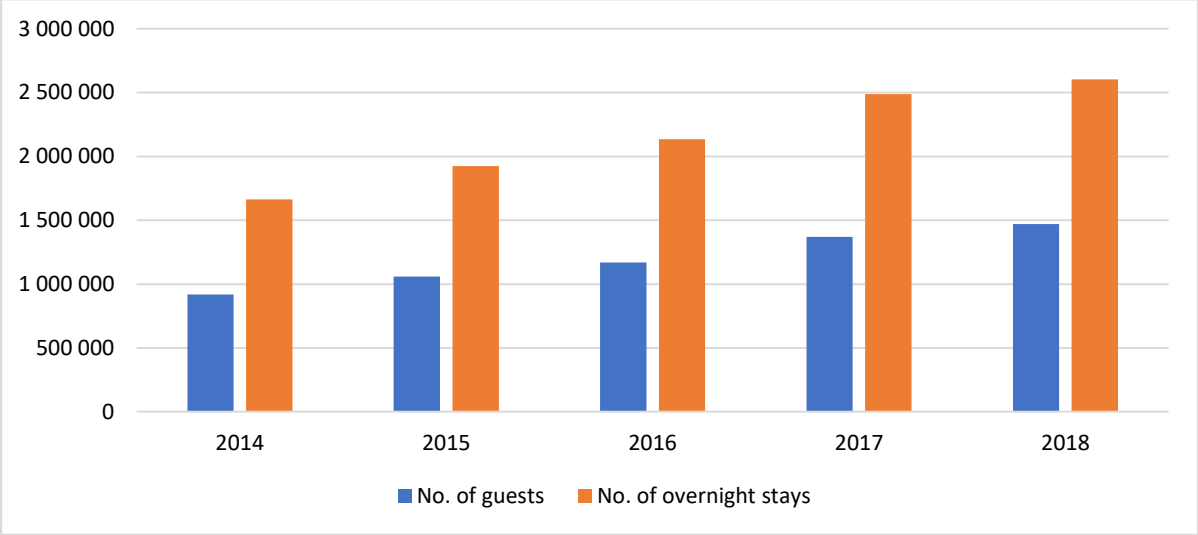


Figure 3.8.3.1: Number of guests and overnight stays in hotel establishments in Alentejo region (INE, n.d.)

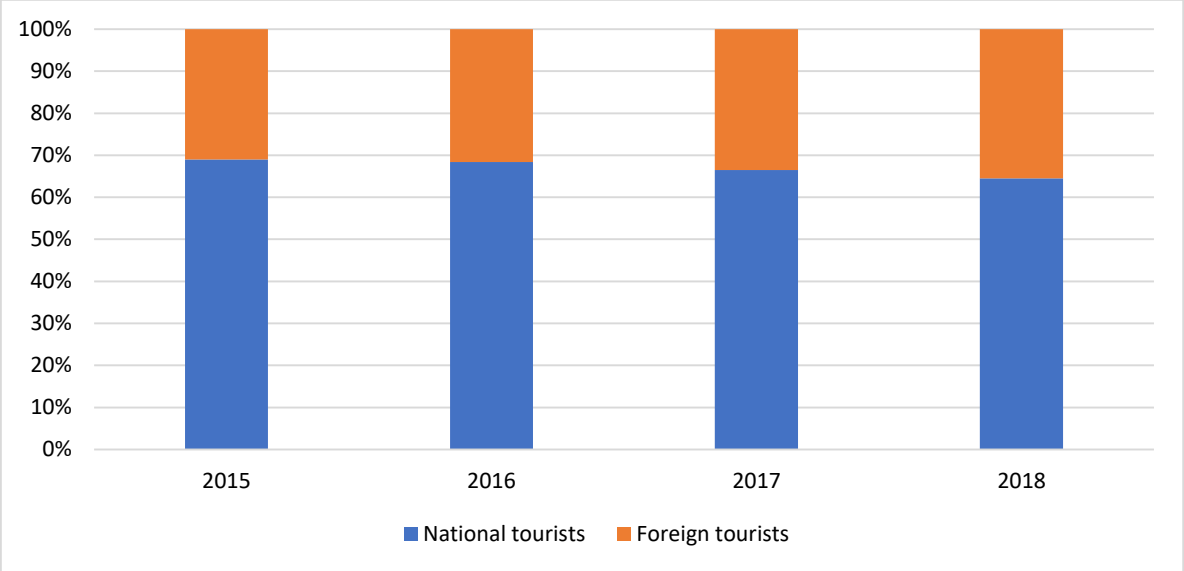


Figure 3.8.3.2: Proportion of national and foreign tourists in hotel establishments, in Alentejo region (INE, n.d.).

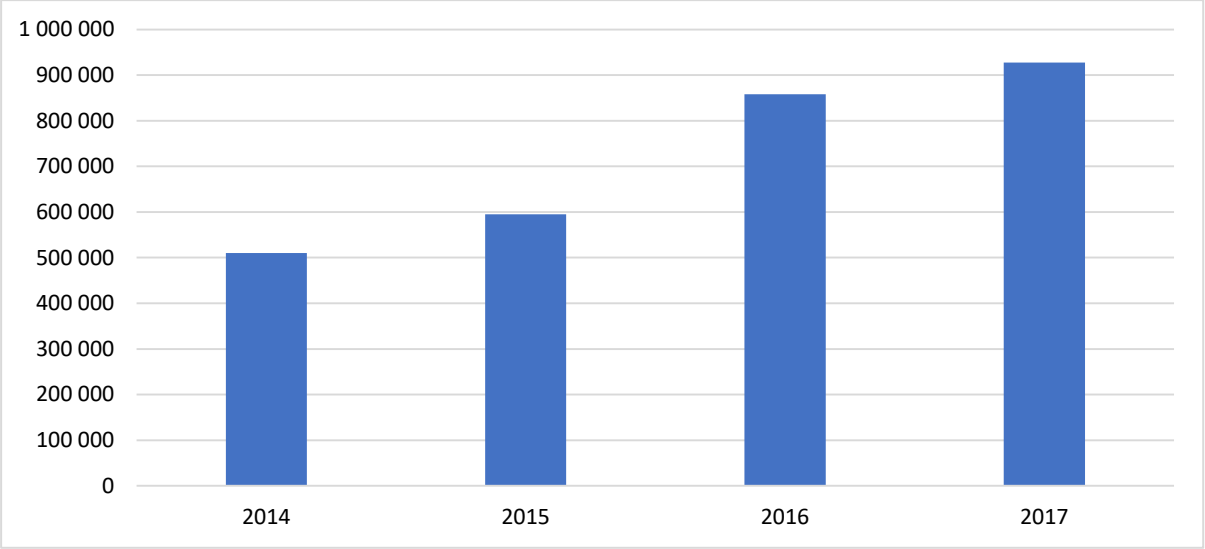


Figure 3.8.3.3: Visitors of museums in Alentejo region (INE, n.d.)

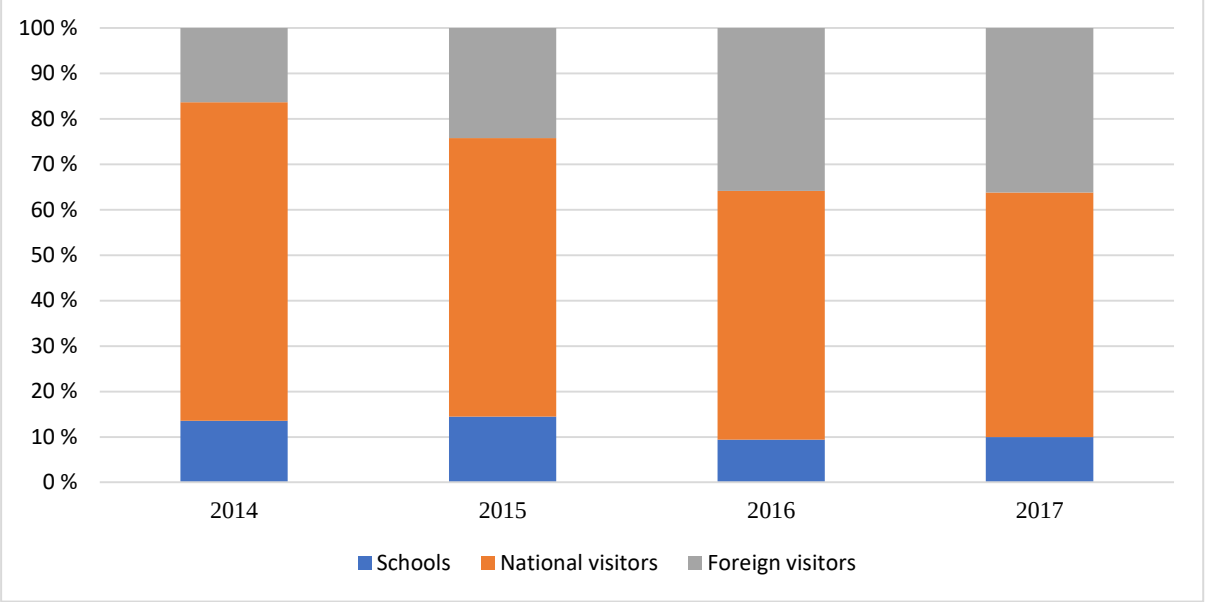


Figure 3.8.3.4: Type of museum visitors, in Alentejo region (INE, n.d.)

For museums in general, in Alentejo region, the visitors has increased since 2014 (Figure 3.8.3.3) and the majority are Portuguese (Figure 3.8.3.4). Regarding specifically mining museums, most of the mentioned mining sites that are now recovered and open to the public for industrial tourism have a free entrance and therefore it is not possible to estimate the number of visitors. Yet, there are some exceptions such as Lousal CCV. As for Aljustrel Mining Park, according to Aguiar (2018), the touristic offer is reduced and presents a low degree of diversification (accommodation, products and entertainment).

Lousal CCV belongs to the Ciência Viva centres network (science museums), that is a net of 20 science centres throughout Portugal. The main goal of these centres is to promote widespread access to

scientific culture with focus on local characteristics, being the focus of Lousal CCV the "Mining Heritage".

According to Campos (2018) Lousal CCV received 12,515 visitors. The same study explored the profile and motivations of the visitors of CCV Lousal in order to characterise its visitors. The study contemplated the application of a questionnaire from March 15 to June 17 of 2017. According to the study, about 94% of the respondents are Portuguese and the majority of the respondents visit the centre with their family (**Figure 3.8.3.5**). The majority of the visitors are young (6 to 17 years old) or older (47 to 82 years old), they are usually students (probably visiting with school) or employees. Regarding their academic qualifications, the majority has a Bachelor's degree or completed the Basic Education (Figure 3.8.3.6). The main motivations indicated by the visitors to go to CCV Lousal are: to know a new Ciência Viva Centre, to get in touch with scientists/researchers/science communicators and to enrol in a training action and/or a conference (Campos, 2018).

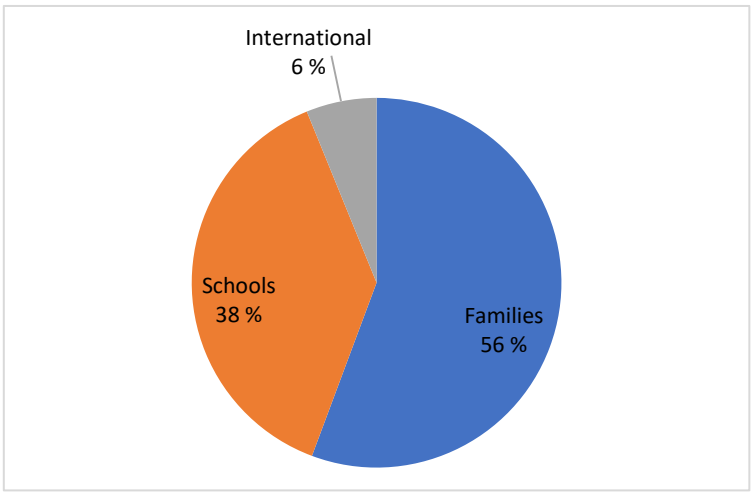


Figure 3.8.3.5: Type of visitors of CCV Lousal in 2017 (Campos, 2018)

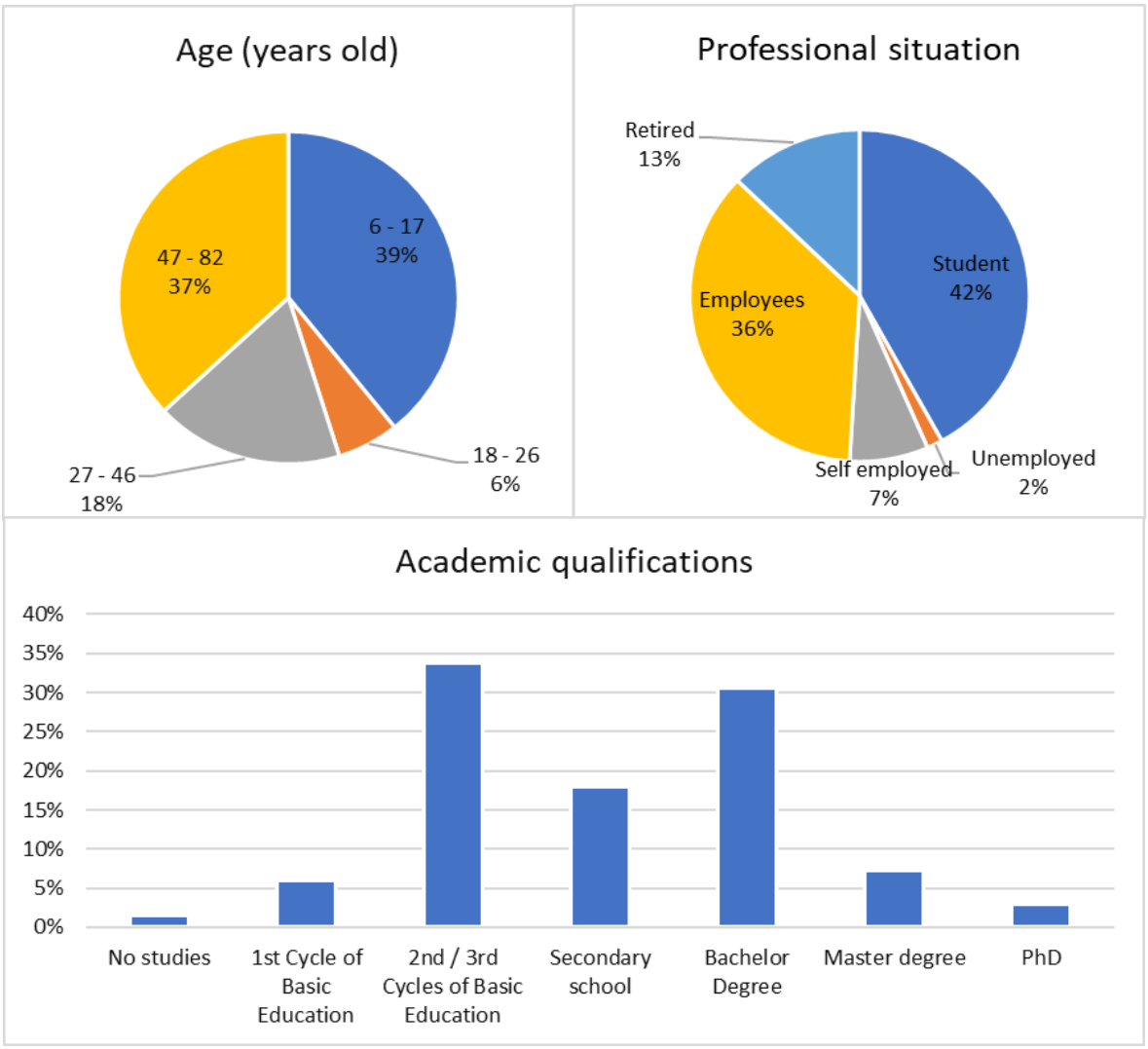


Figure 3.8.3.6: Characterisation of visitors in Ciência Viva Lousal Centre in 2017 (Campos, 2018)

4. REGIONAL FUNDING OPPORTUNITIES FOR INNOVATION AND ENVIRONMENTAL PROTECTION

4.1 CASE STUDY: REGION OF STEREA ELLADA

4.1.1 Funding Opportunities at a National level

According to REMIX project, in the country of Greece there are two national funding instruments related to mining and metallurgy:

EPAnEK

Name of instrument	▪ Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020 (EPAnEK)
Funding authority	▪ Partnership Agreement (PA) for the Development Framework 2014-2020, co-funded by European Structural and Investment Funds (ESIF) of the European Union.
General Objectives of the instrument	▪ The pivotal strategic objective of EPAnEK is to enhance the competitiveness and extroversion of enterprises, to facilitate transition to quality entrepreneurship with innovation and the growth of domestic added value as the cutting edge. The budget of this Action amounts to a total of € 542,535,722 (Public Expenditure) and is designed to be deployed in 2 Phases (Phase A: budget €342,535,722 –CLOSED & Phase B: budget €200,000,000-ONGOING).
Type of project	▪ Funding
Geographical limitations	▪ National
Proposal deadlines	▪ Phase B electronic submission of Applications (via State Aid Information System - www.ependyseis.gr/mis) is set for the on Thursday 28 March 2019 at 18.00 with a deadline of Wednesday 29 May 2019 at 16.00.
Technical Requirements	▪ Funding applications for research, technological development and innovation projects to be supported through Phase B of EPAneK Action may be submitted either by individual enterprises or by business groups or by business partnerships with research organizations and should be included in one of the following four (4) categories of intervention (Acts): I. Enterprise Research and Development, supporting research, promote innovation and strengthen networking in small and medium-sized enterprises.

	II. Business Partnerships with Research Organizations, enhancing the cooperation between businesses and research organizations II. Exploitation of Research Outcomes aiming to promote research at a next level of technological readiness, building on results produced in previous research projects. ✓. Seal of Excellence for business, concerning the funding of proposals that have passed the EU Horizon 2020 SME Entrepreneurship Scoreboard, ie they have received the Seal of Excellence as highly innovative proposals but have not received financial aid, as the funds have been exhausted ▪ Beneficiaries of the Action are: (a) Research organizations and 'Other bodies treated as such; and (b) Enterprises and 'Other entities treated as such.
Financial Requirements	▪ The Higher Total Budget per proposal and Intervention in Phase B has been defined as follows: ▪ Enterprise Research and Development 600,000 euros ▪ Business Partnerships with Research Organizations 1,000,000 euros ▪ Exploitation of Research Outcomes 2,000,000 euros. ▪ Seal of Excellence: The maximum total budget of each proposal (and its allocation per co-beneficiary / partner if it concerns a business group) is the approved budget from the Horizon 2020 evaluation. ▪ The duration of the submitted project proposals must not exceed thirty (30) months. Specifically, for proposals of Intervention IV "Seal of Excellence", these should be implemented at the time approved by the H2020 - SME Instrument. ▪ The aid intensity ranges from 25 to 80%, depending on the type of business and the eligible activity / cost.
Characteristics	▪ Eligible cost categories: Staff costs, Instrument & Equipment Costs, Expenditure on buildings and stadiums, Expenditure for contract research, patents, purchased or licensed from outside sources in accordance with the principle of equal distances, and expenditure on advisory and equivalent support services used exclusively for the project, Additional overheads and other operating costs that are a direct result of the project, Feasibility study costs, Innovative costs, Expenditure on participation in trade fairs.
Special requirements for project staff or organisations implementing the project	▪ ND
Apply	▪ www.ependyseis.gr/mis.gr
More information	▪ http://www.antagonistikotita.gr/epanek/prokirixeis.asp?id=47&cs.gr

EquiFund

Name of instrument	▪ EquiFund
Funding authority	rCo-financed by ▪ EU and national funds, ▪ EIF and the European Investment Bank (EIB) through the European Fund for Strategic Investments (EFSI). ▪ Private Sector
General Objectives of the instrument	▪ To foster the establishment and growth of start-ups knowledge-intensive companies from Universities, the researchers of this institutions but also indented private investigators who have nee of support for the commercialization of mature research results and innovative ideas ▪ To establish, in overall,l a private equity and venture capital ecosystem for SME's
Type of project	▪ Equity funding platform
Geographical limitations	▪ National
Proposal deadlines	▪ Open continuously
Technical Requirements	▪ Recognising that each start-up business passes through a lifecycle, EquiFund's investment strategy includes three windows: ▪ The Innovation window (supporting both Technology Transfer and Acceleration), is targeted at researchers and innovators, who are still at the idea and research stage. Investment partners offer financial expertise and backing to get your idea off the ground by funding the development of prototypes for production or launch of version 1.0. Favoured sectors: Deeptech ▪ The Early Stage window targeted at start-ups who have launched their companies and whose ideas are achieving initial traction. These funds offer financing with expertise, business know-how and access to networks to help your start-up fuel sales, increase productivity, as well as build the corporate infrastructure and distribution system. Favoured sectors: ICT ▪ The Growth Stage window, targeted at scale-ups who have established businesses with strong sales. Growth capital fund managers have expertise to help you fund expansion through export, internationalisation and many other ways. Favoured sectors: ALL

Financial Requirements	▪ Indicative investment amount for each window : ▪ The Innovation window EUR 30k - 5m (including follow-on investments) ▪ The Early Stage window EUR 400k - 5m (including follow-on investments) ▪ The Early Stage window EUR 2m - 12m (including follow-on investments)
Characteristics	▪ The investment period can range from around five to seven years, after which your investor will look for a return on their money through the sale of the company or by offering to sell shares in the company to the public. In addition to capital, investors also provide valuable know-how and access to networks, helping you progress your venture or business efficiently and effectively.
Special requirements for project staff or organisations implementing the project	▪ Example: ▪ NO
Apply	▪ equifund.gr
More information	▪ equifund.gr

4.2 CASE STUDIES: REGIONS OF NORTH KARELIA AND LAPLAND

4.2.1 Funding Opportunities at a European level

Several funding opportunities, regarding Finland, at a European level namely:

- **Interreg Nord** (Finland, Sweden Norway)**, Interreg Botnia-Atlantica** (Finland, Sweden Norway)**, Interreg Baltic Sea Region, Interreg Central Baltic** (Finland, Sweden Estonia, Latvia, Åland)**, Interreg Europe, Interreg Northern Periphery and Arctic NPA** (Sweden, Finland, Svalbard, Greenland, Norway, Iceland, Ireland, Faroe Islands, Scotland, N. Ireland)**.**
- **Horizon 2020**
- **EIT Raw Materials**
- **European Neighbourhood Instrument Cross-Border Cooperation (ENI CBC)** Three ENI CBC programmes are currently under way on the border between Finland and Russia: Kolarctic, Karelia and South-East Finland - Russia. The programmes, which will cover the period 2014 - 2020, are a continuation to the programmes implemented between 2007 and 2013. Even though each ENI CBC programme has its own themes there are also joint priorities: business development, environmental protection, border management and border security. The regions involved are responsible for the content and implementation of the programmes. Cross-border cooperation programme supporting EU's external actions with the financing from the European Union, the Russian Federation and the Republic of Finland. ENI CBC programmes are co-financed and based on equal partnership. Half of the financing for the programmes along the border between Finland and Russia comes from the EU, while the remaining 50 per cent is provided by the participating countries.
- **COST.** European cooperation in Science and Technology.
- **BONUS.** Science for a better future of the Baltic Sea Region
- **LIFE** The EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU.

4.2.2 Funding Opportunities at a National level

The structure of the main public research funding sources is presented in **Figure 4.2.2.1. Business Finland** (formerly TEKES) offers funding for research, product development, and many kinds of business development needs, especially for small and medium-sized companies. Large companies and research organizations can receive funding for joint projects with smaller companies. Funding is also offered for joint actions between companies and research organizations, preparation for commercialization of research results and development of radical innovations and creation of new cooperation. Others are R&D funding, Innovation Voucher to purchase new knowledge or skills, into funding to buy innovation expertise and Innovative Public Procurements for public procurement units. The Business Finland replaced TEKES.

Academy of Finland's mission is to fund high-quality scientific research, provide expertise in science and science policy, and strengthen the position of science and research. It is an agency within the administrative branch of the Finnish Ministry of Education, Science and Culture. Funding is carried out primarily through the core Academy funding schemes for research projects, research careers and research environments. Academy of Finland also cooperates with international funding e.g. ERA-NET

and Nord Forsk calls, support to EU funding applicants, and mobility grants to select countries outside Europe.

Strategic Research Council (SRC) is a body established within the Academy of Finland. It funds projects based on the annually proposed key strategic research themes approved by the Finnish Government. After the Government's decision, the SRC can launch its programmes around the joint theme. Mineral Resources and Material Substitution, MISU programme (2014-2019). The aim of the Programme was to provide a broad and in-depth coverage of the occurrence, properties, processing, use and recycling of rare, especially metallic minerals as well as alternative materials used as substitutes for metallic minerals. A Climate-Neutral and Resource-Scarce Finland, PIHI programme (2015-2021). The research under this programme supports sustainable use of natural resources, mitigation of climate change and making full use of circular economy.

FINNVERA provides financing for the start, growth and internationalisation of enterprises and guarantees against risks arising from exports. Finnvera strengthens the operating potential and competitiveness of Finnish enterprises by offering loans, domestic guarantees, export credit guarantes and other services associated with the financing of exports. The risks included in financing are shared between Finnvera and other providers of financing

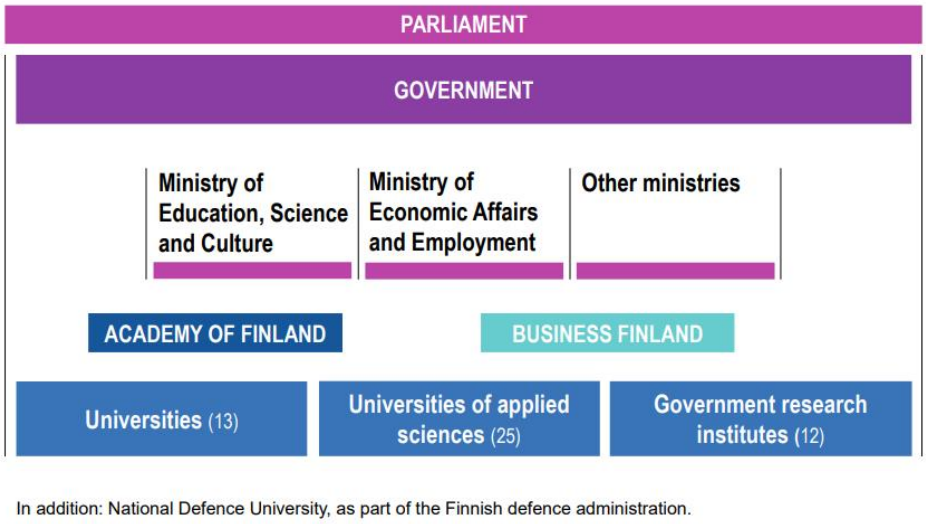


Figure 4.2.2.1: The public research funding in Finland.

4.2.3 Funding Opportunities at a Regional level

Structural fund programme: European Regional Development Fund (ERDF) and European Social Fund (ESF). 'Sustainable growth and jobs 2014 - 2020 - Finland's structural funds programme' has five priority axes and 13 specific objectives. Each project must deliver at least one of these specific objectives. Development priorities in Finland's Eastern and Northern regions have been specified in the regional plan for Eastern and Northern Finland, which supplements the Sustainable Growth and Labour Programme. In addition to national and Eastern and Northern Finland's priorities, each region has selected its own priorities, which it will aim to focus funds on. Companies, educational institutions,

research institutions, municipalities, regions and other incorporated societies as well as combinations of these may apply for the ERDF funding.

The following policy lines include mining and metallurgy:

1. Competiveness of SMEs (ERDF),
    - Generating new business
    - Improving transport and logistic connections that are important to SMEs (only in Eastern and Northern Finland)
    - Promoting growth and internationalization of enterprises
    - Promoting energy efficiency in SMEs

2. Producing and using the latest information and expertise (ERDF)
    - Development of the centres of research, expertise and innovation on the basis of regional strengths
    - Strengthening innovation in enterprises
    - Developing solutions based on renewable energy and energy-efficient solutions

4. Education, skills and lifelong learning (ESF)
    - Improving services supporting transitional periods and equality in education
    - Improving the availability and quality of education in growth sectors and sectors affected by structural change

The North Calotte Council is a Nordic cross-border cooperation organization funded mainly by the Nordic Council of Ministers. The North Calotte Council provides funding for Nordic projects related to the focus areas selected by the Council.

4.3 CASE STUDY: REGION OF STYRIA

4.3.1 Funding Opportunities at a European level

[See attached document "Task 6.2. Financial instruments - PP23 VESTE – Styria"]

The main funding program for innovation is **Horizon2020** which is used in **various projects** (university as well as companies). **Interreg** is also an important possibility. E.g. in the field of industrial heritage 3 projects in the program "Central Europe" have been carried out in the past years.

LEADER, the European program for rural development, is an additional opportunity. Especially in the field of industrial culture and industrial & mining heritage it is an important source for funding, and many projects (e.g. museum association Eisenstrasse – see above, "Adventure Erzberg" or the UNESCO intangible heritage) are supported. The "**Creative Europe**" program can also provide fundings (e.g. the ERIH route – the European Route of Industrial Heritage) is supported by Creative Europe.

4.3.2 Funding Opportunities at a National level

[See attached document "Task 6.2. Financial instruments - PP23 VESTE – Styria"]

There are also specific project-related fundings possible via the **Government of Styria** or via **Austrian ministries** (e.g. ministry for environment - includes mining, transport, sciences & research).

The new "**tunnel research and training center**" at the Erzberg (35 Mio € project; to be opened in spring 2020; Europe´s most modern institution of its kind) is financed by a mix of fundings: ministries of transport and of science, Styrian government and mining university)

A further possible funding source for heritage-related projects is the **Austrian ministry of culture.**

4.3.3 Funding Opportunities at a Regional level

Apart from the **municipalities** (limited resources), the **department of culture** of the Styrian government (department A9) is the major source of regional fundings. It can provide financial support for museums and monuments as well as for heritage-related events. For environment-related projects, the **department of environment** can give support.

For the touristic valorization of the mining heritage, the **regional tourism associations** ("Hochsteiermark" – the three main pillars are "montane"; "Leoben", "Erzberg Land") can support marketing.

4.4 CASE STUDY: REGION OF SAXONY

4.4.1 Funding Opportunities at a European level

This section requires the opportunities of funding, for the sector of M&M industry, e.g. Horizon 2020, LIFE etc. The following is an example of the European program of **Horizon 2020**:

Name of instrument	▪ Horizon 2020
Funding authority	▪ European Commission
General Objectives of the instrument	▪ Horizon 2020 is the biggest EU research and innovation programme, designed to help to achieve smart, sustainable and inclusive economic growth. The goal is to ensure Europe produces world-class science and technology, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering solutions to big challenges facing EU society.
Type of project	▪ Research and Innovation programme

4.4.2 Funding Opportunities at a National level

This section requires the opportunities of funding, for the sector of M&M industry, e.g. according to REMIX for Greece, one of the national funding instruments related to mining and metallurgy is **EquiFund**:

Name of instrument	▪ EquiFund
Funding authority	Co-financed by ▪ EU and national funds, ▪ EIF and the European Investment Bank (EIB) through the European Fund for Strategic Investments (EFSI). ▪ Private Sector
General Objectives of the instrument	▪ To foster the establishment and growth of start-ups knowledge-intensive companies from Universities, the researchers of this institutions but also indented private investigators who have nee of support for the commercialization of mature research results and innovative ideas ▪ To establish, in overall, a private equity and venture capital ecosystem for SME's
Type of project	▪ Equity funding platform

4.5 CASE STUDY: REGION OF KOŠICE

4.5.1 Funding Opportunities at a European level

The data that follow describe the funding opportunities **at a European level**.

Name of instrument	▪ Horizon 2020
Funding authority	▪ European Commission
General Objectives of the instrument	▪ Horizon 2020 is the biggest EU research and innovation program, designed to help to achieve smart, sustainable and inclusive economic growth. The goal is to ensure Europe produces world-class science and technology, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering solutions to big challenges facing EU society.
Type of project	▪ Research and Innovation program
Name of instrument	▪ KIC KAVA projects
Funding authority	▪ EIT Raw materials
General Objectives of the instrument	▪ Support of the research and development in the fields connected with the raw materials value chain
Type of project	▪ Research and Innovation program

4.5.2 Funding Opportunities at a National level

The funding opportunities at a National level consists of grants provided by Slovak Research and Development Agency, Environmental fund founded by Ministry of the Environment of the Slovak Republic and by Ministry of Education, Science, Research and Sport of the Slovak Republic. The different grant schemes have different areas of focuses: **APVV projects** are focused on **research and development**, **projects** subsidised by the Environmental fund are focused on **environmental projects** associated with the **remediation** of old environmental burdens, **VEGA projects** are focused on **science and research projects**.

Name of instrument	▪ APVV
Funding authority	Financed by ▪ Slovak Research and Development Agency
General Objectives of the instrument	▪ research and development in particular science and technology fields ▪ within the Agency's programmes ▪ within bilateral or multilateral contracts on scientific and technological cooperation and projects within the Slovak participation in international programmes of research and development and community programmes projects as well as initiatives of European Union in research and development including preparation costs
Type of project	▪ research and development projects
Name of instrument	▪ Projects subsidized by the Environmental Fund
Funding authority	Financed by ▪ Environmental fund founded by Ministry of the Environment of the Slovak Republic
General Objectives of the instrument	The main mission of the Fund is to provide funding to applicants in the form of grants or loans to support projects under activities aimed at achieving national environmental policy objectives at national, regional or local level.
Type of project	▪ environmental projects
Name of instrument	▪ VEGA
Funding authority	Financed by ▪ Ministry of Education, Science, Research and Sport of the Slovak Republic
General Objectives of the instrument	▪ The Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences (VEGA) is an internal grant system for the Ministry of Education and the Slovak Academy of Sciences. It proposes to the Minister of Education, Science, Research and Sport of the Slovak Republic and to the President of the SAS the amount of the subsidy to be provided for the solution of selected new and ongoing scientific projects from institutional funds.
Type of project	▪ science and research projects

Tools for support of **R&D**, resulting from available legislation are as follows:

1. State programs realized according to the Law No. 172/2005 Z. z. about organization of state support of research and development.
2. Agency for support of research and development (APVV) supports programs of research and development according Law No. 172/2005 Z. z. Programs of agency are approved by Slovakian government.
3. Stimulus for research and development are provided to businessmen in accord with Law No. 185/2009 Z. z. about stimulus for research and development with aim businessmen base their development and business aims on results of research and development, increasing of personal capacities in area of RaD, as well as increasing of investment volume to RaD. Stimulus are decisive tool for support of business sector.
4. Donation to legal and physical persons, provided according Law No. 172/2005 Z. z. are provided by central organs of state administration.
5. Donation to scientific and technical services according Law No. 172/2005 Z. z. can be provided from state budget for activities of business for RaD support. Provider can be also Slovakian academy of science or state help.
6. Tools from structural funds from EU are presently decisive source of RaD financing.

4.5.3 Funding Opportunities at a Regional level

Possibilities for obtaining of financial means for research and innovation development in area of RM: Košice self-governing region is not providing any additional funding in the fields of M&M.

4.6 CASE STUDY: REGION OF LOWER SILESIA

4.6.1 Funding Opportunities at a National level

Possible funding is available from the **National Fund for Environmental Protection and Water Management** (**NFEP&WM**). The NFEP&WM manages the EU funds as the Implementing Authority for five priorities, of the Infrastructure and Environment Operational Programme 2007-2013 (OPI&E) and for two priorities in OPI&E 2014-2020.

4.6.2 Funding Opportunities at a Regional level

Possible funds are available from the **Voivodeship Fund for Environmental Protection and Water Management**, as well as **Regional Operational Programme**. Activity of the Funds is ocused on financial support for projects aimed at environmental protection and respect for its values, based on the constitutional principle of sustainable development while maintaining the ecological security of the country and the implementation of ecological programs of the region. Among the main environmental priorities supported by the Fund are rational waste management and protection of the earth's surface, protection of biodiversity and ecosystem services, ecological education. The same applies to the National Fund described above.

Other opportunities arise from the **Regional Operational Programme** (2014-2020). The Regional Operational Programme of the Lower Silesia Voivodeship 2014-2020 administered by the Voivodeships Self-government is one of the 16regional programmes in Poland. The Program consists of 11 priority axes, within this 7 from the European Regional Development Fund and 4 from the European Social Fund.

4.7 CASE STUDIES: REGIONS OF ANDALUCIA AND CASTILLA Y LEÓN

4.7.1 Funding Opportunities at a European level

There are many examples of funding opportunities at **European Level** in Andalusia, some of them with public Administration (SGIEM) like, Horizon 2020 projects: MIREU, INFACT (Innovative, non-invasive and fully acceptable mineral exploration technologies), MINELAND (Mining and Land Use Planning) or ERDF POCTEP GEO_FPI (Transborder Observatory for geo economic development of Iberian Pyrite Belt) ERDF Restoration of Abandoned historic mining land, and some of them with other publics or private bodies: INTMET (Cobre las Cruces), NEMO (IDENER S.A.).

The accessibility to EU funding tools is possible but not easy, because of lack of information, difficulties on taking part of partnerships and consortium, e.tc., while the information about projects from industry and university or research bodies is unavailable.

4.7.2 Funding Opportunities at a National level

Andalucia

The **National Plan on Scientific** and **Technical Research and Innovation** runs from 2017 to 2020, and it is considered as different tools, so as to find innovation in mining industry. Other programmes from the National Government, are funding projects about safety and health in mining companies or landscape and waste deposits, restoration in abandoned mines, that do exist from 1982.

Castilla y Leon

The **Management Committee of INTERREG V** to Spain Portugal (POCTEP), funded by the **European Regional Development Fund** (ERDF), met in Faro, the 6th April 2017,and there the Committee agreed to grant ERDF of 1,888,879.80 € to project 0284_ESMIMET_3_E, being the **General Management of Energy and Mines** one of the beneficiaries (158,743.08 €).

The objective of the Project is to generate a network of scientific-technical knowledge and I+D+i around the development of the metal mining capabilities of the border strip between the 3 participating regions that allows:

The development of regional and joint activities, high value-added projects and initiatives in different areas of I+D+i (exploration, use and processing technologies, materials science, industrial and control technology, environmental and energy technologies) that allows the generation not only of strategic projects, but also the training of scientific-technical profiles of high added value, and the generation of high-skilled employment in the participating regions.

The General Management is also involved in the project **REMIX**

The project is part of the Interreg Europe program, which encourages the flow of experience and knowledge to improve regional development policies. It is aimed at public and private non-profit entities in Member States and focuses on four lines: research and innovation, competitiveness in SMEs, low-carbon economics and efficient use of the environment and resources.

4.7.3 Funding Opportunities at a Regional level

Andalucia

Andalucia' s Mineral Strategy 2020 takes into account the diverse funding lines for attracting investments (company creation or extension), as well the commercialization, internationalization, joint-ventures, and others, through the Agency for Development and Innovation of Andalucia.

Castilla y Leon

The aforementioned **Strategy for Mineral Resources of Castilla y León** 2017-2020 contemplates selective and deliberate support for mining projects, which is implemented through the **Institute for Business Competitiveness of Castilla y León**, which has also launched round tables with the approach related to the innovation ecosystem in the raw materials environment – mining:

Sustainable Land Use, Expanding the Mining Value Chain to the Transformation Industry, Legislation, Social Awareness, Innovative technologies, is near the Green mining?, Research and development in mining sector, where does the sector is focused to?, Circular economy, primary RM interaction in the loop, Business development, possibility of new business models, entrepreneurship?, Financial possibilities for Exploitation and R&I in mining sector (https://empresas.jcyl.es/web/jcyl/Empresas/es/Plantilla100/1284715318822/_/_/_).

Currently, funds are provided for projects to rehabilitate natural areas affected by coal mining, as well as for the creation of infrastructures that allow sustainable development of coal mining regions. On the other hand, training and advisory courses in mining safety are also subsidized.

4.8 CASE STUDY: REGION OF ALENTEJO

4.8.1 Funding Opportunities at a European level

Name of the instrument	Erasmus +
Funding authority	European Comission
General Objectives of the instrument (What kind of activities and objectives are funded from this instrument)	Erasmus+ is the EU's programme to support education, training, youth and sport in Europe. Its budget of €14.7 billion will provide opportunities for over 4 million Europeans to study, train, and gain experience abroad. Set to last until 2020, Erasmus+ doesn't just have opportunities for students. Merging seven prior programmes, it has opportunities for a wide variety of individuals and organisations. The Erasmus+ Programme shall contribute to the achievement of: • the objectives of the Europe 2020 Strategy, including the headline education target; • the objectives of the strategic framework for European cooperation in education and training (ET 2020), including the corresponding benchmarks; • the sustainable development of Partner Countries in the field of higher education; • the overall objectives of the renewed framework for European cooperation in the youth field; • the objective of developing the European dimension in sport, in particular grassroots sport, in line with the EU work plan for sport; • the promotion of European values in accordance with Article 2 of the Treaty on the European Union Specific issues tackled by the programme include: 1. Reducing unemployment, especially among young people 2. Promoting adult learning, especially for new skills and skills required by the labour market. 3. Encouraging young people to take part in European democracy 4. Supporting innovation, cooperation and reform 5. Reducing early school leaving 6. Promoting cooperation and mobility with the EU's partner countries
Type of projects (Research, development, Innovation, SME - support, education, coordination etc.)	Erasmus+ supports EU transparency and recognition tools for skills and qualifications – in particular Europass, Youthpass, the European Qualifications Framework (EQF), the European Credit Transfer and Accumulation System (ECTS), the European Credit System for Vocational Education and Training (ECVET), the European Quality Assurance Reference Framework (EQAVET), the European Quality Assurance Register (EQAR), the European Association for Quality Assurance in Higher Education (ENQA) – as well as EU-wide networks in the field of education and training supporting these tools, in particular the National Academic Recognition Information Centre (NARIC), Euroguidance networks, the National Europass Centres and the EQF National Coordination Points. In the field of higher education, Erasmus+ supports the following main Actions targeting cooperation with Partner Countries:

	• International credit mobility of individuals and Erasmus Mundus Joint Master Degrees (under Key Action 1) promoting the mobility of learners and staff from and to Partner Countries; • Capacity-building projects in higher education (under Key Action 2) promoting cooperation and partnerships that have an impact on the modernisation and internationalisation of higher education institutions and systems in Partner Countries, with a special focus on Partner Countries neighbouring the EU; • Support to policy dialogue (under Key Action 3) through the network of Higher Education Reform Experts in Partner Countries neighbouring the EU, the international alumni association, policy dialogue with Partner Countries and international attractiveness and promotion events; • Jean Monnet activities with the aim of stimulating teaching, research and reflection in the field of European Union studies worldwide. In the field of youth, Erasmus+ supports the following main Actions: • Mobility for young people and youth workers (under Key Action 1) promoting Youth Exchanges and mobility of youth workers in cooperation with Partner Countries neighbouring the EU; • Capacity-building projects in the field of youth (under Key Action 2) promoting cooperation and mobility activities that have a positive impact on the qualitative development of youth work, youth policies and youth systems as well as on the recognition of non-formal education in Partner Countries, notably in African, Caribbean and Pacific (ACP), Asian and Latin American countries; • Involvement of young people and youth organisations from Partner Countries neighbouring the EU in Youth • Dialogue Projects (under Key Action 3) through their participation in international meetings, conferences and • events that promote dialogue between young people and decision-makers. In addition, other Actions of the Programme (Strategic Partnerships, Knowledge Alliances, Sectors Skills Alliances, Collaborative Partnerships) are also open to organisations from Partner Countries in so far as their participation brings an added value to the project

4.8.2 Funding Opportunities at a National level

Name of instrument	PT2020 NOTICE No. 15 / SI / 2019
Funding authority	ERDF (European Regional Development Fund)
General Objectives of the instrument	• Increase corporate investment of large companies in activities innovations (product or process), reinforcing business investment in innovative activities, promoting the increase of tradable production and internationalization and changing the productive profile of the economic fabric through development of innovative

	solutions based on R&D results and technological development) and the integration and convergence of new technologies knowledge and the creation of qualified employment; • Strengthening SME entrepreneurship for the development of goods and services through business investment in innovative and contributing to its value chain progression.
Type of project	A) Creation of a new establishment; B) Increase of the capacity of an existing establishment, which shall increase corresponds to at least 20% of the installed capacity in relation to the pre project year. In this typology the company must increase its capacity production of goods and / or services already produced in this establishment; C) Diversification of production of an establishment for products not previously produced in the establishment and the eligible costs must exceed by at least 200% the book value of the assets that are reused as recorded in the fiscal year preceding the beginning of the works (2018); D) Fundamental change in the overall production process of an establishment existing (in this typology is not in the presence of new productions: goods or typology corresponds to a fundamental change in the overall process), eligible costs must exceed the amortization and depreciation of the assets associated with the process to be modernized during the three fiscal years (2016, 2017 and 2018).

4.8.3 Funding Opportunities at a Regional level

Name of instrument	Alentejo 2020 – Environment and Sustainability
Funding authority	ERDF (European Regional Development Fund)
General Objectives of the instrument	The axis Environment and Sustainability prioritizes: Preservation and protection of the environment and promotion of efficient use of resources
Type of project	Promotion of the cultural and natural heritage through an integrated approach, contributing to develop the tourism potential of the region (ERDF). Establish measures to improve the urban environment, to revitalize cities, to recover and decontaminate abandoned industrial areas, including conversion areas, to reduce air pollution and to promote noise reduction measures The typologies of contractual operations include: Programs and actions for the development of nature-related tourism, including digital content, digital platforms and specific marketing plans, based on natural resources and aimed at strengthening the internal and external visibility of the Classified Areas and the region, in articulation with the conservation of these resources

5. SWOT ANALYSIS

According to bibliography, SWOT Analysis constitutes a form of appraisal of the current position of an organization at a particular time, and also the future potential. It is an analysis' tool that is very helpful to determine and evaluate the strengths, weaknesses, opportunities, and threats of an organization, as it is represented by the initials of the word SWOT (www.oxfordreference.com).

The following diagram (**Figure 5.1.1**) represents the general information for **SWOT Analysis**:

	Helpful **to Achieving the scope**	**Harmful** **to Achieving the scope**
Internal Environment	Strengths Advantages of the MIREU Region, in relation to others	Weaknesses Disadvantages/Improvements needed to implement in the MIREU Region
External Environment	Opportunities Factors that could improve the situation of the MIREU Region	Threats Factors that could hamper the situation of the MIREU Region

Figure 5.1.1: Diagram of the SWOT Analysis, in accordance with www.wikipedia.gr

For the SWOT Analysis of each Region of interest, the examined factors have been analyzed initially through the general aspect, that provides data for the general framework of the Region. The specific data provide helpful information, for both possible options for the exploitation of the abandoned/closed mining sites (Mining Heritage and Reopening of Mines). Furthermore, at the next level of analysis, factors that might be helpful emphasizing on the Mining Heritage or the Reopening of Mines, are also presented.

The referred procedure will provide the most important **Strengths** (**S**), **Weaknesses** (**W**), **Opportunities** (**O**), and **Threats** (**T**), related to Mining Heritage and Reopening of Mines. Moreover, this analysis will be helpful for the understanding of the framework conditions for each Region, and it provides an orientation for the next actions/planning, that could be held. It's important to refer that the presentation of the strategies, from the combination of the above mentioned factors of SWOT Analysis (such as the **SO**, **WO**, **ST** and **WT**), are not presented at the specific deliverable, mainly because Regions are responsible for the decision-making, of one of the two referred aspects. In this deliverable there are presented only the factors that could be strategic for the decision-making.

5.1 SWOT ANALYSIS: REGION OF STEREA ELLADA

Based on the **Figure 5.1.1**, the main Strengths, Weaknesses as regards to the Internal Environment and the Opportunities and Threats in accordance with the External Environment, are represented on the next tables (**Table 5.1.1-5.1.4**). The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Sterea Ellada.

5.1.1 Strengths/Region of Sterea Ellada

As can be seen on the **Table 5.1.1**, Sterea Ellada' s general strengths are related to Region's position, human capacity, economy, environment, infrastructure, as well to administrative policies and funding opportunities.

Regarding to the strengths, it seems that the Region has achieved to maintain strong human capacity, as can be seen through the population perspective. At the same time, the key-position of Sterea Ellada in a country level, the proximity in the most significant logistic centers and harbors, as well the strong economic position related to metals, suggest advantages for the development of both mining heritage, or new mining industries.

Other advantages of the Region are the fact that it can be characterized by the transport accessibility, providing road and railway network, as well proximity through the ports (**Figure 5.1.3 & 5.1.4**), and the significant activity participating to many RES projects for engaging energy, so as to be autonomous. Furthermore, the participation of the Region in research programs and events, the presence of Environmental actions of Greek Mining & Metallurgy Industry and the land-use planning policies, suggest the regional development, and the booming of the two referred sectors.

Analyzing the aspect of Mining heritage, the components contributing in the development of the sector are the employment, the cultural and mining heritage, the environmental factor and the administrative policies. Specifically, the presence of large areas characterized as Natura 2000, and the geothermal fields (**Figure 5.1.2 & 5.1.3**), suggest advantages that can be helpful for the development of tourist activities. Other advantages of the Region, such as the presence of abandoned/closed mines, the strong mining history and other examples of good practices, and at the same time the huge potential of cultural background (archaeological sites, museums and monuments) constitute strengths of the Region of Sterea Ellada. Finally, the fact that administrative policies aim to strengthen the urbanization and the tertiary sector, constitute an advantage for the exploitation of Mining heritage.

Focusing on the re-opening of mines, the strengths of Sterea Ellada are related to economy, mining – processing – recycling sectors and to business activities. Moreover, another important aspect is the education capacity. In detail, the main job creator at the Region is the metal industry and M&Q activities, with the mining sector being characterized by the presence of unexplored areas and mineral differentiation, the willingness of the companies to invest in new technologies and the digitalization of the mining sites (**Figure 5.1.2**). Furthermore, the modernized metallurgical processes and technologies, and the fact that Sterea Ellada has potential of waste, suggest two more advantages of the Region for the Reactivation of mines. Finally, Sterea Ellada constitutes a region of great export position, characterized by the regional educational, research potential, and potential of other types of training, with proximity to the most important educational and research organizations. Mining companies and universities cooperating in R&D, is another strength of Sterea Ellada, helpful for the Reactivation of mines.

5.1.2 Weaknesses/Region of Sterea Ellada

As can be seen on the **Table 5.1.2**, Sterea Ellada' s general weaknesses are related to Region's human capacity, infrastructure, economy, environment and waste, and the perspective of education capacity, administrative policies, and social acceptance of the mining activities.

The main weaknesses of the specific Region, regarding the human potential, are related to the fact that the region's population is characterized by a high percentage of ageing people, with the social acceptance being neutral to negative, for the mining activities. Furthermore, another weakness for the Region's human capacity is related to the educational level and seems to be the absence of universities related to M&Q sector, a fact which could disempower the potential of the region to generate innovation and high-tech know how for the specific sector.

Regarding the infrastructure network, even though there is an extensive transportation network, this network is of low-quality, constituting a significant disadvantage of the Region (taking also into account the mountainous profile of the Region). Another important weakness for the exploitation of inactive mines either as Mining Heritage site or as re-opened mines is the difficulties for securing regional funding. Finally, the fact that the de-identification of the exploitation sites is not clear combined with the complexity of the mineral ownership, suggest two more disadvantages that could inhibit both potential uses of inactive mines.

Analyzing the factors related only to the exploitation of Mining heritage, the main disadvantage of the area is the closeness of the abandoned/closed mines to the active ones, that could hinder their exploitation through touristic activities.

On the other hand, the main weaknesses for the reactivation of mines, are mainly related to exploration, exploitation and recycling-recovery sectors. More specifically, the exploration of the biggest part of the area-exploitation of the greatest quantities of surface occurrences, as well the unknown extractive waste volume, suggest disadvantages for the development of the mining sector, in the Region of Sterea Ellada. Furthermore, there seems to exist conflicting interests with the agricultural sector (**Figure 5.1.4**). The social footprint of the environmental issues of this type of activities, that may result in the existence of toxic substances and hazardous elements in the waste, intense problems by industrial activity, degradation of landscape, and to large areas covered by waste, is another considerable weakness of the Region. The Region's previous bad history concerning

environmental problems created by industrial activities related to the Sector of metals (e.g. the contamination of Asopos river) consists one of the major fears for the Region's population. Finally, regarding the population aspect, the low-density of the Region is a weakness for the mining sector, mainly because it results in the absence of workforce for the mining activities.

5.1.3 Opportunities/Region of Sterea Ellada

Opportunities recorded in a country's level are mainly related to the education capacity and funding opportunities for Sterea Ellada (**Table 5.1.3**).

Specifically, the fact that Region of Sterea Ellada constitutes the Regional Center of Greece for the EIT Raw Materials is very helpful for the development of both potential uses of inactive mines. Furthermore, another aspect of the opportunities of the specific Region is the fact that it participates through NTUA in research programs such as REMIX, MIREU, as well in the industrial modernization platform, while at the same time local industries participate in EU funded R&D projects.

Emphasizing on the development of Mining heritage, facts that are very helpful for the exploitation of the inactive miens through touristic activities, is the presence of old mines, and monument of global importance, as well the uniqueness of the cultural sites. Furthermore, the presence of examples of good practices in Sterea Ellada, the fact that there are no plans/measures for supporting RM sector and the presence of activities for the promotion of tourism, cultural sites and naturalistic values of Sterea Ellada, constitute opportunities for the booming/strengthening of Mining heritage.

On the other hand, opportunities related to the reactivation of mines, are connected with the mining-processing-recycling sectors. The main ones are the presence of strong industries (and the related ones) around aluminium (mining, metallurgy, processing, recycling), nickel (mining, pyrometallurgy), and magnesite (mining, thermal processing), the high productivity position in a world scale, the presence of M&M and processing plants, and the strong aluminium processing and recycling industries.

Moreover, the presence of associations and clusters such as the Greek Mining Enterprises association (SME), the Hellenic Federation of Enterprises (SEV), the Technical Chamber of Greece, the EIT Raw Materials/ Regional Centre of Greece, and the upcoming National mineral strategy (including Special Spatial Plan for RM sector), constitute Region's opportunities. At the same time, the Region's proximity to educational and research organizations, constitutes another opportunity for the Reopening of mines.

5.1.4 Threats/Region of Sterea Ellada

Emphasizing on the threats for the Region of Sterea Ellada, the most important are connected with components such as economy, infrastructure, education, and with social acceptance and administrative policies (**Table 5.1.4**).

In detail, the economic factors that could be harmful for both the exploitation of Mining heritage and Reactivation of mines, are the unstable economy of the country, resulting in the decreasing of the National GDP, and could be creating concerns on the reliability of framework conditions and investment environment in Greece. Furthermore, the absence of infrastructures of good quality, in a country-level

(for example Greece has the lowest scores for performing cluster of countries for telecommunication) suggests a significant threat for the development of the Region.

Moreover, the results of the economic crisis inhibit the development of both potential uses of inactive mines, with the most important being the brain-drain, and the low human potential for the establishment of mining and tourism activities. The neutral to negative social acceptance of those actions by the society, and the lack of information about RM industry achievements and the environmental protection, suggest threats for both exploitation routes as well. Finally, administrative policies also create a negative context, mainly because of the absence of plans and measures for the supporting of RM sector, and the complexity of mineral ownership.

Focusing only on the factors related to the Reopening of mines, the main threats in country-level are the conflicting interests of mining with tourist and agricultural sectors and the reduced extroversion of the Greek, business activities. Finally, the national policies emphasizing in the promotion of tourist activities, and the Long and complex permitting procedures, contribute to the creation of negative climate for the re-establishment of mining activities.

Strengths/General Framework:

1. Position:
   - Key-position in a country-level
   - Proximity to logistic centers/harbors
2. Human capacity: Population perspective – 5.2% of the country's population
3. Economy factor: Strong economic position
4. Infrastructure:
   - Transport accessibility
   - Energy capacity – Active region for engaging RES projects
5. Environment factor: Environmental actions of Greek Mining & Metallurgy Industry
6. Administrative policies: Land use planning
7. Funding: Participation in Research programs and events

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Tourism activities - Dynamic tourism industry - Highest percentage of employment - occupation in tertiary sector
   - Mining heritage - Strong mining history - Presence of abandoned/closed mines - Good practises
   - Cultural background - Presence of archaeological sites, museums and monuments
2. Environment factor:
   - Presence of areas of Natura 2000 – Landscape
   - Water - Geothermy field of low enthalpy
3. Administrative policies: Strengthening of urbanization and tertiary sector

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
   Processing/Metallurgy X
2. Economy factor: Main job creator the metal industry and M&Q sector
3. Mining sector:
   - Exploration - Presence of unexplored areas
   - Exploitation – Mineral differentiation
   - RDI - Willingness to invest in New Technologies
   - Digitalisation – For geological sites
4. Processing: Technologies and expertise - Metallurgical processes and technologies
5. Recycling/recovery: Potential of waste - Opportunities for exploitation (SRM)
6. Business: Proximity to logistic centres/harbours - strong export position
7. Education capacity:
   - Regional Educational, Research potential, and potential of other types of training
   - Mining collaboration and university cooperating in R&D

Table 5.1.1: Strengths for the Region of Sterea Ellada

Weaknesses/General Framework:

1. Human capacity: Ageing population
2. Infrastructure: Quality of infrastructure (Low)
3. Economy factor:
   - Conflicting interests with agricultural sector
   - No Regional funds
4. Environment factor:
   - Existence of toxic substances and hazardous elements in the waste
   - Intense problems by industrial activity
   - Degradation of landscape
5. Waste: Large areas covered with waste
6. Education capacity: Absence of universities related to M&Q sector
7. Social concerns/acceptance: Neutral to negative
8. Administrative policies:
   - Not clearly de-identification of the exploitation sites
   - Complex mineral ownership

Factors related to Mining Heritage:

1. Cultural and Mining heritage: Mining heritage – Position/distribution of abandoned mines in close proximity to active

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
   Recycling and recovery X
2. Human capacity: Density population (Low)
3. Waste: Unknown extractive waste volume

Table 5.1.2: Weaknesses for the Region of Sterea Ellada

Opportunities/General Framework:

1. Education capacity: EIT Raw materials - Regional Center Greece
2. Funding:
   - Participation through NTUA (REMIX, MIREU)
   - Participation in industrial modernization platform, participation of local industries in EU funded R&D projects

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Mining heritage - Presence of old mines – Good practices
   - Cultural background - Uniqueness of cultural sites - Existence of monuments of global importance
2. Administrative policies: No plans, measures supporting RM sector - activities promoted tourism, cultural sites, nature

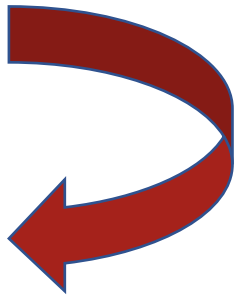
Factors related to Reopening of Mines:

1. Mining sector:
   - Current activity - Strong industry around Al (mining, metallurgy, processing, recycling) - Nickel (mining, pyrometallurgy) Magnesite (mining, thermal processing)
   - Production - Good position in a world scale
2. Processing:
   - Important MM and processing plants
   - Strong Al processing industry
3. Recycling: Strong Al recycling industry
4. Associations and clusters: Greek Mining Enterprises association (SME), Hellenic Federation of Enterprises (SEV), Technical Chamber of Greece, EIT Raw Materials/ Regional Centre Greece
5. Administrative policies: National mineral strategy, (upcoming Special Spatial Plan including RM)
6. Education capacity: Proximity to Educational and Research organizations

Table 5.1.3: Opportunities for the Region of Sterea Ellada

Threats/General Framework:

1. Economy factor:
   - Unstable economy
   - National GDP (Decrease)
   - Concerns/unreliable partner
2. Infrastructure: Low performing cluster of countries for telecommunication - internet factors (lowest scores)
3. Education capacity: Brain-drain due to economic crisis
4. Social concerns/acceptance:
   - Neutral to negative – distrust for the M&Q activities
   - Lack of information about RM industry achievements/environment protection e.tc.
5. Administrative policies:
   - No plans - measures supporting RM sector
   - Complex mineral ownership



Factors related to Reopening of Mines:

1. Economy factor: Conflicting interests of mining with tourist and agricultural sectors
2. Business: Reduced extroversion
3. Education capacity: Lack of experienced and skilled labor
4. Environment factor: Intense problems caused by industrial activity
5. Administrative policies:
   - Activities promoted – tourist activities
   - Long and complex permitting procedures

Table 5.1.4: Threats for the Region of Sterea Ellada

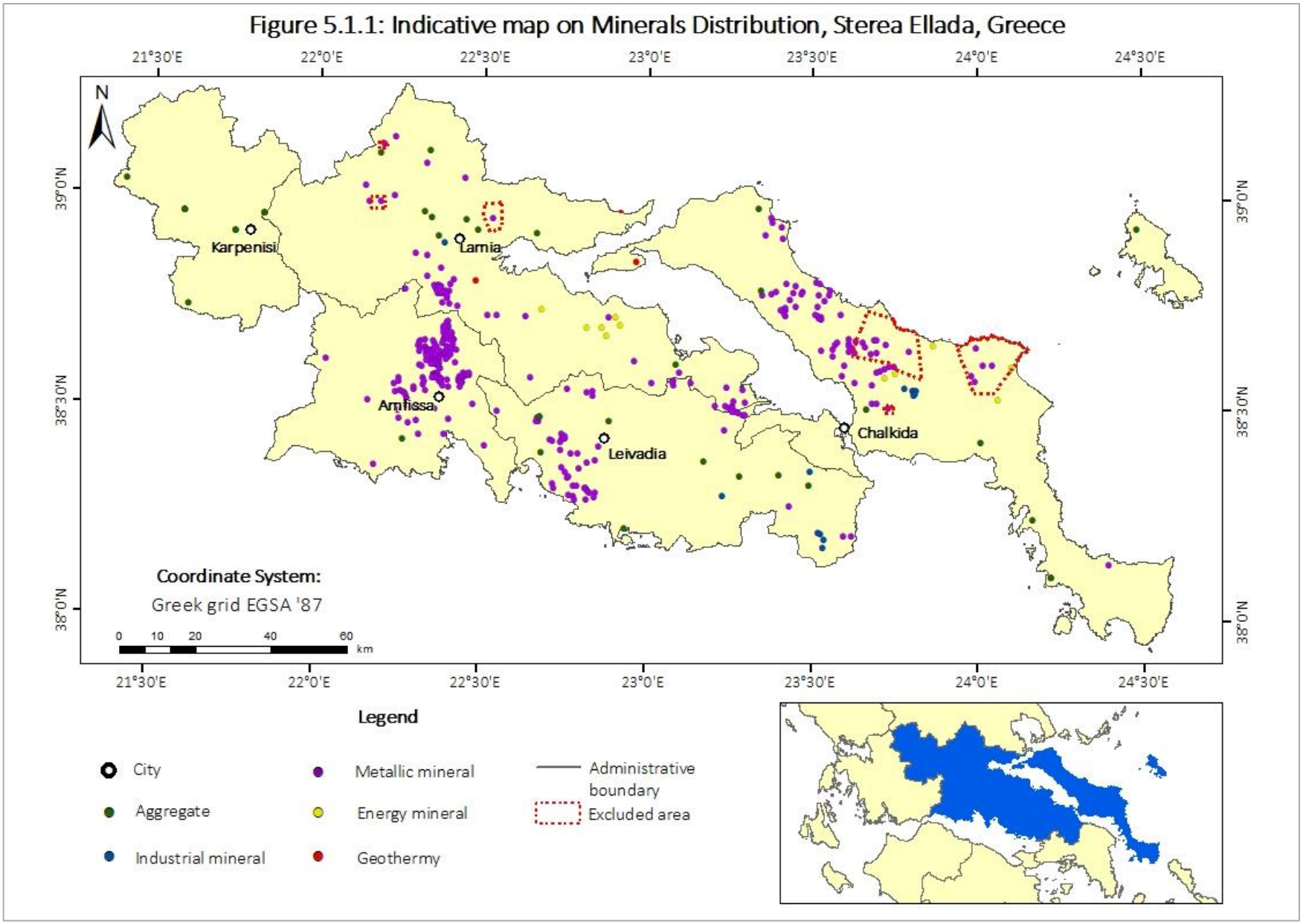


Figure 5.1.2: Indicative map on Minerals Distribution. Source: own work on the basis of: ec.europa.eu; geodata.gov.gr; land.copernicus.eu; www.diva-gis.org; ypeka.gr.

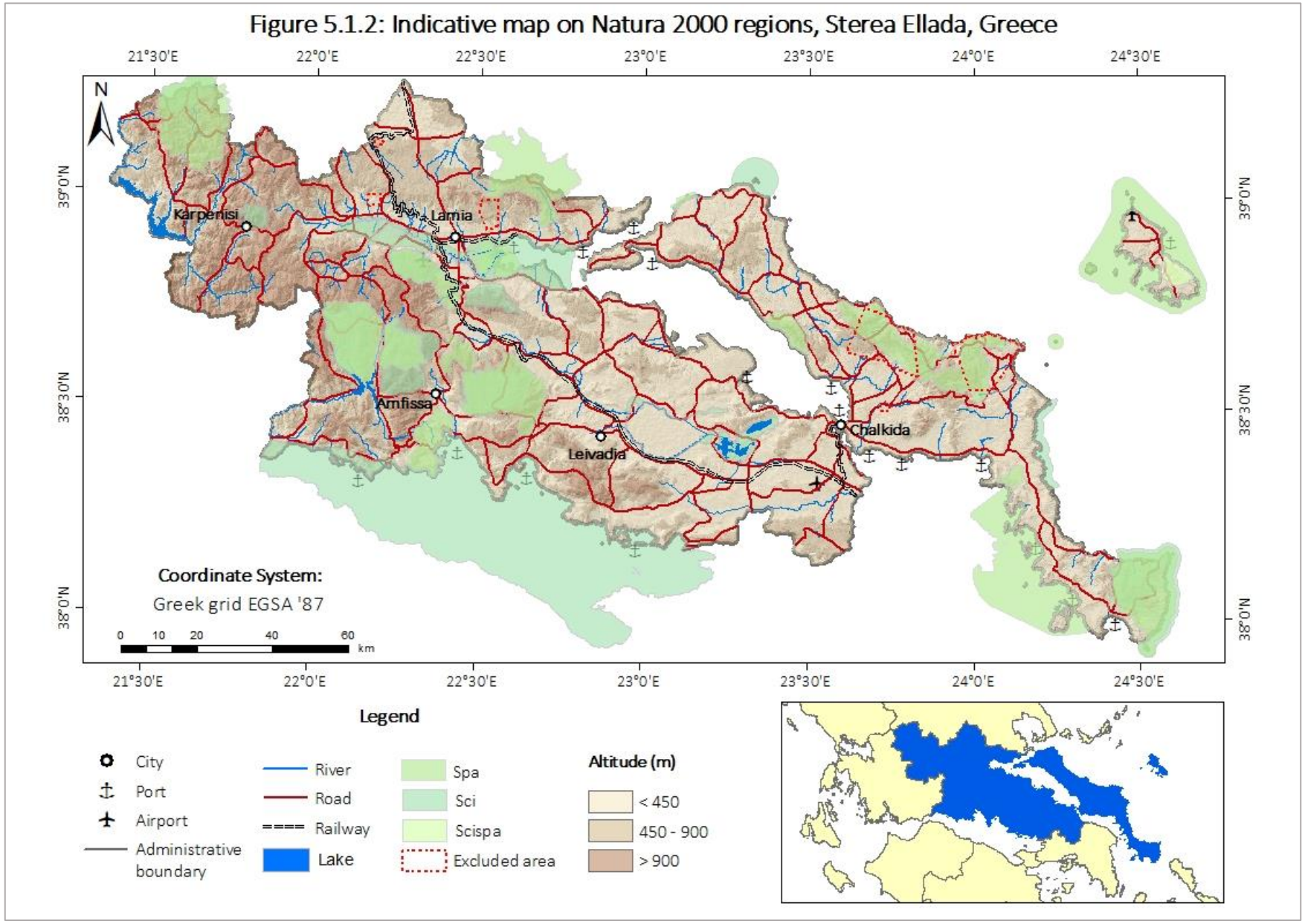


Figure 5.1.3: Indicative map on Natura 2000 regions. Source: own work on the basis of: ec.europa.eu; geodata.gov.gr; land.copernicus.eu; www.diva-gis.org; ypeka.gr.

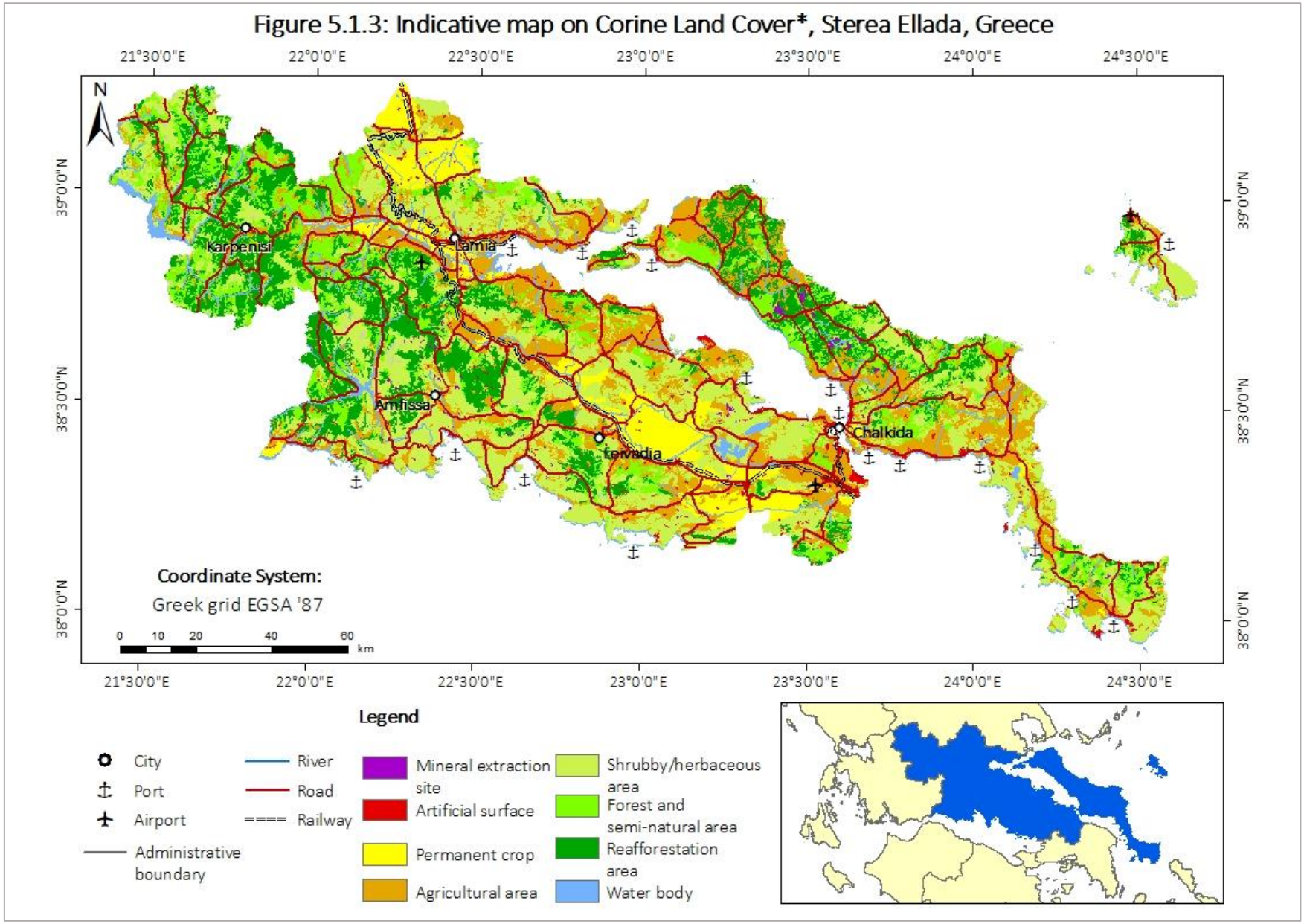


Figure 5.1.4: Indicative map on Corine Land Cover. Source: own work on the basis of: ec.europa.eu; geodata.gov.gr; land.copernicus.eu; www.diva-gis.org. (*representing CORINE Land Cover data for reference year 2018 in 100m resolution)

5.2 SWOT ANALYSIS: REGION OF NORTH KARELIA

Based on the **Figure 5.1.1**, the main Strengths, Weaknesses as regards to the Internal Environment and the Opportunities and Threats in accordance with the External Environment, are represented on the next tables (**Table 5.2.1-5.2.4**). The following data represent the most important factors, examined for the SWOT Analysis, for the Region of N. Karelia.

5.2.1 Strengths/Region of North Karelia

As can be seen on the **Table 5.2.1**, North Karelia's general strengths are related to Region's human capacity, employment, economy, infrastructure, raw materials life cycle, education capacity and social acceptance of the mining activities.

It seems that the Region has achieved to maintain strong Human Capacity since a decreasing trend for net migration rate can be observed, while at the same time the employment and unemployment rates are stable, resulting in societal stability. Furthermore, another advantage recorded in the N. Karelia, that could result in the development of both mining heritage or new mining industries, is the positive social acceptance of mining activities.

Another factor that can be considered as Strength for both exploitation routes of inactive mines, is the economic status of the Region where constant to increasing values for the economic indicators of Regional GDP and GDP per capita have been recorded, resulting in a good financial climate, appealing for new investments. The main advantage of the mines is their position, located mainly in the western part, resulting in the concentration of mining activities at a specific region. The good transport system of North Karelia which provides accessibility to capital cities, harbors or other important logistic points (through the road network, railway system e.tc.), along with the energy self-sufficiency (mainly because of the share of renewable energy) showcase the presence of very important infrastructure that can be considered as significant Strengths for both potential uses of inactive mines .

Focusing on mining heritage, the factors of existing cultural and mining heritage as well as the proximity with regions of high naturalistic value can contribute significantly in the exploitation of the sites. First of all, since the region is characterized by the presence of a number of abandoned/closed mines, the exploitation potential through Mining Heritage activities is evident. The strong mining history of N. Karelia which includes examples of good practices (such as Outokumpu Old Mine and Mining Museum) can further assist the development of such activities. Regarding the Region's cultural background, there are important, cultural monuments attracting tourists interested in enjoying nature and sports (eg. National Parks, skiing, hiking) or culture and music events. As for the environment factor, the area is characterized by the presence of Natura areas, which contribute to the reinforcement of tourist streams. It must be noted that the presence of touristic streams in the area is considered as a Strength for the Development of Mining Heritage sites mainly because the success and sustainability of such a site depends heavily on their ability to attract visitors. Therefore, if touristic streams are already available in a Region, it is simply a matter of marketing activities to turn the flow also towards the sites of interest.

Emphasizing on the potential of reopening mines, one important Strength of the Region is the prominent role of Raw Material Industries in the Economy of the Region. Thus, in North Karelia the mining industry constitutes the main job creator, the Region is characterized by the presence of unexplored areas, an increasing number of registered companies and by the analytics and processing exploration for extractive sector. N. Karelia presents also strengths regarding raw materials life cycle, related to the fields of exploration, exploitation and processing/metallurgy, for the metallic ore

commodities (include Cu, Zn, Co, Au, U and Ni, commodities) and the industrial minerals (including talc, dolomite and natural stone), indicating that there is a significant know-how related to mining and metallurgical activities. In the processing sector, the advantages are mainly the chemistry-related materials expertise and machinery - engineering workshop solutions. The fact that the Region possesses a significant technical know-how in Raw Materials can not only favor the creation of value chains but also become a significant strength for re-opening of inactive mines. Finally, the last but not least of the North Karelia Strengths regarding the option of re-opening of mines is the will of the Region to "invest" to the Raw Material sector (along with other compatible sectors) as indicated by the Strategic development plans for mining industry and the intertwining sectors of forest, metal and extractive industries.

5.2.2 Weaknesses/Region of North Karelia

According to the **Table 5.2.2**, weaknesses are analysed through the aspects of employment, economy, raw materials life cycle, as well education capacity, cultural and mining heritage and social acceptance, with the lack of mineral differentiation referred as a weakness for both potential uses of inactive mines. This happens mainly because the mineral differentiation means that there is a decreasing variety of RM for the Region (and for the production of product), and regarding the Mining heritage results in a "limited" geological framework.

One of the main Weaknesses of N. Karelia concerning the option of re-opening of mines, is related to the Education potential related to the Raw material Sector: the Region has a small number of Universities with subjects related to these Sectors, resulting in a low potential of experienced manpower in the mining sites. Regarding the Human Capacity of the Region, there seems to be a low percentage of people occupying in the M&Q sector, leaving to other industries, thus it would be difficult to supply the new industries with the necessary specialized workforce. The Weakness of the Region for the case of re-opening of mines is case specific for uranium mines: even though in general the social perception of mining is very positive, it seems that uranium mines had a very negative impact on social acceptance, thus any kind of activity related to this type of deposits will probably encounter strong opposition. Also, the mining potential has a lack of mineral differentiation, that also participates in the weaknesses of N. Karelia.

Focusing on the exploitation of mining heritage, there are two recorded weaknesses both related to the position of the inactive/ abandoned mines:

- at the western part of the area, the areas appear to be in close proximity to the active mining sites, thus their exploitation as Mining Heritage sites might be impeded
- The abandoned/inactive mines are sparsely distributed, therefore a holistic approach for their exploitation as Heritage sites might not be easily achieved.

5.2.3 Opportunities/Region of North Karelia

Opportunities recorded in a country's level are mainly related to the booming economy of the country, education capacity and funding (**Table 5.2.3**).

In detail, the economic indicators of National GDP and GDP per capita, are constant to increasing, resulting in a good economic climate. Furthermore, the area provides a high number of funding opportunities (such as Interreg Nord, Interreg Botnia-Atlantica e.tc.) and RDI access to EU's structural funds, constituting opportunities for both the development of projects related to reopening of mines and mining heritage activities.

Regarding the re-opening of mines, opportunities for the Region of North Karelia might arise as component of education capacity: the high percentage of graduates, the presence of Universities and Training centers in mine specialization programs and Vocational Training, related to M&Q, and the co-operation between mining companies, and Universities, constitute opportunities in a country's level, for the reinforcement of mining activities. The technical know-how can be further enhanced by the significant education capacity of the region, attributed to the closeness to important Universities.

Furthermore, the component of reopening of mines, includes opportunities, with the main parameters/components being mining resources and context, processing procedure, social acceptance and administrative policies, as analyzed in the Table. In detail, N. Karelia's mining sector that constitutes a strength for the economy, includes an important mining potential, characterized by advanced exploration projects for metallics. The growth of export turnover, the presence of processing Industries, projects, service providers and technology companies for specific equipment for M&M, suggest opportunities for the reactivation of the mines, mainly because of the highly specialized climate/context created for RM sector. Moreover, the social license and political will to M&M, the administrative policies (such as the National Mineral Strategy and Plan, the promotion of M&M through the Regional Strategy, the ongoing Regional Strategy for Extractive Industry, the active Regional Management, the innovation experiences (e.g. EDP) and the Regional Administration in EU projects and platforms), suggest opportunities that contribute to the uniqueness of the specific Region, and the reactivation of the mining activities at several mining sites. Finally, the presence of National and Suprarregional associations and cluster, supports actions of reopening.

Emphasizing on the mining heritage, the parameters that could consist an opportunity for North Karelia is the presence, in a country level, of reputable old mines, of museums of global importance, as well the high number of exhibitions related to M&Q field. In this aspect North Karelia would be facilitated in placing in the map of Finland's Mining Heritage, the North Karelia Mining Heritage sites and can benefit from the country's promotion on this subject.

5.2.4 Threats/Region of North Karelia

In the Region of N. Karelia have been recorded conflicting interests between the mining industry and the tourist activities, consisting a threat for the growth of mining activities, in general. Apart from the conflicting interests, the fact that there is a lack of graduates highly specialized in the field of geosceinces, because it is not considered necessary, constitutes a threat for the development of activities related to mining, as well (**Table 5.2.4**).

In terms of economy, even though by the provided data it is indicated that the economic environment is stable and appealing for investments, a decreasing trend for the GVA indicator (which an economic productivity measure) has been recorded. This indicates that the economy is less dependent to production and there seems to be a turn towards the supply of services or other economy sectors.

Emphasizing on the reactivation of mining sites, **Table 5.2.4** indicates the most important threats, with one of them being related to the associations and clusters. Despite the fact that there are important associations and clusters, the mining cluster activity is characterized as weak. The slow turnover growth rate and the weak mining cluster activity, are also factors that have a negative impact on the development of the sector, including the possibility of re-opening of old mines. Finally, the lack of territorial approach and land use planning at the National Mining policy constitutes a disadvantage in a country's level, for the growth of mining sector, including the re-opening of mines.

Strengths/General Framework:

1. Human capacity: Net migration rate (Decrease)
2. Employment:
   - Employment rate (Constant)
   - Unemployment rate – Youth Unemployment (Constant)
3. Economy factor:
   - Regional GDP and GDP per capita (Constant to Increasing)
4. Infrastructure:
   - Transport accessibility
   - Energy capacity - self-sufficient - share of renewable energy
5. Mining sector:
   - Position - distribution mainly on the western part
   - Exploration - new potential mining sites for metals and industrial minerals
6. Social acceptance : Public perception toward mining positive

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Tourism activities - Helpful type of tourism
   - Mining heritage - Strong mining history – Presence of abandoned/closed mines - Good practises
   - Cultural background - Presence of cultural monuments
2. Environment factor: Presence of National reserves, parks and areas characterized as Natura 2000

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
   Processing/Metallurgy X
2. Economy factor:
   - Main job creator the metal industry and M&Q sector
   - Intertwining sectors: forest, metal and extractive industries
3. Mining sector:
   - Presence of unexplored areas
   - Number of registered companies (increase)
   - Analytics and processing exploration for extractive sector
4. Processing:
   - Chemistry-related materials expertise
   - Machinery – engineering workshop solutions
4. Administrative policies: Strategic development plans for mining industry

Table 5.2.1: Strengths for the Region of North Karelia

Weaknesses/General Framework:

1. Mining sector: Lack of mineral differentiation

Factors related to Reopening of Mines:

1. Social acceptance: Negative (related to the uranium mines)
2. Employment: Percentage occupying with M&Q sector (low)
3. Education capacity: Number of universities in the region (small)

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Mining heritage:
     Position/distribution of abandoned mines in close proximity to the active - western part
     Sparsely distribution all over the region

Table 5.2.2: Weaknesses for the Region of N. Karelia

Opportunities/General Framework:

1. Economy factor:
   - National GDP and GDP per capita (Constant to Increasing)
2. Funding:
   - Interreg Nord, Interreg Botnia-Atlantica (European level), access to funds through nat. Business Finland and other funding opportunities (National and Regional level)
   - RDI access to EU's structural funds

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Mining heritage - Presence of old mines
   - Cultural background - Existence of museums of global importance - Exhibitions related to geology e.tc.

Factors related to Reopening of Mines:

1. Mining Resources:
   - Current activity - Strong Mining sector
   - Advanced exploration projects for metallics
   - Important mining potential
2. Mining context: Market – Growth of export turnover
3. Processing:
   - Processing Industries and Projects
   - Presence of Service providers – Technology companies provide equipment for MM
4. Education capacity:
   - Percentage of graduates (High)
   - Presence of Universities, Training centres, Mine specialization programs and Vocational Training, related to M&Q - Closeness to Universities
   - Co-operation between Mining companies, and Universities
   - Closeness to important Universities
5. Social acceptance: Social license and political will to MM
6. Administrative policies:
   - National Mineral Strategy and Plan
   - Development Strategies: Promotion of MM, Reg. Strategy - In prep. Reg. Strategy for Extractive Ind. - Active Reg. Management - Innovation experiences (e.g. EDP) - Reg. Admin. in EU projects and platforms)
7. Associations and clusters: National and Suprarregional associations/cluster supporting MM

Table 5.1.3: Opportunities for the Region of North Karelia

Threats/General Framework:

1. Economy factor:
   - Trend of GVA (Decrease)
   - Conflicting interests of the mining with tourism sector
2. Education capacity: Lack of graduates highly specialized in geosciences

Factors related to Reopening of Mines:

1. Business:
   - Not self-sufficient – Dependent on imports of energy and raw materials
   - Turnover growth rate (slow)
   - Weak mining cluster activity
   - Ownership – Need for development
2. Employment:
   - Percentage occupying with M&Q sector (Low)
   - Percentage of employees leaving to other industries
   - Number of employees occupying in the M&Q sector (Decrease)
3. Administrative policies:
   - National mining policy - lack of territorial approach
   - Land use planning - limitations for extractive operations – unexploited mining sites (rehabilitated)
   - Permitting procedures – long and complex procedures
4. Associations and clusters: Weak mining cluster activity

Table 5.2.4: Threats for the Region of N. Karelia

5.3 SWOT ANALYSIS: REGION OF LAPLAND

Based on the **Figure 5.1.1**, the main Strengths, Weaknesses as regards to the Internal Environment and the Opportunities and Threats in accordance with the External Environment, are represented on the next tables. The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Lapland.

5.3.1 Strengths/Region of Lapland

As can be seen in the Table, the main strengths of Lapland, affecting both exploitation routes for inactive mines are related to factors such as position, employment, economy, infrastructure, raw materials life cycle, education capacity, and the parameter of social acceptance.

As indicated by the provided data, the Region of Lapland has a key-position in Finland, being in close proximity to the largest urban centers and logistic hubs of the country, thus offering security benefits and providing Finland with an alternative to trade via the Baltic Sea. Regarding the Region's infrastructure, Lapland possesses an organized, transport system, which consists a strong asset for both types of exploitation either by facilitating the accessibility of the general public to the Mining Heritage sites or by facilitating the transportation of produced materials. Furthermore, the area is characterized by the abundance of energy sources, utilizing a plenty of hydropower, local wood fuels, peat and waste liquor from forest industry, rendering the attraction of new investments very appealing in terms of energy availability.

The economy of the Lapland is characterized by an increasing trend, with the Regional GDP and GDP per capita, presenting constant to increasing values, while in general the employment rate of Lapland region indicates an increasing trend. This fact outlines a flourishing economy which can be financially attractive for new investments. Furthermore, one of the most important Strengths for Lapland, for both Mining Heritage exploitation or re-opening of inactive mines, seems to be the fact that the most important developments in economy are attributed to the sectors of mining and tourism achieving a relatively positive outlook for industries by the society.

On the one hand, focusing on the indicators related to the exploitation of inactive mines as mining Heritage sites, it appears that the fast-growing sector of tourism could assist with the visitor streaming and the sustainability of this type of sites. The current touristic capacities of Lapland includes the presence of museums in the region and the large number of exhibitions related to M&Q sector, as well the presence of National parks and reserves, widerness areas which also provide a great attraction for the region of Lapland. Finally, the good practices referring for the region, could be implemented for the abandoned/closed mines.

On the other hand, regarding the reopening of mines, strengths that have been recorded for Lapland, are related to exploration and extraction activities, as well as to business and employment sectors. The presence of exploration projects, the increasing production volume of mines, the intertwining sectors of wood processing and M&Q sector e.tc. are some of the strengths recorded for the region, constituting helpful factors for the re-opening of mines, since they indicate that the Region possesses a significant technical know-how.

European Commission
This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 776811

5.3.2 Weaknesses/Region of Lapland

According to the Table, weaknesses are analysed through the aspects of human capacity, employment, economy etc.

Regarding the human capacity, region of Lapland has only the 3.4% of the total Finland's population, characterized by an increasing net migration rate. As for infrastructure (helpful for both exploitation of mining heritage and mining sector), the high costs of the development of the transportation system and the oppositions of the Sami for the development of infrastructure, consist a weakness of the specific region.

As for the aspect of mining heritage, the high mining potential of the region, and the position of abandoned mines close to the active ones (for the western part of the country), recommend weaknesses for the region of Lapland. On the other hand, factors related to the economy, the environment and employment, constitute weaknesses for the development of mining sector. Specifically, the decreasing turnover and the conflicting interests of the mining sector with the touristic sector, as well the low percentage of people occupying on the M&Q sector, are disadvantages for the region of Lapland. Finally, the presence of projects in close proximity to Natura 2000 (e.g. Sakatti project next to Natura 2000 Viikinkiaapa wetland area) is a significant obstacle for the exploitation of M&Q. Finally, regarding the human capacity, the low-density population consists a weakness, mainly because of the fact that results in the absence of workforce for the mining activities.

5.3.3 Opportunities/Region of Lapland

The recorded opportunities in a country's level are related to Finland's booming economy (constant to increasing National GDP, GDP per capita) and the high percentage of total turnover of the M&Q sector (in national level) which constitutes the country a promising destination for international investments. Within this economic development frame, Lapland can find the Opportunity in attracting more international investors in the Region. Apart from the economy indicators, Finnish society seems to have a positive outlook for the M&Q sector, therefore both exploitation types for the inactive mines could receive a positive reception by the Finnish public, thus be assisted in terms of development and sustainability. Finally, other opportunities for both exploitation of Mining Heritage or re-opening of mines are in relation to Finland's administrative policies (e.g. Mineral Strategy and Action Plan, Industrial Strategy of Lapland 2030) that could potentially set the right framework conditions for further development. the presence of universities, related to the M&Q sector, constitute advantages for the growth of both mining heritage and industry, as well the infrastructure network, mainly because it is subject to several major infrastructure development plans (regarding railway), that will be profitable in itself, and it could be used to transport minerals and other products..

Focusing on the opportunities for the exploitation of mining heritage, the high potential of old mines, museums of global importance and exhibitions for fields such as geology and mining, are the main recorded advantages in a country level.

European Commission
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On the other hand, for the option of reopening of mine, the fact that the region is characterized by the presence of the biggest mines in a country and EU level (largest operating gold mine, the only operating chromium mine in EU), the existence of new exploration permits, and the high mining potential of the region, constitute opportunities of the region, in relation to the external environment, mainly because it is an area that could be potentially of paramount interest for the mining sector. Another advantage for Lapland, appears to be the closeness to important centers of education, research and education institutes, providing graduates with educational background, helpful for the growth of mining activities. Finally, as can be seen on the **Table 5.3.3**, in the advantages of the area participate factors such as the mining resources and context, business and processing, employment etc., that differentiate the region and the country of Finland from the external environment (country and EU level respectively).

5.3.4 Threats/Region of Lapland

The threats that the Region of Lapland is facing concerning the exploitation of inactive mining site either as Mining Heritage sites or as re-opened seem to be related to certain economical aspects, educational specialization in country level as well as to the environmental aspect.

Specifically, analyzing the Lapland's economy, the main disadvantages regarding the external environment are the exports and imports, the share of those activities of the national private companies was 80% and foreign companies 15%, which is the lowest in Finland.

Another threat for the region of Lapland, is the lack of graduates, that will be highly specialized in geosciences, resulting in the limited workforce, with the specific, educational background, so as to be employed in the mining sites. Furthermore, regarding the environmental aspect, the wastes and the emission related to the mining activities, if not dealt with efficiently, might become an eminent threat to future mining activities including the re-opening of mines. As indicated in the sections above, a Sector that contributes significantly to Lapland's economy is tourism. Tourism for Lapland is associated with high naturalsitc values and any activity that could depreciate natural landscape is expected to generate significant opposition. Focusing only on the factors that could be potentially threats for the reactivation of mines, there are many threats for the region of Lapland, such as the lack of reconciliation with Sami culture issues, the need for automation procedures e.tc.

European Commission
This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 776811

Strengths/General Framework:

1. Position:
   - Key-position in a country-level
   - Proximity to logistic centers/hubs
2. Employment: Growth of employment rate
1. Economy factor:
   - Regional GDP (Increase)
   - GDP per capita (Increase)
   - Largest growth for the sectors of mining and tourism
2. Infrastructure: Energy capacity - Abundance of energy sources
3. Education capacity¨Presence of educational institutes
   For vocational education (High), research institutes
4. Social acceptance: Positive

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Tourism activities – Fast growing sector
   - Mining heritage:
     Strong mining history - Presence of abandoned/closed mines - mainly closed metal mines – Good practices
     Close proximity to each other - high density
   - Cultural background - Presence mainly of museums - High number of exhibitions related to M&Q field
2. Environment factor: Presence of areas characterized as Natura 2000, National parks and reserves, widerness areas

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
   Processing/Metallurgy X
2. Mining sector:
   - Exploration – Presence of exploration projects
   - Extraction – Production volume of mines (Increase)
   - Intertwining sectors: wood processing and mining sector
3. Mining Resources: New projects - permit application stage
4. Business:
   - Exports - Key-position of ports - vital for exports and imports
   - Growth of export turnover in M&Q
   - Concentrated heavy industry
5. Employment:
   - Mining operations – formulation of demographic structure
   - Growth of the percentage of employment

Table 5.3.1: Strengths for the Region of Lapland

Weaknesses/General Framework:

2. Human capacity:
   - Percentage of population (3.4%)
   - Number of residents (Decrease)
   - Net migration rate (Increase)
3. Infrastructure:
   - Development plans – high costs
   - Opposition from local communities (e.g. Sami)

Factors related to Mining Heritage:

1. Mining sector: Mining potential (active mines)
2. Cultural and Mining heritage: Mining heritage – Position/distribution of abandoned mines in close proximity to active ones- western part

Factors related to Reopening of Mines:

1. Economy factor:
   - Percentage of turnover (Decrease)
   - Conflicting interests with touristic sector
2. Environment: Projects close to areas of Natura 2000
3. Employment: Percentage occupying with M&Q sector (Low)
4. Human capacity: Density population (Low)

Table 5.3.2: Weaknesses for the Region of Lapland

Opportunities/General Framework:

1. Economy factor:
   - National GDP (Constant to Increasing)
   - GDP per capita (Constant to Increasing)
   - Percentage of total turnover (High
2. Infrastructure: Development plans (continuous) - commercial passage
3. Administrative policies:
   - Mineral Strategy and Action Plan
   - Industrial Strategy of Lapland 2030
4. Social acceptance/concerns: General social acceptance for MM
5. Education capacity: Presence of Universities related to M&Q sector

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Mining heritage - Presence of old mines
   - Cultural background - Existence of museums of global importance - Exhibitions related to geology e.tc.

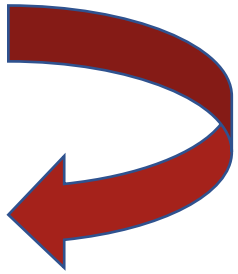
Factors related to Reopening of Mines:

1. Mining sector:
   - Positive outlook – many exploration permits
2. Mining Resources:
   - Current activity - Strong Mining sector – Biggest mines
   - Important mining potential – EU CRM potential – uniqueness of mines
   - Exploitation – Improved infrastructure
   - RDI – Funding from companies to Universities
3. Mining context: Markets – Growth of turnover from exports
4. Business: New companies/activities - Number of registered companies (Increase)
5. Processing:
   - Processing industries - Percentage of manufacturing (High)
   - Service providers - Percentage of mining support service activities (High) - Global provider of equipment and technol.
6. Employment: Presence of skilled workforce
7. Associations and clusters: Leadership of the European Industrial Modernization platform (Lapland)
8. Sustainability: Model region - sustainable processing in natural resource
9. Education capacity: Proximity to important centres of education

Table 5.3.3: Opportunities for the Region of Lapland

Threats/General Framework:

3. Economy factor: Share of export and imports (Low)
4. Education capacity: Lack of graduates highly specialized in geosciences
5. Environment: Need for limitation of emissions – wastes



Factors related to Reopening of Mines:

1. Economy factor: Main sectors of activity - manufacturing
2. Mining Resources: Low-grade or deep-seated deposits
3. Mining context: Markets - Volatility in the demand/value of mineral resources
4. Business:
   - Not self-sufficient – Dependent on imports of energy and raw materials
   - Turnover growth rate (slow)
   - Op. costs – Need for automation procedures
   - Labour costs - Water and energy consumptions (High)
   - Weak mining cluster activity
   - Ownership – Need for development
5. Employment:
   - Percentage occupying with M&Q sector (Low)
   - Percentage of employees leaving to other industries
   - Number of employees occupying in the M&Q sector (Decrease)
6. Administrative policies:
   - Nat. mining policy - lack of territorial approach
   - Land use planning - limitations for extractive operations – unexploited mining sites (rehabilitated)
   - Permitting procedures – long and complex procedures
7. Social acceptance: Reconciliation issues (e.g. with culture of Sami)

Table 5.3.4: Threats for the Region of Lapland

5.4 SWOT ANALYSIS: REGION OF STYRIA

Based on the **Figure 5.1.1**, the main Strengths, Weaknesses regarding the Internal Environment and the Opportunities and Threats related to the External Environment, are represented on the next tables. The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Styria.

5.4.1 Strengths/Region of Styria

As can be seen on the **Table 5.4.1**, the main Strengths recorded for the Region of Styria are related to employment, economy, infrastructure, as well to social acceptance and funding opportunities.

According to the provided data, it seems that the Region has achieved to maintain high level of employment, while at the same time, the Region's economy is characterized by an increasing trend. Emphasizing on the infrastructure network of the Region, Styria exhibits good transport accessibility, through the presence of highways and railway, providing connection to all major Austrian and Central European cites. Moreover, another Strength related to the position of the district of Leoben the fact that it is situated in the center of the tetragon of the 4 major Austrian cities: Graz – Salzburg – Linz– Wien/Vienna.

Another advantage of the Region of Styria is related to the energy capacity, and specifically to the high percentage of use of renewable energy at the Region. Furthermore, other positive aspects of Styria that could become assets for the deployment of r projects related to both the exploitation of Mining heritage and the Reactivation of mines, are the positive social acceptance and the presence of funding opportunities, at a European, National, and Regional level. Finally, the accessibility of M&M sector at the European Regional Development Fund (ERDF), could prove to be beneficial for the development of the sectors of interest.

Focusing on the field of Mining heritage, the fact that the tertiary sector contributes to the GVA for the State of Styria the highest percentage combined with an observed increase of the GVA for the tertiary sector at the specific Region, constitute a Strength of the Region, for the exploitation of mining sites, for touristic activities, Other aspects that could potentially be proven to be assistant to the development of Mining heritage sites , are the strong, regional mining history, the presence of mining monuments and remains, as well as M&M museums and historical sites that consist areas of good practices at Styria. All this important mining heritage background is further enhanced by the easy accessibility to the mining sites of the Region. Finally, the presence of areas of high naturalistic value, in close proximity to old mining areas, could be helpful for the booming of tourism activities, since they could potentially assist to the concentration of visitors. The fact that there are already in place promotional activities related to M&M sector, combined with a high percentage of tourists that stay more than one night higher constitute factors that could beneficial for the development of activities related to Mining heritage.

Emphasizing on the Styria' s mining sector, positive aspects that could promote the reactivation of mines, is the fact that the metal mining consists one of the main job creators at the specific area, and it also supports and other branches of the Regional economy. Moreover, the production of metallurgical products, the high potential for mining-related/metallurgical/downstream activities, the presence of companies for mining services, and industries and value chain, related to ore, in combination to the exporting activities of specific minerals, suggest Strengths of the Mining sector for the Region of Styria. Regarding the associations and clusters of Styria, the networking potential on R&D

and the establishment of SME companies, are advantages for the development of Mining sector. Finally, regarding the education capacity of Styria, it provides a good climate for the development of mining activities, and the creation of a skilled workforce that could potentially supply the appropriate human capacity for those activities.

5.4.2 Weaknesses/Region of Styria

As can be seen on the **Table 5.4.2**, Styria' s general weaknesses are related to Region's human capacity, energy capacity, and social acceptance of the mining activities.

In detail, the decreasing trend of the number of inhabitants at the Region of Styria, in combination to the increasing trend of net migration rate, and the decrease of the number of youth population (increase of the number of ageing population), suggest a weakness of the Region's human capacity. Furthermore, another negative aspect related to society, the social acceptance is characterized as negative in some cases of metallurgy activities, while the lack of awareness about the need for RM assists also for a negative pre-deposition for the development of projects both for Mining heritage and Re-opening of mines.

Focusing on the Re-opening of mines potential, the identified weaknesses are mainly related to the fact that there is a decrease for the economic factor of GVA, related to secondary sector, as well there is a small number of large-sized registered companies with a, related to M&M. Furthermore, the small number of registered mines at the Region, and the limited potential through the geological aspect, as well the limited chances of mining activities, the exhaustion of deposits (e.g. for Erzberg mine), and the strong dependency on the industry, in combination to the absence of mining potential, suggest weaknesses for the development of new Mining projects such as the re-opening of existing mines .

Finally, the scarce workforce by the decreasing population of the area, and at the same time the presence of areas of high, naturalistic value in close proximity to the old/abandoned/closed mines of the Region, consist disadvantages for the potential Reopening of these sites.

5.4.3 Opportunities/Region of Styria

Opportunities recorded in a country's level are mainly related to the employment, economy, funding opportunities and social acceptance of Styria (**Table 5.4.3**).

More specifically, the high employment rate at a country level, the increasing trend for the economic indicator of National GDP, the presence of European and National funds, and the general positive social acceptance regarding to M&M sector in combination to the RM communication efforts towards the society, suggest opportunities for the development of either Mining Heritage site or the re-opening of mines for the Region of Styria. .

Focusing on factors beneficial for the development of Mining heritage sites, the increasing trend of GVA, in relation to the tertiary sector (regarding the country of Austria), the presence of areas of high naturalistic value, protected by UNESCO, in close proximity to the old mines, as well the presence of awarded mining traditions of UNESCO e.tc., suggest opportunities for the exploitation of the mining sites, as touristic fields.

Emphasizing on the aspect of mining sector, the main, recorded opportunities at the Region are the strong mining sector, with the outstanding Fe Erzberg, that constitutes the unique iron mine at the area of Central Europe. Moreover, the fact that Styria is an important producer in a world-scale, for the

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production of metallurgical products (specifically for crude steel), suggest another opportunity of the Region. At the same time, the highly skilled workforce, in the sector of metallurgy constitutes an advantage of the Region, in comparison to the other Regions of Austria.

Another opportunity that differentiates the Region of Styria from the other Regions of Austria's country, is related to the education capacity of Styria. Specifically, the presence of the Word-renowned university of Leoben, as well the presence of the only technical high school, related to M&M, consist opportunities for the development of the educational background of the students, and for the development of mining sector. Finally, the existence of the Regional Development Strategy, providing support to metallurgy sector, could be beneficial for the interests of the M&M sector.

5.4.4 Threats/Region of Styria

Emphasizing on the threats for the Region of Styria (**Table 5.4.4**) about the Reopening of Mines, the most important connected with components are the mining sector and administrative policies. In detail, the fact that the mining sector is characterized by dependence on global market prices, is a negative aspect for the development of the mines, through the aspect of the exploitation of the geological potential. Finally, for the administrative policies, the fact that the land use planning has high environmental regulations, as well the fact that the activities promoted show a preference for activities conflicting with the mining sector, and at the same time the absence of master plans, are threats for the booming of the mining sector.

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Strengths/General Framework:

1. Employment: Rate of employment (High)
2. Economy factor:
   - Regional GDP and GDP per capita (Increase)
3. Infrastructure:
   - Transport accessibility – presence of highway and railway – well connectivity
   - Energy capacity – Use of renewable energy
4. Social acceptance/concerns: Positive social acceptance
5. Funding:
   - Presence of regional funds
   - M&M sector access to European Regional Development Fund

Factors related to Mining Heritage:

1. Economy factor: GVA of tertiary sector (Increase – High values)
2. Cultural and Mining heritage:
   - Tourism activities – Promotion events for M&M industry - type of tourists
   - Mining heritage - Strong mining history – Outstanding Iron Route - Preservation of Mining heritage – Presence of mining monuments and remains, M&M museums and historical sites - Good practises – easy access
3. Environment factor: Presence of areas of high naturalistic value – proximity to old mining areas

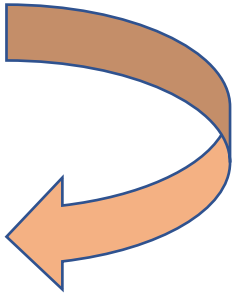
Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploitation X
   Processing/Metallurgy X
2. Economy factor: Main job creator at the specific cities – base of economy metal mining
3. Processing/Metallurgy:
   - Production of metallurgical products
   - Potential for further mining-related/metallurgical/downstream activities (High)
   - Presence of companies for mining services
   - Industries and value chain related with ore
4. Business: Export – export activities of steel, graphite e.tc.
5. Associations and clusters: Networking potential on R&D (MUL. ZAB) - establishment of SME clusters.
6. Education capacity :
   - Presence of universities, national and international events related to M&Q sector
   - Presence of technical high school, advanced training courses related to M&Q sector
   - Strong co-operation between universities – M&M industry

Table 5.4.1: Strengths for the Region of Styria

Weaknesses/General Framework:

- Human capacity:
  - Number of inhabitants (Decrease)
  - Youth population (Decrease) - Ageing population (Increase)
  - Net migration rate (Increase)
2. Social acceptance/concerns:
  - Negative regarding the metallurgy activities in some cases
  - Lack of social awareness about the need of RM



Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
2. Economy factor: GVA of secondary sector (Decrease, Ranked second)
3. Mining sector:
   - Exploration – limited geological potential – number of registered mines (Low)
   - Exploitation – limited chances of mining activities – exhaustion of deposits (Erzberg mine) - Strong dependency on the industry - No further mining potential (especially CRM)
4. Business: Number of registered companies, with large size related to MM sector (Low)
5. Employment: Scarce workforce by decreasing population
6. Environment factor: Presence of areas of high naturalistic value – proximity to old mining areas

Table 5.4.2: Weaknesses for the Region of Styria

Opportunities/General Framework:

1. Employment: Employment rate (High)
2. Economy factor: National GDP (Increase)
3. Funding: Presence of European and National funds
4. Social acceptance/concerns:
   - General social acceptance of M&M as base of the economy
   - Efforts to be aware about the need of M&M

1. Economy factor: GVA of tertiary sector (Increase – High values)
2. Cultural and Mining heritage:
   - Mining heritage - Presence of UNESCO awarded mining traditions - tangible and intangible cultural assets characterized as UNESCO heritage - Styrian Iron Route - European Route of Industrial Heritage – Presence of unique processing machines – Good practises
   - Cultural background
3. Environment factor: Presence of areas of high naturalistic value – proximity to old mining areas – protected by UNESCO

Factors related to Reopening of Mines:

1. Mining sector:
   - Strong mining sector - outstanding Fe Erzberg
   - Exploitation – uniqueness of iron mine in Central Europe
2. Processing/metallurgy: Production of metallurgical products - important world producer (crude steel)
3. Employment: Highly skilled workforce in the sector of metallurgy
4. Education capacity:
   - Uniqueness of technical high school related to M&Q sector
   - Primary education highlights M&M topics
   - World-renowned Mining university in Leoben
5. Administrative policies: Regional Development Strategy – support to metallurgy sector

Table 5.4.3: Opportunities for the Region of Styria

Factors related to Reopening of Mines:

1. Mining sector: Dependence on global market prices
2. Administrative policies:
   - Land use planning - High environmental regulations
   - Activities promoted - Preference for activities in conflict with mining
   - Absence of master plans

Table 5.4.4: Threats for the Region of Styria

5.5 SWOT ANALYSIS: REGION OF SAXONY

Based on the **Figure 5.1.1**, the main Strengths, Weaknesses as regards to the Internal Environment and the Opportunities and Threats in accordance with the External Environment, are represented on the next tables. The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Saxony.

5.5.1 Strengths/Region of Saxony

As can be seen on the **Table 5.5.1**, Saxony' s general strengths are related to Region's human capacity, employment, economy, infrastructure, social acceptance, and administrative policies.

Regarding to the strengths, it seems that the Region's human capacity is characterized by an increasing number of youth population. Furthermore, the fact that the Saxony has a booming economy, with the economic indicators of the regional GDP, GDP per capita for the region of Saxony, regional GDP of production industry and the corresponding GDP per capita being increased, and with the exporting activities also having an increasing trend, are all strengths for the exploitation of the area with abandoned/closed mines through one of the two options. Moreover, the transport and telecommunication accessibility of the Region, as well the energy capacity, with the area using in a great percentage the renewable resources, are also helpful factors for the booming of the projects of interest, referred in this Deliverable.

Other factors correlated with the employment, are the increase of the Region's employment rate, as well the decrease for the youth unemployment, also indicating an area of a booming economy. Moreover, the society's positive opinion, with the mining activities having a good reputation, as well the fact that the residents are aware of the Mining heritage and Mining activities (mainly those lining near to the activities), with the awareness being cultivated by programs of mining industry, constitute strengths of Saxony's region. Finally, from a societal aspect, it is concluded that the area is characterized by the community acceptance, resulted mainly by the Region's mining history. In addition, another positive aspect is connected with the fact that there is financial support by Saxon government, for the reclamation works of old mines.

Focusing on the aspect of Mining heritage, the components contributing in the development of the sector are the economy, and the cultural and mining heritage. Specifically, the increasing values of the GVA for tourist industry, and the high number of the high percentage of the sector of Services, and at the same time the presence of visitor mines and other objects open for inspection, underground caves and historical mining objects, refurbishment plants/facilities under mining supervision, and good practices, constitute advantages for the exploitation of Mining heritage. Furthermore, the fact that Saxony is a well-known touristic destination, as well the presence important cultural significance, historical sites, monuments e.tc., are strengths for the reactivation of mining sites through the aspect of Mining heritage. Finally, the position of the cultural sites in distance from the areas with permissions granted, could be helpful in order to avoid issues, related to the activation or not of the mining areas for their Mining heritage.

Analysing the option of new mines, the strengths of Saxony are related to factors such as the mining sector, the processing/metallurgy, the recycling/recovery, and to administrations and clusters, environmental aspect and education capacity, as well to Raw Materials Life Cycle. In detail, regarding the Region's economy, the high percentage of the sector of industry, and the high participation in the industrial turnover and metal production, are two more strengths indicating the booming economy for the mining sector of Saxony. For the situation of the mining sector, the fact that there are many deposits unexplored, that are

under investigation, the presence of permits granted at the SW and NE parts, in combination to the good knowledge of the area (highly explored through geological-geophysical perspective), indicate the positive climate for the mining sector. Moreover, the presence of investigations, so as to valorise the substantial occurrences of close to surface low-grade ore and deep-seated potentially high-grade or, that are in present subject to R&D and extensive data exploration, are also a good sign for the exploitation of the mining sites, used in the past.

Regarding the processing/metallurgy/recycling sectors, there are several companies for pyro/hydrometallurgical/recycling processes, and smelters operating with scraps, indicating the developing sectors for the creation of products, in relation to the M&Q sector. Apart from the booming sectors of pyro/hydrometallurgical/recycling processes, the area has a market, characterized by the growth of export turnover.

Finally, emphasizing on the environment factor, the area of the old mining sites is not overlapped so much with the areas of naturalistic values, constituting an advantage, regarding the applicable permissions. Other factors constituting strengths for the development of the mining sector, are the presence of administration structure, regional networks and mining authorities (Saxon Mining office, Saxon RM Strategy), in combination to the Regional policies, that are very supportive for those type of activities. At the same time, the presence of excellent research infrastructure, universities, institutes for vocational training, programs and events related to M&M sector, as well the medium to high cooperation between academia and industry, suggest strengths for the development of activities related to Mining heritage or Mining sector.

5.5.2 Weaknesses/Region of Saxony

As can be seen on the **Table 5.5.2**, Saxony' s general weaknesses are related to Region's human capacity, economy, infrastructure and social acceptance of the mining activities.

The main weaknesses of the specific Region, regarding the human potential, are the decreasing number of residents at the Saxony's region, with the population corresponding to 4.9% of the country's population. Moreover, for infrastructures the only recorded aspect of the region, creating a negative climate for the mining activities, is the telecommunication factor, with the SME characterized by a low digitalization rate. As for the factors related to society's aspect, the lack of awareness for the Region's population regarding to the M&Q sector, is also a weakness recorded for the Saxony area.

Emphasizing on one of the two options for the reactivation of the abandoned/closed mining sites, the spatial distribution of the sites in close proximity to the active ones, at the SW part of Saxony, as well the position of the old mines in distant from the areas with high naturalistic value, suggest weakness for the development of activities, for the exploitation of Mining heritage.

Analysing the option of new mines, the main weaknesses are related to the presence of conflicting interests of the mining sector, with automotive industry and tourist sector. Moreover, other weaknesses for the sectors of exploration and exploitation of the mining sites, are the decreasing number of registered companies related to M&Q sector, the presence of small-scale deposits and occurrences, as well the presence of deposits depleted or not viable anymore.

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5.5.3 Opportunities/Region of Saxony

The main opportunities recorded for the Saxony's region, is the fact that it constitutes a focal point of RM in a country' s level. The main characteristics of the country are the increasing trend for the economic indicators of National GDP and GDP per capita, as well for the employment rate. On the other hand, the country represents a decrease for the percentage of youth unemployment.

Regarding to the social acceptance, population is characterized by a high social acceptance. Other opportunities at a country's level are the presence of European funds, mainly because they provide the essential funding for those type of activities, and for the investment factor, the increase of GERD and Private GERD at a National level, indicating a good level for the field of investments. The three mentioned factors constitute positive aspects for the development of activities for the exploitation of the mining sites.

Analyzing opportunities related to the Mining heritage, the main recorded opportunities are referred to the high potential of the mining sites. Specifically, the presence of mining cultural landscapes, characterized as UNESCO heritage, the historical sites and the monuments of World cultural heritage, and UNESCO World Heritage, indicate the rich heritage (cultural and mining) of the area.

Emphasizing on the option of creation of new mining sites, the high percentage of the sector of industry, the good rate of exporting activities, and specifically the good rate of exporting activities for RM sector, are some of the positive aspects at the country's economy, that could potentially be helpful for the booming of the mining sector. Moreover, the fact that the mining sector is characterized by a strong, industrial mining activity, with the mining potential including deposits of world class deposits constitute opportunities for the development of the mining sector.

Other positive aspects of the mining sector, are the presence of innovative recycling industry (related to pyro/hydro processes), of associations and clusters (such as EIT Raw Materials, GERRI, GKZ Freiberg networking at regional / EU levels), and also the presence of policies and strategies at a National level that could potentially be helpful for the development of M&Q sector (Federal Mining Act, Mineral Deposits Act, German Federal Government e.tc.).

5.5.4 Threats/Region of Saxony

Emphasizing on the threats for the Region of Saxony about the Reopening of Mines and Mining heritage, the most important connected with components of human capacity and social acceptance.

In detail, regarding the human capacity, the increasing urbanization rate is the only recorded threat for the development of both type of projects. As for the component of social acceptance, it is affected by the social media, while it is characterized by an increasing bad image for industries in general, with the mining activities being at the least popular industries. Finally, the society has as main characteristic of the absence of awareness about the need of RM sector.

For the threats related to the reopening of the mining sites, the lack of skilled labor force for new mines, and knowledge for industries, as well the fact that M&M sector needs to compete for skilled workforce, are the basic components, constituting the threats of the parameter of employment. Other facts that do affect the mining sector, consisting threats are the administrative policies, with the federal laws in mining and environmental issues affecting the regional performance, the land use

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planning indicating conflicts for the surface of the area, the M&M plans, that are subject to political/public debates, and the long and complex administrative policies of M&M projects.

For the businesses, the high production and energy costs, in combination to the stable-decreasing number of registered companies, related to M&Q sector, are two more threats for the Region's mining sector. Finally, for the human's component, the high density population constitutes a threat, creating an obstacle for those type of activities, while at the same time, the decreasing number of students in RM sector, is another threat, mainly because of the limited workforce for the M&Q sector.

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Strengths/General Framework:

1. Human capacity: Youth population (Increase)
2. Economy factor:
   - Regional GDP and GDP per capita (Increase)
   - Regional GDP of Production Industry and GDP per capita (Increase)
   - Export activities (Increase)
3. Infrastructure:
   - Transport accessibility - railway - road network - airport lines
   - Telecommunication accessibility
   - Energy capacity – Use of renewable energy (Increase)
4. Employment:
   - Employment rate (increase)
   - Youth unemployment (Decrease)
5. Social acceptance/concerns:
   - Public reputation
   - Awareness of Mining heritage and Mining activities (near to the activities)
   - Community acceptance – mining history
   - Presence of programs by mining industry for social awareness
6. Administrative policies: old mines reclamation work – financial support by Saxon government

Factors related to Mining Heritage:

1. Economy factor:
   - GVA of tourist industry (Increase)
   - Percentage of the sector of Services (High)
2. Cultural and Mining heritage:
   - Tourism activities - well-known tourist destination
   - Mining heritage - Strong mining history - Presence of visitor mines and other objects open for inspection, underground caves and historical mining objects – Presence of refurbishment plants/facilities under mining supervision -Exploitation of mining traditions for tourist activities – good practices
   - Cultural background – Position of cultural sites distant from the areas with permissions granted
   - Cultural background – Important cultural significance - Presence of historical sites, monuments e.tc.

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
   Processing/Metallurgy X
   Recycling/Recovery X
2. Economy factor:
   - Percentage of the sector of Industry (High)
   - Participation in the industrial turnover – metal production (High)
3. Mining sector:
   - Many permits granted at the SW and NE part
   - Highly explored through geological-geophysical perspective
   - Exploration – Deposits under investigation
   - RDI – Occurrences close to surface low-grade and deep-seated high grade
4. Processing:
   - Presence of companies for pyro/hydrometallurgical processes
   - Several smelters operating with scraps
5. Recycling/recovery: Presence of recycling companies
8. Business: Market – Growth of export turnover
6. Education capacity:
   - Excellent research infrastructure - presence of universities, institutes vocational training, programs and events related to M&M sector
   - Medium-high cooperation between academia and industry
7. Administrations and clusters:
   - Presence of administration structure, regional networks and mining authorities (Saxon Mining office, Saxon RM Strategy)
   - Supportive Regional policies
8. Environmental factor: Areas of naturalistic values not too much overlapping with old mining sites

Table 5.5.1: Strengths for the Region of Saxony

Weaknesses/General Framework:

1. Human capacity:
   - Population perspective –
     4.9% of the country's population
   - Number of residents (Decrease)
2. Infrastructure: Telecommunication – SME with low digitalization rate
3. Social concerns/acceptance: Lack of social awareness about the need of RM

Factors related to Mining Heritage:

1. Cultural and Mining heritage: Mining heritage – Position/distribution of abandoned mines in close proximity to active, at the SW part

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
2. Economy factor: Conflicting interests with automotive industry, tourist sector
3. Mining sector:
   - Number of registered companies related to M&Q sector (Decrease)
   - Exploitation – small-scale deposits/occurences
   - Exploitation – deposits depleted or not viable

Table 5.5.2: Weaknesses for the Region of Saxony

Opportunities/General Framework:

1. Position: Saxony - focal point of RM in Germany
2. Economy factor:
   - National GDP and GDP per capita (Increase)
3. Employment:
   - Employment rate (increase)
   - Youth unemployment (Decrease)
3. Social acceptance/concerns: Relatively high social acceptance
4. Funding opportunities: Presence of European funds
5. Investment: GERD and Private GERD at a National level (Increase)

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Mining heritage - Presence mining cultural landscapes characterized as UNESCO heritage – Presence of historical sites and monuments of World cultural heritage
   - Cultural background – monuments of UNESCO World Heritage

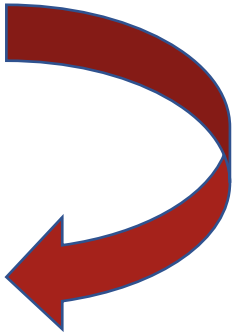
Factors related to Reopening of Mines:

1. Economy factor: Percentage of the sector of Industry (High)
2. Business: Export Good Rate (Stable to Increase) – Export Goods Rate of RM (Stable)
3. Mining sector:
   - Strong industrial mining activity
   - Mining potential – World class deposits
4. Recycling: Innovative recycling industry (pyro/hydro)
5. Associations and clusters: EIT Raw Materials, GERRI, GKZ Freiberg networking at regional / EU levels
6. Administrative policies: Presence of policies and strategies at a National level (Federal Mining Act, Mineral Deposits Act, German Federal Government e.tc.)

Table 5.5.3: Opportunities for the Region of Saxony

Threats/General Framework:

1. Human capacity: Urbanization rate (Increase)
2. Social concerns/acceptance:
   - Complex interaction – increasing bad image for industries
   - Social media – affection on the social acceptance
   - Lack of social awareness about the need of RM
   - Mining industry - least popular industries



Factors related to Reopening of Mines:

1. Employment:
   - Lack of skilled labor force for new mines
   - Lack of knowledge for industries
   - M&M need to compete for skilled workforce
2. Human capacity: Density population (High)
3. Mining sector: High production and energy cost
4. Business: Number of registered companies related to M&Q sector (Stable to decrease)
5. Education capacity: Number of students in RM sector (Decrease)
6. Administrative policies:
   - Federal laws in mining and environmental issues affect the regional performance
   - Land-use planning – conflicts
   - M&M plans - subject to political/public debates
   - Long and complex administrative policies of M&M projects

Table 5.5.4: Threats for the Region of Saxony

5.6 SWOT ANALYSIS: REGION OF KOŠICE

Based on the **Figure 5.1.1**, the main Strengths, Weaknesses regarding the Internal Environment and the Opportunities and Threats arising through the interaction with the External Environment, are represented on the next tables. The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Košice.

5.6.1 Strengths/Region of Košice

As can be seen on the **Table 5.6.1**, Košice's general strengths are related to Region's human capacity, employment, economy, infrastructure, energy capacity, social acceptance of the mining activities and associations and clusters.
It seems that the Region's population corresponds to the 14.68%of the country's population, having achieved to maintain an increasing trend for the perspective of population. Another characteristic of the Region that constitutes a Strength is the Region's increase of the economically active population, while at the same time, the recorded unemployment rate is decreased.

Emphasizing on the Region's economy, it is of paramount importance to refer the increase of the Regional GDP, in accordance to the latest, available data. Furthermore, another aspect that contributes to the increase of both projects for the expoitation of mining activities, is the infrastructures. Specifically, the high level of transport accessibility, in combination to the high potential of energy capacity (due to the deposits of natural gas and lignite, the presence of power generation plants and the high potential of geothermal energy), consist Strengths for the development of that type of activities (related to Mining heritage and Reopening of mines).

Other Strength could be the social acceptance of the mining activities, that it is positive in some cases of the mining sector. Specifically, the social acceptance is depended on the type of mining activities, and whether society is accustomed at those (for example to surface mining of building materials), and whether they contribute to the job creation. Another helpful fact, is that national media that are partially supportive to MM policies, creating a good climate for investment. Also, projects of geotourism provide a positive impact on public awareness of the mining activities, enhancing the mining industry. Finally, the presence of EIT Raw Materials HUB Regional Center Kosice contributes to enhance the innovative potential of the region, through the development of both mining heritage or new mining industries.

Focusing on the Mining heritage, the fact that Košice is characterized as a European Capital of Culture, may result in the creation of several hundred new jobs linked to tourism, culture and a variety of services in the creative economy, for the next years. This fact indicates an orientation for the development of the Region, and it constitutes a positive aspect for the exploitation of Mining heritage. Moreover, the presence of mining towns/museums/educational paths, in combination to cultural monuments, consists the Regional potential that will be attractive for tourists. Another aspect contributing in the Strengths of the Region is the increasing number of tourists, in accordance to the most recent, available data.

As for the case of Reopening of mines, the fact that the main job creator, participating in GVA, GDP are metallurgical and metal-working industries, is helpful for attracting new investments for M&Q sector. Other Strengths of the mining and metallurgy industries, that are present in the Region, are the

existence of exploitation activities for the industrial non-metallic minerals, the metallurgical processes and technologies, as well the production of ceramic / refractory materials and recycling of refractory materials. Furthermore, the high level of participation at the region's industrial outputs and exporting activities, constitute another advantage related to metallurgy sector, is the fact it accounts for 60% of the region's industrial output and 50% of its exporting activities, indicating a profitable field of investment. Finally, the presence of training programs, lecture activities and projects, related to the sectors of interest, as well the cooperation between the only University related to mining and the Self – Governing Region, for the entire value chain of mineral resources, constitute advantages for the specialization of the human capacity.

5.6.2 Weaknesses/Region of Košice

According to the **Table 5.6.2**, weaknesses are analysed through the aspects of human capacity, funding, and social acceptance, referred as weaknesses for both exploitation of mining heritage and reopening of mines.

One of the main Weaknesses of Košice, is related to the ageing population, as well to the presence of indigenous group, to the high rate of urbanization and net migration. Other aspect is the absence of regional funds at Region of Košice, and the parameter of social concerns, that is negative in some cases, depending on the type of activities and the job creation, resulting in the absence of integration of MM sector in society.

On the one hand, focusing on the development of activities related to Mining heritage, the fact that there is no information about the specific sites of abandoned/closed mines, is a weakness for the planning of the exploitation of those sites.

On the other hand, the weakness related to the mining sector, is mainly the lack of supportive actions for the exploration activities at the Region, while there are weaknesses also related to the procedure of exploitation. Furthermore, another aspect related to the weaknesses of the Region, is the small number of registered companies, with large size (with a number of employees greater than 249), corresponding only to one company, while at the same time, another disadvantage is the need for new markets, so as to increase the mining sector.

Finally, the absence of clustering activities at the Region, in relation to the Business sector of M&Q, constitutes a disadvantage for the development of the mining, while also the low number of universities, related to M&Q sector, results in the small number of opportunities for residents to be graduated in fields, such as those of mining, geology, metallurgy e.tc.

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5.6.3 Opportunities/Region of Košice

As can be seen on the **Table 5.6.3**, advantages of the Region in relation to the external environment, are the residents' employment, the economy, the energy capacity, the administrative policies and the associations and clusters, are the main opportunities of the Region.

Specifically, the increasing number of economically, active population, the decreasing rate of unemployment, as well the increasing trend of the economic indicators, in a country level (such as the National GDP and GDP per capita), constitute advantages of Slovakia's country, that will affect in the booming of projects both for the Mining heritage and Mining sector.

Furthermore, other advantages for the development of the sectors are related to the energy capacity of the Region, and specifically the fact that it includes significant deposits of natural gas and lignite, as well the high potential of the geothermal field, in comparison to the entire country. Moreover, another advantage is related to the administrative policies, that are very helpful for the booming of those sectors. In detail, the development of RM policy, the presence of the National strategy of regional development, and the establishment of the Regional Innovation Strategy, and Regional Innovation Policies, in combination to the presence of a main Ming Office, suggest opportunities for the development of activities related to RM.

Finally, another positive aspect of the Region of Košice, is the presence of associations, such as the EIT Raw Materials HUB Regional Center Kosice and the Mining Guilds of Slovakia, that provide the essential networking – clustering.

Emphasizing on the advantages that could constitute opportunities for the Region of Košice, the strong mining history, the presence of mining towns/museums/educational paths, and monuments of global importance, characterized as UNESCO monuments, suggest a combination helpful for the exploitation of the mining sites, through the aspect of Mining heritage. Furthermore, the increasing rate of tourism, proved by the increasing number of tourists in the Region of Košice, is also a factor that will contribute to the development of activities related to the Mining heritage, while at the same time the presence of natural monuments of uniqueness at a European level, is also helpful for the booming of tourist activities through the aspect of Mining heritage.

On the other hand, Region's concentration on RM' s self-sufficiency, as well the presence of the biggest companies in a country – level, suggest two of the advantages registered for the reactivation of mines at Košice. Furthermore, the high percentage of Slovakian SME in the mining industry (99,57%), as well at a regional level the existence of companies characterized as world-scale producer for industrial non-metallic minerals (for the mineral of magnesite), and the high rate of exporting activities of industrial non-metallic minerals, contribute to the increase of the mining activities at the Region. Finally, another advantage that could help the mining activities of Košice, is the modernization that have been recorded in the procedures.

5.6.4 Threats/Region of Košice

In the Region of Košice have been recorded several threats, related to projects for both the Reactivation of mines and the aspect of Mining heritage. In detail, the factors in which detected threats are Region's human capacity, the mining context, the administrative policies and the social acceptance/concerns (**Table 5.6.4**).

Specifically, the presence of indigenous group in a country – level (apart from the regional level), is a real threat to the MM industries, mainly because this factor can affect the triggering of the investment

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to such an extent that it may result in the termination of the investment procedures. Another factor harmful is the fact that economic, environmental, and social data for the mineral deposits are absent, while at the same time, regarding the administrative policies, administrative barriers, bureaucracy, and long-lasting and complicated processes, create a complexity at the activities related to RM sector. Finally, the social acceptance is negative in general, for the majority of the M&Q activities.

Regarding only the Reactivation of mines, one of the recorded threats, related to the business sector, is the fact that the country of Slovakia is still dependent on the imports of Energy RM (mostly from Russia) and Metallic minerals from other countries. At the same time, another threat recorded for the country of Slovakia, is the low number of registered companies, with large size, related to the RM sector. Specifically, for the country of Slovakia, have been recorded only 3 companies with large size, while for the registered metallurgy and metalworking companies, the number corresponds only to 49 companies.

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Strengths/General Framework:

1. Human capacity:
   - Population perspective – 14.68% of the country's population
   - Number of inhabitants (increase)
2. Employment:
   - Economically active population (Increase)
   - Unemployment rate (Decrease)
3. Economy factor: Regional GDP (Increasing)
4. Infrastructure:
   - Transport accessibility - regional, railway - road network - airport lines - waterway and energy transregional
   - Energy capacity:
     Deposits of natural gas and lignite - power generation plants
     Potential of geothermal energy (High)
5. Social acceptance:
   - National media – partially support of MM activities
   - Projects linked to geotourism - positive impact on public awareness of mining – enhance of the mining industry
   - Positive social acceptance – dependence on the type of activities and job creation
6. Associations and clusters: EIT Raw Materials HUB Regional Center Kosice

Factors related to Mining Heritage:

1. Employment: New jobs linked to tourism, culture and a variety of services
2. Cultural and Mining heritage:
   - Tourism activities:
     Geotourism – Good practises
     Number of visitors (Increase)
   - Mining heritage - Strong mining history –
     Presence of mining towns/museums/educational paths
   - Cultural background - Presence of cultural monuments
3. Environment factor: Presence of natural monuments

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploitation X
   Extraction X
   Processing/Metallurgy X
   Recycling/Recovery X
2. Economy factor: Main job creator - participation in GVA, GDP: metallurgical and metal-working industries
3. Mining sector: Exploitation – mainly industrial non-metallic minerals
4. Processing/Metallurgy:
   - Technologies and expertise – Metallurgical processes and technologies
   - New products - Production of ceramic / refractory materials
   - Participation at the region's industrial output (High)
   - Participation at the region's exporting activity (High)
5. Recycling/Recovery: Recycling of refractory materials
6. Business: Presence of mining and metallurgy companies
7. Education capacity:
   - Cooperation between University of Kosice - Self-Governing Region for the entire value chain of mineral resources
   - Training programs - lecturing activities - projects

Table 5.6.1: Strengths for the Region of Košice

Weaknesses/General Framework:

1. Human capacity:
   - Ageing population
   - Net Migration rate (High)
   - Degree of urbanization (High)
   - Presence of indigenous group
2. Funding: No regional funds
3. Social acceptance:
   - Negative social acceptance
   - Integration of MM in society is not addressed

Factors related to Mining Heritage:

1. Cultural and Mining heritage: Mining heritage: No reference – existence of old mines?

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
2. Mining sector: Exploration - Lack of support
3. Business:
   - Number of registered companies, with large size related to MM sector (Low)
   - Need for new markets
   - Clusters – No mention to clustering activities
4. Education capacity: Number of universities related to M&Q sector (Low)

Table 5.6.2: Weaknesses for the Region of Košice

Opportunities/General Framework:

1. Employment:
   - Economically active population (Increase)
   - Unemployment rate (Decrease)
2. Economy factor:
   - National GDP (Increasing)
   - GDP per capita (Increasing)
3. Energy capacity:
   - Significant deposits of natural gas and lignite in a country level
   - Potential of geothermal energy (High)
4. Administrative policies:
   - Development of RM policy
   - Presence of National strategy - Regional Innovation Strategy – Regional Innovation Policies
   - Presence of Mining Office
5. Associations and clusters:
   - EIT Raw Materials HUB Regional Center Kosice
   - Mining Guilds of Slovakia

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   4. Tourism – Number of tourists (High)
   5. Mining heritage - Strong mining history - Presence of mining towns/museums/educational paths
   6. Cultural background - Existence of monuments of global importance - characterized as cultural UNESCO monuments
2. Environment factor: Presence of natural monuments – uniqueness in European level

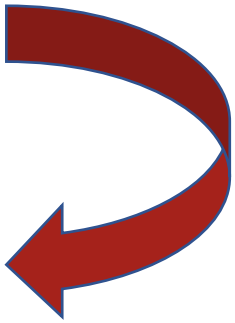
Factors related to Reopening of Mines:

1. Mining sector: Concentration on the RM's self-sufficiency
2. Processing/Metallurgy: Biggest companies in a country - level
3. Business:
   - World-scale producer of industrial non-metallic minerals
   - Exporting activities of industrial non-metallic minerals
   - Percentage of SME companies (High)
   - Modernization of procedures

Table 5.6.3: Opportunities for the Region of Košice

Threats/General Framework:

1. Human capacity: Presence of indigenous group
2. Mining context: Absence of data related to economic, environmental, and social factors for mineral deposits
3. Administrative policies: Administrative barriers, bureaucracy, and long-lasting and complicated processes
4. Social acceptance: Negative social acceptance for the majority of M&Q activities



Factors related to Reopening of Mines:

1. Business:
   - Not self-sufficient – Dependent on imports of Energy RM and Metallic minerals
   - Number of registered companies, with large size related to MM sector

Table 5.6.4: Threats for the Region of Košice

5.7 SWOT ANALYSIS: REGION OF LOWER SILESIA

Based on the **Figure 5.1.1**, the main Strengths, Weaknesses regarding the Internal Environment and the Opportunities and Threats arising from the interaction of the External Environment, are represented on the next tables. The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Lower Silesia.

5.7.1 Strengths/Region of Lower Silesia

As can be seen on the **Table 5.7.1**, Lower Silesia's general strengths are related to human capacity, economy, infrastructure and funding.

Specifically, regarding the Region's human capacity, the Lower Silesia has a population that corresponds to the 7.5% of the country's population, constituting strength mainly because of the potentially workforce. Another strength related to the economy factor, is the increasing trend of the Regional GDP per capita, as well the presence of regional funds, related to M&Q sector. Furthermore, the good transport accessibility of Lower Silesia (e.g. the high density of the railway lines), is another positive aspect of the region, that could be helpful for the development of both projects related to the reopening of mines and mining heritage, as well.

As for the first option of exploiting the mining sites, through mining heritage, the fact that the tourist industry belongs to the emerging industries of Lower Silesia, participates in the advantages of the region' s capacity. Moreover, the presence of cultural monuments with high diversity and a great number of old mining sites, is also a strength for the creation of a good climate, for the development of touristic activities.

Emphasizing on the second option, of reopening the mining sites, the fact that the Lower Silesia's mining sector has an economic importance in the region's economy, creates a good climate for the exploitation of these sites. Furthermore, through a geological aspect, the Lower Silesia is differentiated regarding the minerals, providing a rich underground, with a high number of unexploited deposits (such as for ore deposits), that potentially could be activated. Moreover, the Region has a high potential, to produce components of biofuels.

Other factors that appear to have a significance for the exploitation of the potential of mining sites, is the development of the processing sector, with technologies and new products of advanced materials from the Region's mineral potential, creating a good climate for the booming of mining sector. Furthermore, the new technologies, related to recovery, recycling and waste disposal, are also advantageous for the mining industries, mainly because they have the opportunity to reduce their waste activities. Regarding the environment factor, the monitoring of those type of activities, is also beneficial for the development of projects of mining sector.

Through the business aspect, the presence of a high number of enterprises, with economic activities at the Region, helps the development of the industry sector, and creates a good climate for further investment in the mining sector. The constant high pace of production, and the relatively broad range of industrial activities, are also strengths-advantages of the region.

As for the education capacity, Lower Silesia constitutes one of the biggest education centers of the country, with the universities giving a strong scientific back up. The presence of universities related to M&M sector, as well institutions and companies, with the services supporting R&D sector and the creation of technological parks, centers for technology transfer, academic and business incubators,

and research centers are advantageous for the reopening of mines, providing the educational background for those activities. Finally, the cooperation between academia and M&M industry, as well the promotion of cooperation between entrepreneurs and universities, also participate in the Region's strengths.

5.7.2 Weaknesses/Region of Lower Silesia

Weaknesses at a Regional level are mainly related to factors such as the human capacity and the infrastructure. Specifically, the decreasing number of inhabitants is a factor that may result in the reduced number of workforce, for projects related to mining activities. Moreover, issues such as the underdeveloped infrastructures in some areas, the low density of energy transmission networks, also contribute to the creation of a negative climate for the development of economic activities.

Emphasizing on the component of mining heritage, the only recorded weakness is related to the Region's infrastructure, and it is the low efficiency of public transportation. On the other hand, for the second option of reopening of mines, the fact that education is not corresponding to the enterprises' expectations, in combination to the decreasing, recorded number in a Region's level, are weaknesses for the booming of the mining sector. Finally, another disadvantage recorded in the Region of Lower Silesia, are the social costs of reopening the mines.

5.7.3 Opportunities/Region of Lower Silesia

Opportunities recorded in a country's level are mainly related to the economy factor, infrastructure and funding opportunities for Lower Silesia (**Table 5.7.3**).

Specifically, the fact that Region of Lower Silesia has a higher Regional GDP per capita that the recorded National GDP per capita, is an advantage, in correlation to the external environment. Furthermore, the fact that one of Pan-European Transportation Corridors is within Lower Silesian Voivodeship, also constitutes an opportunity for the development of projects of both mining heritage and reopening of mines, mainly because of the easy access. Finally, the presence of European and National programs, is also another advantage at a Regional level.

Focusing on the mining heritage, the presence of a strong mining history and the high number of important mining sites of global importance, constitute opportunities of the Region, in relation to the country of Poland. Finally, the presence of unique cultural sites, with some of them being characterized as UNESCO's World Heritage, is another advantage of the Region, in comparison to the external environment.

Emphasizing on the second option of reopening mines, the fact that mining sector is significant in the Poland's economy, in combination to the high potential of ore deposits at the region of Lower Silesia, and the good position of the Lower Silesia's region, in a world scale, regarding its productivity ((e.g. copper, silver, and rhenium, building materials e.tc.), constitute opportunities, that may boost the mining sector in general, and in specific, the reopening of the abandoned/closed mines of the area. Apart from the situation of Lower Silesia's mining sector, the education capacity and specifically the fact that the region is located in close proximity to important universities, with their studies related to M&M sector, is also beneficial for the reopening of mines.

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5.7.4 Threats/Region of Lower Silesia

Emphasizing on the threats for the Region of Lower Silesia, the most important are connected with components such as economy, and with social acceptance (**Table 5.7.4**).

In detail, the economic factors that could be harmful for both the exploitation of Mining heritage and Reactivation of mines, is the fact that the Regional GDP is lower than the other European regions. In combination to this component, the fact that the social acceptance for new mining activities is negative, constitute another threat for the exploitation through those type of activities, related to M&Q sector, mainly because it creates a negative climate for the implementation of practises related to abandoned/closed mines.

Focusing only on the factors related to the Reopening of mines, the main threats in country-level are in relation to the mining sector/context, administrative policies, business activities and to education capacity. In detail, the absence of alternatives regarding the closure of mines e.g. for copper ore and lignite, in combination to the fact that the RM prices fluctuate on global markets, and the high costs, in order to introduce innovations to market, are threats for the mining sector, in relation to the external environment. As for the business activities, the fact that are relocated to other regions/countries, has harmful effects for the business domain. Furthermore, the increasing costs (e.g. labor, mining costs) for the businesses in combination to the fact that the highly qualified workers leave to other markets, are important problems, adding a negative aspect in the alternative of reopening the abandoned/closed mines.

Other facts affecting the decision of reopening the abandoned/closed mines, is connected with the administrative policies, and specifically the facts that it is essential a long time to be spent from the decision to start a new mine, as well the presence of variable and unclear legal conditions in the country of Poland, suggest threats, very harmful for the reactivation of abandoned/closed mines. Additionally, regarding the education capacity, the general, recorded trend of decreasing number of graduates, in a country's level, constitute another threat, related to the external environment.

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Strengths/General Framework:

1. Human capacity: Population perspective –
   7.5% of the country's population
2. Economy factor: Regional GDP per capita (High - increase)
3. Infrastructure: Transport accessibility - high density of railway lines
4. Funding: Presence of regional programs

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Tourism activities - Emerging industries – tourism
   - Mining heritage – presence of a number of good practices (High)
   - Cultural background – diversity (High) – archeological sites, monuments, and parks
2. Environment factor:
   - Presence of areas of medicinal and thermal waters
   - Presence of national parks, landscape parks, reserves and nature parks

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploitation X
   Processing/Metallurgy X
   Recycling/recovery X
2. Mining sector:
   - Economic importance for regional economy
   - Mineral differentiation
   - Exploitation – number of unexploited deposits (High)
   - Exploitation – potential of ore deposits (High)
   - Mining potential – high potential to produce components of biofuels
3. Processing:
   - Technologies to acquire new products from mineral
   - New products – advanced materials
4. Recycling/recovery: Technologies for recovery, recycling, disposal waste
5. Business:
   - High pace of production
   - Broad range of industrial activities
   - Number of enterprises with economic activity (High)
6. Environment factor: Systems to monitor threats
7. Education capacity:
   - One of the biggest education centers – strong scientific back up
   - Presence of Universities related to M&M sector
   - Presence of institutions and companies - services supporting R&D sector - technological parks, centers for technology transfer, academic and business incubators, research centers
   - Cooperation between academia and M&M industry
   - Promotion of cooperation between entrepreneurs and universities
8. Associations and clusters: Presence of institution for knowledge/technology transfer services

Table 5.7.1: Strengths for the Region of Lower Silesia

Weaknesses/General Framework:

1. Human capacity: Number of inhabitants (Decrease)
2. Infrastructure:
   - Transport - Underdeveloped infrastructure - low quality of roads
   - Energy capacity - low density of energy transmission networks

Factors related to Mining Heritage:

1. Infrastructure: low efficiency of public transportation

Factors related to Reopening of Mines:

1. Education capacity:
   - Education not corresponding to the enterprises' expectations
   - Number of students and graduates (Decrease)
2. Social acceptance/concerns: Social costs of opening mines

Table 5.7.2: Weaknesses for the Region of Lower Silesia

Opportunities/General Framework:

1. Economy factor: Regional GDP per capita higher than National
2. Infrastructure: One of the Pan- European Transportation Corridors
3. Funding: Presence of European and National programs

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Mining heritage – Strong mining history – mining sites of global importance
   - Cultural background - Uniqueness of cultural sites - Existence of monuments characterized as UNESCO's World Heritage

Factors related to Reopening of Mines:

1. Mining sector:
   - Economic importance for national economy
   - Potential of ore deposits (4.5% of the world's resources for copper ore)
   - Production - Good position in a world scale (e.g. copper, silver, and rhenium, building materials e.tc.
2. Education capacity: Proximity to Universities related to M&M sector

Table 5.7.3: Opportunities for the Region of Lower Silesia

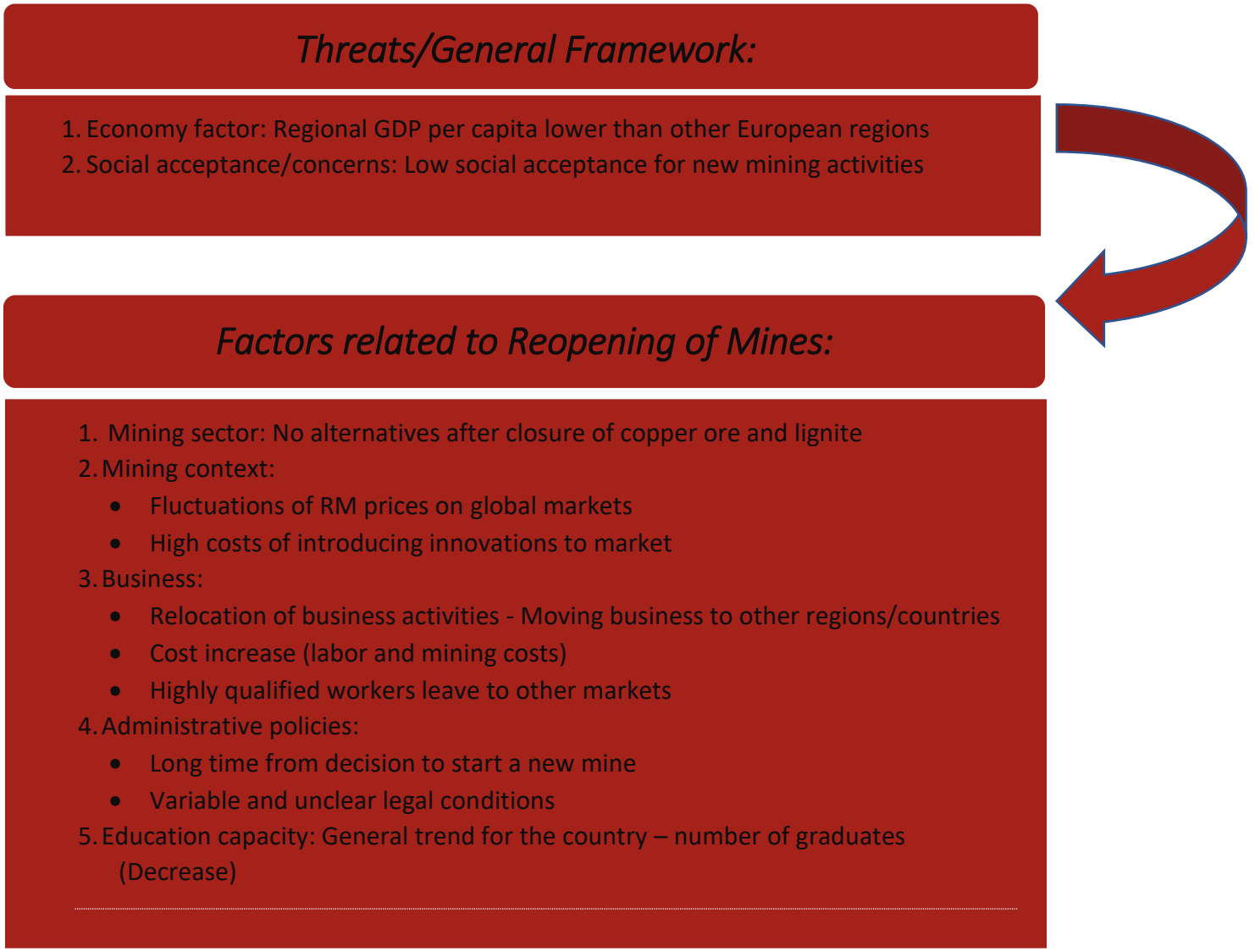

Table 5.7.4: Threats for the Region of Lower Silesia

5.8 SWOT ANALYSIS: REGION OF ANDALUCIA

Based on the **Figure 5.1.1**, the main Strengths, Weaknesses regarding the Internal Environment and the Opportunities and Threats arising from the interaction of the External Environment, are represented on the next tables. The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Andalucia.

5.8.1 Strengths/Region of Andalucia

According to the **Table 5.8.1**, the main strengths for the Region of Andalucia, are related to Andalucia's position, the human capacity of the Region, the structure of the economy, as well to the infrastructure network.

One of the most important Strengths of the Region is arising from the geographical position: Andalucia has a key-position in the country of Spain, connecting the two continents of Europe and Africa, and the Atlantic Ocean to the Mediterranean Sea. Furthermore, Andalucia provides also access to important logistic centres, harbours (Seville, Malaga, Port of Huelva, e.tc.) and train stations. The above- mentioned characteristics of the Region have as a consequent result a high number of Region's trade activities with a variety of countries and continents.

Apart from the significant geographical characteristics, a significant Strength of the Region seems to be the Human potential, since according to the provided data, the population of Andalucia accounts for 18% of the total population of Spain, showing an increasing trend.

The dynamically developing economy of Andalucia, is also characterized by a favourable tax system, and a high level of exporting activities, providing a surplus for the Region. Emphasizing on the infrastructure network, the main strengths are related to the telecommunication - transport accessibility, as well to the energy capacity, that could benefit both potential exploitation routes: mining heritage or re-opening of mines. Moreover, the mineral differentiation of the area (categories such as aggregates, metallic minerals etc.) means that there is a high variety of RM for the Region, and regarding the Mining heritage results in the richness of the geological framework, that will be attractive for the activities for the exploitation of Mining heritage.

Focusing on the factors that could be beneficial for the development of Mining heritage sites, the fact that the economy seems to be highly - related to the sector of services consists an advantage, since this indicates that there will be a network of services already set and available in the Region. Furthermore, the presence of a high number of museums, monuments, and historical sites, that are well distributed at the whole area of Andalucia combined with the high number of visitors and the participation tourist activities in GDP, suggest an appealing fact for the development of tourist activities (such as the establishment of mining heritage sites). Finally, another advantageous fact is the presence of large, protected areas of Natura 2000 (with more than 35% of regional surface being protected by an environmental figure), with a high naturalistic value. Overall, Andalucia seems to have a significant touristic stream and the proper background so as to support this type of actvities which, with the correct marketing activities, could benefit greatly the transformation of old mines to Sites celebrating mining Heritage.

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On the other hand, the reactivation of the specific mining sites, includes many different advantages, with one of them being the skilled workforce of the Region. The fact that Andalucia's economy is rising related to the mining sector -specifically the sub-sector of aggregates- and at the same time the main job creator for the Region is the metal mining activities, suggest strengths for the reopening of mining sites. Other advantages of the mining sector are the high mineral potential, the increasing role of older farms, that will become profitable through an economic aspect, mainly because of the increased material prices and technological advances. Moreover, the high level of digitalization, results in the presence of spatial data infrastructures, while the RDI for mining resources, the high number of exploration activities, and the promotion of M&Q sector through the 3 actors of Administration, Companies, Association/clusters, and joint actions, contribute to the creation of a good climate for the mining activities.

Andalucia is characterized by the presence of giant MM companies, while at the same time the extraction and processing technology for new materials and use of dumps, the complete recycling sector, the RDI and technology in the use of every kind of residues, constitute important strengths for the reactivation of the mines. Andalucia also includes associations of national, regional, and local level.

Finally, through the society aspect, the main advantages are related to the presence of universities, training, and research organisations, co-operation of research groups from universities with companies, as well to the existence of Mining Andalusian Portal, in order to provide information for residents, regarding to the mining activities.

5.8.2 Weaknesses/Region of Andalucia

According to the **Table 5.8.2**, the Region's employment, the regional economy, as well the social acceptance and concerns, constitute the main weaknesses for Andalucia.
More specifically, the high unemployment rate, and especially youth unemployment, suggest weaknesses for the development of activities related to mining. Furthermore, the absence of regional funding, and the low percentage of contribution of M&Q sector's GDP, constitute disadvantages for the exploitation of Andalucia's mining framework. Finally, the negative social acceptance, in combination to the possibility of opposition of groups of ecologists, also contribute in the weaknesses of Andalucia, for the development of projects related to reopening of mines.
Focusing on the factors realted to Mining heritage, the only weakness is the fact that despite that the abandoned/closed mines have been recorded, in the mineral districts of: Iberian Pyrite Belt (Huelva and Seville), Linares-La Carolina (Jaén), Sierra Almagrera-Sierra Alamilla (Almería), Peñarroya-Pueblo Nuevo y Guadiato(Córdoba), the specific distribution of the mines is not known.

On the other hand, emphasizing on weaknesses that may affect the exploitation of the mining potential of the abandoned mines, the low development of RM industry, and the fact that administrative policies for the creation of land use planning, planned the use of the whole territory, without any knowledge of the mineral potential, mineral demands and mineral scarcity, without taking into account whether industry needs some specific minerals, in order to develop the economy and the society aspect, constitute weaknesses for the development of M&Q sector.
As for the environmental aspect, the existence of large, protected areas, characterized as Natura 2000, may be helpful for the exploitation of Mining heritage, but it results in the prohibition of mining activities. Other factors that contribute in the limitation of those activities, are the landscape, the rural environment and the agricultural protection at the Region.

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Finally, regarding the social acceptance, there are oppositions from society, depending on two factors: the age of the activity and the generation of tangible positive effects in employment, and the economic development of the surrounding environment, with the main oppositions of the society being related to activities of aggregates. Another weakness of Andalucia, is the lack of clustering, regarding the production services companies - metallic mining, while there are plans for the creation of that type of clusters.

5.8.3 Opportunities/Region of Andalucia

As can be seen on the **Table 5.8.3**, advantages of the Region in relation to the external environment, are the Region's position, the mining sector, the funding opportunities, and the infrastructure network.

In more detail, Andalucia provides a key-position, not only in a national, but also in a European level, mainly because it connects different contents and seas. Therefore, the community is considered to be one of the richest and most unspoiled regions of Europe, being also characterized by funding opportunities, in a European and National level. Furthermore, the trend suggests the improvement of financing of MM sector, while at the same time the energy capacity of the Region, characterized by the higher percentage of renewable resources, in relation to the country's level, constitute opportunities of Andalucia.

TableXX presents factors that are connected to the exploitation of the abandoned/closed mines through the aspect of Mining heritage. Specifically, the uniqueness of Spanish mining sites, as well examples of good practices in a country level, and the presence of monuments of globally important, constitute opportunities the Region, for the development of Mining heritage, taking the opportunity to benefit from Spain' s tourist industry.

On the other hand, Region's high exporting activity, with a number of partners greater than the country's, and the high participation of aggregates' sector in the national sector, contribute to the opportunities of the Andalucia's economy related to the re-opening of mines. Other advantages are the good position of Andalucia in a European scale, regarding for example the production of industrial minerals (such as gypsum), and the increasing demand of material prices and technological advances.

Finally, opportunities for the reactivation of abandoned/closed mines are also the presence of international competitive companies (such as Cosentino), that contribute to the development of those type of activities, while according to the administrative policies, the Mining Strategy of Andalusia will constitute an opportunity mainly because it will reflect the new situation in the region. As for the education capacity, the high number of Universities related to M&Q sector at the Region consists an advantage of the Region, in comparison to the country's values.

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5.8.4 Threats/Region of Andalucia

According to the **Table 5.8.4**, factors endangering the potential for either the development of mining heritage or the reopening of mines, are related to Region's employment and the social acceptance.

Specifically, regarding the human aspect, the negative social acceptance of the mining activities, mainly due to educational deficiencies related to the Raw Material sector - bad secular image - bad practices of the past - recent cases of environmental damages, suggests a threat for the development of both projects related to mining heritage and mining activities in general. The lack of proper communication regarding the importance of mining activities for the modern lifestyle, suggest threat for the booming of the specific sectors in Andalucia.

Emphasizing on the mining sector, the absence of production services companies, in combination to the need of linking the companies with the innovation framework, the high costs for the reduction of environmental impacts, the necessary professionalization of the clusters and associations and the little integration of mining in land use planning, constitute important threats for the booming of the sector. Finally, regarding the human capacity indicators, the ageing of working population and the deficit of centres for generating knowledge, are negative for the development of the M&Q sector.

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Strengths/General Framework:

1. Position:
   - Key – position in a country level
   - Proximity to logistic points/harbours/train stations
   - Trade activities – variety of countries
2. Human capacity:
   - Population perspective – 18% of the country's population
   - Number of residents (Increase)
3. Economy factor:
   - Value of Regional GDP (about 15% of National)
   - Value of GDP per capita (High)
   - Favorable tax system
   - Exporting activities - surplus
4. Infrastructure:
   - Telecommunication accessibility
   - Transport accessibility – connection of mining areas with harbors, trains stations, and important logistic points
   - Energy capacity – percentage of Renewable resources (High)
5. Mining sector: Mineral differentiation

Factors related to Mining Heritage:

1. Economy factor: Main job creator services (about 76% of employment)
2. Cultural and Mining heritage:
   - Tourism activities – Number of tourists and visitors (High) - Percentage of GDP from tourist activities (High)
   - Mining heritage - Mining tradition from ancient years - historical mining remains – Good practises
   - Cultural background – Number of museums, monuments, historical sites – well distributed all over the Region
3. Environmental factor: Presence of large/protected areas Natura 2000

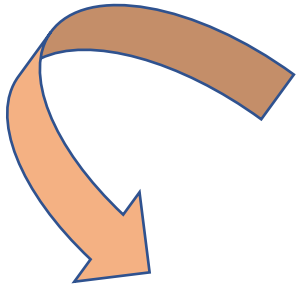
Factors related to Reopening of Mines:

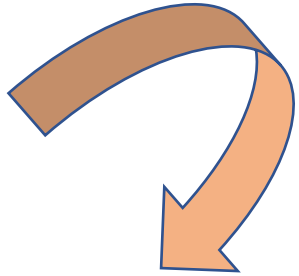
1. Raw Materials Life Cycle: Exploration X
   Exploitation X
   Processing/Metallurgy X
   Recycling/Recovery X
2. Economy factor: Main job creator – rising for mining sector
3. Mining sector:
   - Mineral potential
   - Increasing role (older farms – profitable)
   - Presence of spatial data infrastructures
   - RDI - for mining resources
   - Promotion of mining (Administration, Companies, Association/clusters e.tc.)
4. Mining Resources: Number of exploration activities – investment (High)
5. Processing: Extraction/processing technology for new materials
6. Recycling/Recovery:
   - Complete recycling sector
   - RDI and tech. in the use of every kind of residues
7. Business: Presence of giant mining and metallurgy companies
8. Associations and clusters: Presence of associations (national, regional, local level)
9. Environment factor: Extraction/processing technology for use of dumps
10. Employment: Skilled workforce
11. Education capacity:
    - Presence of universities, training and research organisations
    - Co-operation of research groups from universities with companies
12. Social acceptance/concerns: existence of Mining Andalusian Portal – information for residents

Table 5.8.1: Strengths for the Region of Andalucia

Weaknesses/General Framework:

1. Employment: Unemployment rate – Youth Unemployment (High)
2. Economy factor:
   - No Regional funds
   - Percentage of M&Q sector in Regional GDP (Low)
3. Social acceptance/concerns:
   - Negative social acceptance
   - Possibility of opposition from ecologist groups





Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Mining heritage: Abandoned/closed mines – Unknown position at the districts of: Iberian Pyrite Belt, Linares-La Carolina, Sierra Almagrera-Sierra Alamilla, Peñarroya-Pueblo Nuevo y Guadiato.

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Processing/Metallurgy X
2. Processing: Low development of RM industry-related
3. Environment factor:
   - Presence of large/protected areas Natura 2000 – prohibition of mining
   - Limitation/prohibition of mining activities – landscape, rural environment and agricultural protection
3. Administrative policies: Land use planning - no account of the needed minerals by industries – absence of panning taking into account the right factors
4. Social acceptance/concerns: Activities of aggregates – opposition from society
5. Associations and clusters: lack of a cluster (production services companies/metallic mining)

Table 5.8.2: Weaknesses for the Region of Andalucia

Opportunities/General Framework:

1. Position: Key – position in a National - European level
2. Mining sector: Rich – unspoiled region in EU level
3. Funding:
   - Improvement of financing of MM sector
   - Funding opportunities (European and National level)
4. Infrastructure: Energy capacity – percentage of Renewable resources

Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   - Mining heritage: Uniqueness of mining sites – Good practices
   - Cultural background:
     Existence of monuments of globally importance
     Number of monuments, historical sites, monuments of World cultural heritage

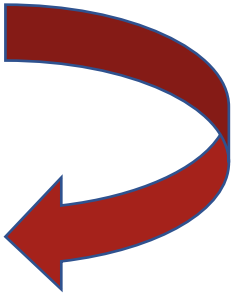
Factors related to Reopening of Mines:

1. Economy factor:
   - Export activity – great number of partners
   - Important sector of aggregates – 24% of the national sector
2. Mining sector:
   - Good position in a European scale – production of industrial minerals (such as gypsum)
   - Demand, material prices and technological advances (Increase)
3. Business: International competitive companies
4. Administrative policies: Mining Strategy of Andalusia
5. Education capacity: Number of Universities related to M&Q sector (High)

Table 5.8.3: Opportunities for the Region of Andalucia

Threats/General Framework:

1. Employment: Unemployment rate (High)
2. Social acceptance:
   - Negative (educational shortage - bad secular image - ancient activities - recent cases of environmental damages)
   - Lack of knowledge of the mining importance



Factors related to Reopening of Mines:

1. Processing: absence of production services companies
2. Business:
   - Need for linking the companies with the innovation framework
   - Costs to reduce environmental impacts (High)
3. Employment: Ageing of working population
4. Associations and clusters:
   - Need to professionalization
   - Little integration of mining in land use planning.
5. Education: Deficit of centres for generating knowledge

Table 5.8.4: Opportunities for the Region of Andalucia

5.9 SWOT ANALYSIS: REGION OF CASTILLA Y LEÓN

Based on the **Figure 5.1.**1, the main Strengths, Weaknesses as regards to the Internal Environment and the Opportunities and Threats in accordance with the External Environment, are represented on the next tables. The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Castilla y León.

5.9.1 Strengths/Region of Castilla y León

Table 5.9.1 presents the main Region's Strengths, related to both cases of Mining Heritage and Re-opening of mines. Specifically, the main factors are the Region's position, the component of human capacity, the economy, the infrastructure, as well the environmental factor.

In detail, the key-position of Castilla y León, and the proximity to logistic points, harbours as well to capital cities, could be beneficial for the development of the cases of Mining heritage and Re-opening of mines, mainly because of the accessibility of the Region. Another aspect that could contribute to the development of the two cases, is the fact that Castilla y León is characterized by an increasing number of inhabitants, with a low to medium density of population, constituting an advantage for the development of both projects related to Reopening of mines and Mining heritage activities.

Furthermore, other facts that add a positive value at those type of activities, are the transport and telecommunication accessibility, as well the energy capacity of the Region. Regarding the two first components, the great access of telecommunication and the presence of a good transport system, suggest advantages for the exploitation of the areas of abandoned/closed mines, due to the fact that the infrastructure network creates a good climate for those activities. Moreover, the booming economy, regarding the available economic indicator of GDP per capita, consists another advantage for the development of business activities at the Region.

Focusing on the factors beneficial for the development of Mining heritage, the fact that the percentage of employment, and the GDP for the sector of services are characterized by increasing trend, contribute to the exploitation of abandoned/closed mines through Mining heritage. Furthermore, the presence of touristic mining sites, in combination to cultural monuments, consist sites that could be attractive for tourist activities. Finally, regarding the component of environment, the presence of springs and thermal waters, adds a naturalistic value at the Region and it is advantageous for the booming of tourist activities.

For the second possible use, that of Reopening of Mines, the stable values of the Regional GDP of Industry, in combination to the economic dependence of the surrounding areas, regarding the coal, suggest advantages indicating that the Region's economy is at a good level. Furthermore, the high mineral potential, the geological knowledge of the Region, as well the advanced projects for the further exploitation of metals, are related to the booming of the mining sector. Moreover, the fact that the production of Castilla y León contributes at a high rate, in the national production of Spain, is another fact very helpful for the development of mining sector.

Regarding to the processing/metallurgy sector, the presence of downstream industries and companies for mining services, and the technological achievements, for the increase of the efficiency's sector, participate in the creation of a good climate, for the development of mining

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sector. As for the waste, from that type of activities, companies try to achieve the use and promotion of activities related to waste, while at the same time, in the Region there are recycling companies-industries, that could also contribute to the framework of circular economy.

Finally, the existence of associations and clusters, as well the presence of plans for the financial support of mining activities, in combination to the educational capacity of the Region, because of the existence of universities, conferences, meetings and events related to M&Q sector, suggest advantages for the mining sector. As for the component of employment, the skilled workforce of Castilla y León, regarding the M&Q sector, is also a helpful parameter providing staff in this growing sector.

5.9.2 Weaknesses/Region of Castilla y León

According to the **Table 5.9.2**, the Region's human and energy capacity, the employment, as well the social acceptance and concerns, constitute the main weaknesses for Castilla y León.

In detail, the decreasing level of the number of inhabitants, and at the same time the decreasing values of employment, and the increasing values of the factors of unemployment - youth unemployment, constitute weaknesses for the development of sectors such as the touristic and mining. At the same time, through the society aspect, the lack of awareness about the need of RM sector, in combination to the negative acceptance of the society for activities of mining, and the presence of examples of non-rehabilitated mines, participate in the creation of a negative climate for those type of activities.

Emphasizing on the component of Mining heritage, the main weakness is the fact that there is an absence of geospatial data related to the abandoned/closed mines, so as to extract the specific sites and conclusions, in comparison to the active mines of Castilla y León.

Focusing on the second possible use of mines, and extracting the main disadvantages of the mining sector, the recently closed mines of activities related to the extraction of coal, constitutes a harmful aspect for the mining activities. Moreover, the fact that the employment, as well the percentage of people employed in the Industry sector is decreased, suggest another disadvantage for the development of business sector, and at the same time, for the mining.

Furthermore, another factor crucial for the development of mining sector is the Region's economy. The decreasing trend of economic indicators, such as the Regional GDP and GDP per capita of M&M industry, the reduction of the number of registered companies in the Region and the value of production, suggest disadvantages for the mining sector, contributing to possibly decline of the mining activities. As for the aspect of exploitation, it has been recorded a decreasing trend in the values, while the same trend has been recorded and for the number of metallic mines. Finally, regarding the oil and gas production, it has been recorded a decrease.

Other weaknesses for the reactivation of abandoned/closed mines are the reduction in the number of medium-large companies, and regarding to the administrative policies, the long permitting procedures, characterized by complexity, are also harmful for the projects of the mining sector.

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5.9.3 Opportunities/Region of Castilla y León

The Region's position, the economy factors, the social concerns, the infrastructure and the funding opportunities of Castilla y León, in comparison to the National and European level, suggest opportunities for the development of projects both of Mining heritage and Mining sector (**Table 5.9.3**).

Specifically, the fact that the Region has a key-position at a country's and European level, as well the high level of exporting activities recorded in Castilla y León, participate in the advantages, so as to develop both types of activities. Furthermore, the increasing number of companies, in contribution to the increasing trend of the economic factors of the National GDP per capita, participate in the advantages of Castilla y León. Furthermore, regarding the energy capacity, the high percentage of renewable resources, to the Regional energy capacity (in comparison to the country's), constitute another positive aspect for the exploitation of the abandoned/closed mines. Finally, the fact that at a country's level, the social acceptance is positive, is one more component that could be helpful for the Region's development.

As can be seen on the sub-table for the mining heritage, the increasing trend at a country's level of the percentage of employment related to the sector of services, and at the same time the increase in the GDP for the same sector, participate in the opportunities related to the reactivation of mines for the tourism industry. Finally, the presence of attractive mining sites of global interest and of monuments of globally importance, suggest the poles of attraction of the area.

Regarding the strong mining sector of Castilla y León, one of the main advantages of the Region, helpful for the booming of the mining activities, is the advances projects for metallic minerals, in combination to the good production's position at a National and European level. Finally, the presence of administrative policies, helpful for the investments at the Region, suggest another advantage for the mining sector.

5.9.4 Threats/Region of Castilla y León

Emphasizing on the Castilla y León's threats, the employment, as well the economy, consist disadvantages for the region. In detail, the increasing rate of unemployment and youth unemployment, and the general economic crisis, contribute to the main threats, in comparison to the outdoor environment.

As for the mining sector, the main threats at a country's level are the decreasing percentage of employment in general, and for the sector of Industry, while other disadvantages related to the economy are the reduction of the National GDP and GDP per capita of the M&M industry, and the decrease for the value of production.

For the country of Spain, it has been recorded a decrease for the number of exploitation and for the number of medium-large companies, suggesting a negative aspect for the development of mining sector. Finally, for the administrative policies, the need of update for the Mining Act, in contribution to the fact that the activities promoted are not related to the mining sector, as well the land use planning that ignores the mining potential of the Region, are harmful for the development of mining activities.

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Strengths/General Framework:

1. Position:
   - Key – position
   - Proximity to logistic points/harbours/capital cities
2. Human capacity:
   - Number of residents (Stable - Increase)
   - Density population (Medium - low density)
3. Economy factor:
   - GDP per capita (Increase)
4. Infrastructure:
   - Telecommunication accessibility
   - Transport accessibility – presence of railway, road network
   - Energy capacity – percentage of Renewable resources (High) – potential of wind/hydraulic energy (High)

Factors related to Mining Heritage:

1. Employment: Percentage of employment for the sector of Services (Increase)
2. Economy factor: GDP for the sector of Services (Increase)
3. Cultural and Mining heritage:
   - Mining heritage - Mining tradition – touristic mining sites – Good practises
   - Cultural background – Presence of cultural monuments
4. Environmental factor: Presence of springs and thermal waters

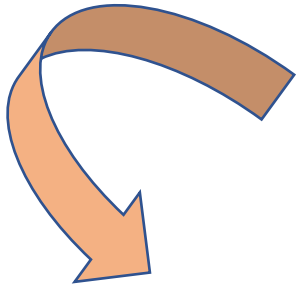
Factors related to Reopening of Mines:

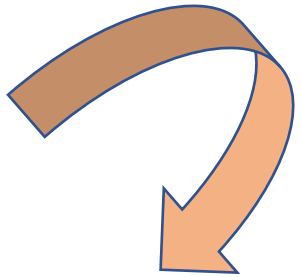
1. Raw Materials Life Cycle: Exploration X
   Exploitation X
   Processing/Metallurgy X
   Recycling/Recovery X
2. Economy factor:
   - Regional GDP of Industry (Stable)
   - Support – economic dependence of the surrounding areas (coal)
3. Mining sector:
   - Exploration - metallic minerals
   - Exploitation - mineral potential and geological knowledge
   - Exploitation - resurgence of metal mining – advanced projects for the exploitation of metals
   - Contribution to the national production (High – ornamental rocks, metallic and industrial minerals)
4. Processing/metallurgy:
   - Presence of downstream industries & companies for mining services
   - Technologies to increase efficiency
5. Waste: Use and promotion of waste
6. Recycling/Recovery: Presence of recycling industry (for example Al)
7. Associations and clusters: Cluster of Mining – networking among mining companies – institutes – administration, and a variety of associations and advisory collegiate entities
8. Employment: Presence of skilled workforce
9. Education capacity: Presence of universities - conferences, meetings and events related to M&Q sector
10. Administrative policies: Strategy of Mineral Resources, Regional Industrial Master plan, Regional Mining Strategy - plans for financial support of mining activities

Table 5.9.1: Strengths for the Region of Castilla y León

Weaknesses/General Framework:

1. Human capacity: Number of young inhabitants (Decrease)
2. Employment:
   - Employment rate (Decrease)
   - Unemployment - Youth Unemployment rate (Increase)
3. Social acceptance/concerns:
   - Negative social acceptance – social opposition - social rejection for mining in some areas
   - Negative effects of non-rehabilitated mines
   - Lack of awareness about the need of RM





Factors related to Mining Heritage:

1. Cultural and Mining heritage: Mining heritage: Abandoned/closed mines – Unknown position at the districts

Factors related to Reopening of Mines:

1. Employment: Employment and Percentage of employment for the sector of Industry (Decrease)
2. Economy factor:
   - Number of registered companies (Decrease)
   - Value of production (Decrease)
   - Conflicting interests of mining with other sectors
   - Regional GDP and GDP of M&M per capita (Decrease)
3. Mining sector:
   - Exploitation – Number of exploitations (Decrease)
   - Exploitation – Number of metallic mines (Low)
   - Production – Oil/gas limited production
4. Energy capacity: Coal mines recently closed
5. Business: Number of medium-large companies (Low)
6. Administrative policies: Long and complex permitting procedures

Opportunities/General Framework:

1. Position: Key – position in a National - European level
2. Economy factor:
   - Number of Registered companies (Increase)
   - GDP per capita (Increase)
   - Exporting activities (High)
3. Funding: Funding opportunities (European and National level)
4. Infrastructure: Energy capacity – percentage of Renewable resources (High) – leader in renewable energies
5. Social acceptance/concerns: Positive in general

Factors related to Mining Heritage:

1. Employment: Percentage of employment for the sector of Services (Increase)
2. Economy factor: GDP for the sector of Services (Increase)
3. Cultural and Mining heritage:
   - Mining heritage: Mining tradition - Existence of mining sites of globally importance
   - Cultural background: Existence of monuments of globally importance

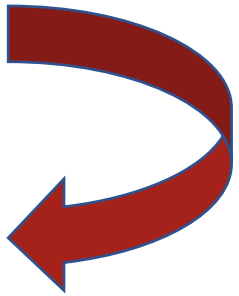
Factors related to Reopening of Mines:

1. Mining sector:
   - Strong mining sector
   - Presence of advanced projects – mineral potential
   - Production - Good position in a National/European scale – production of metallic, industrial minerals and ornamental rocks
2. Administrative policies: Spanish Mining Act – Exhaustion factor – helpful for investments

Table 5.9.3: Opportunities for the Region of Castilla y León

Threats/General Framework:

1. Employment: Unemployment – Youth Unemployment rate (Increase)
2. Economy factor: Economic crisis



Factors related to Reopening of Mines:

1. Employment: Employment and Percentage of employment for the sector of Industry (Decrease)
2. Economy factor:
   - Value of production (Decrease)
   - National GDP of M&M (Decrease)
   - National GDP of M&M per capita (Decrease)
3. Mining sector: Exploitation – Number of exploitations (Decrease)
4. Business: Number of medium-large companies (Low)
6. Administrative policies:
   - Need for update – Mining Act
   - Land use planning – environmentally protected areas and urban development plans prohibition – ignore of mining potential
   - Activities promoted - Preference of alternative rural activities

Table 5.8.4: Threats for the Region of Andalucia

5.10 SWOT ANALYSIS: REGION OF ALENTEJO

Based on the **Figure 5.1.1,** the main Strengths, Weaknesses as regards to the Internal Environment and the Opportunities and Threats in accordance with the External Environment, are represented on the next tables. The following data represent the most important factors, examined for the SWOT Analysis, for the Region of Alentejo.

5.10.1 Strengths/Region of Alentejo

Table 5.10.1 presents indicators such as Human and Education capacity, Economy, and Infrastructure providing the general outline of the Region, which can be considered as Strengths for the Region of Alentejo. The two sub-tables following the general table present the provided data that can be categorised as Strengths for the case of Mining Heritage and the case of Re-opening of mines, respectively.

The economy of the Region presents constant to increasing values concerning the Regional GDP and GDP per capita, therefore it can consist a significant Strength for both potentials uses. Concerning the infrastructure, the Region provides good transport accessibility, through road and railway network linking the main cities, while the available ports consists the necessary infrastructure for international connection. It must be noted that in the Region there is a relevant shift towards decarbonisation, through the sustainable use of the endogenous resources, thus by 2020, it is expected that a significant percentage of the energy will be produced by renewable sources (around 15% of all energy in the region), and by 2050, the region will have maximized its natural renewable resources to produce energy (with the change between coal to Natural Gas) (Guilherme and Fialho, 2017). The good infrastructure of Alentejo and the energy investments that seem to present an increasing tendency, set a favourable environment for both types of exploitation of closed/ abandoned mines.

Other factors that appear to have a significance for the exploitation of Mining Heritage in Alentejo, are the mining differentiation and the fact that the specific region is characterized as a rich metallogenic province rendering it appealing for the tourists and visitors. Furthermore, the combination of i) high diversity of cultural heritage, ii) strong mining tradition, iii) increased number of the registered abandoned/closed mines with known status, along with the increasing touristic activity , can set the right conditions that can favour the exploitation of Alentejo's Mining heritage. Moreover, strengths related to the environmental aspect empowering the option of exploitation of Alentejo's mining Heritage, are the presence of areas with naturalistic value in close proximity to abandoned mines and good practices (e.g. concession for environ. remediation of abandoned mines) that can be used as poles for the attraction of tourists in the Region. Finally, regarding the economy of the Region, the GDP for tourist industry presents constant to increasing values, constituting a Strength for the exploitation of Region's Mining heritage.

For the second possible use, that of Reopening of Mines, one of Alentejo's strengths is that metal industry and the M&Q sector is the main job creator, characterised by sustainable exploration, presence of unexplored areas, mineral differentiation and sustainable production technologies. This means that a cutting - edge technologies for a variety of minerals are already active in the area, which may facilitate the start-up of a re-opened mine. Furthermore, the sustainability of

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current active mines could serve as a good reference point for gaining social acceptance for the re-opened mines.

Regarding the business factor, the dominating companies are those involved the valorisation of territorial resources creating a significant strength for the re-opening of mines since the new potential mine will try to enter in a flourishing economic sector. Other strengths empowering the option of re-opening of mines are the mineral resources clustering, the strengthening of Reg. Techno. Transfer System, and finally, the closeness of the specific region's businesses, to logistic centres and harbours with strong export position.

As for RM Life Cycle, the strengths of the Region are related to exploration (and considerable reserves of ornamental rocks (marble, granite and schist), aggregates and metallic minerals (with emphasis on the resources of the pyrite range of BaixoAlentejo)), exploitation (10 mines with concessions authorized (active), 4 mines with its concession in advertising, and 2 mines with concession areas requested, from which 2 major mines in activity (Neves-Corvo and Aljustrel), and 150 active quarries), and processing/metallurgy, factors that constitute not only the strengths for the Reopening of Mines, mainly because of the presence of infrastructures that potentially could provide areas, exploited for their Mining Heritage.

Finally, the education capacity in Alentejo is characterized by the existence of institutions and research centres providing professional training related to M&Q sector, promoting at the same time research and development activities. This parameter is very crucial for the case of re-opening of mines, since it indicated that: i) highly qualified and trained personnel will be available within the Regions' workforce and ii) there is a research and innovation potential within the Region, therefore in case needed, synergies between academia and industry might occur in order to identify high-tech innovative solution for the exploitation of wastes or low-quality ores. As indicated by the data provided by the Region, already there seems to be research activities focuses on the use of wastes from extractive industry/natural stone, as well the research on mining waste, and the mining I/D related to environmental issues, therefore a significant know-how is already present in the Region.

5.10.2 Weaknesses/Region of Alentejo

Table 5.10.2 presents the general indicators exported by the the general outline of the Region, which can be considered as Weaknesses for the Region of Alentejo. The two sub-tables following the general table present the provided data that can be categorised as Weaknesses for the case of Mining Heritage and the case of Re-opening of mines, respectively.

Regarding the Human capacity of Alentejo, the population of the Region constitutes the 6.94% of the total number of the country's inhabitants. (INE, AnuárioEstatístico da Região Alentejo 2006, 2009, 2010, 2016, 2017). Despite the fact that this Region hosts a significant percentage over the total population, the recent demographic data indicate that the population in Alentejo presents decreasing tendencies, the population density exhibits low levels, while the ageing index is increasing. A second indicator that is related with the Human Capacity of the Region is unemployment. Even though for the general population of the Region the employment rate is stable and with less variations contrary to the country's rate during the same period, for the younger ages the unemployment rate presents increasing tendencies. (INE, AnuárioEstatístico da

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RegiãoAlentejo 2006, 2009, 2010, 2016, 2017). The combination of the aging population and the increased youth unemployment constitutes a significant weakness of the Region, since it is expected that it will not be easy to cover the workforce needs for both types of exploitation of old mines.

In relation to the infrastructure indicators and according to the provided data, even though Alentejo seems to be investing in RES (a great strength for the Region), currently there seems to be a high dependence on energy imports, a fact which constitutes a significant weakness for both the exploitation of Mining Heritage and the Reopening of Mines.

Apart from the factors referred on the General Outline of the Region, focusing on the component of Mining Heritage, the main weakness of the Region seems to be related to the distribution of the abandoned mines which seems to be located closely to areas of granted concession or requested concession, for the northern part of the region. The exploitation of the abandoned mines as mining heritage sites is not easily reconciled with active mining activity, therefore their location can become a great disadvantage for their exploitation as a site for Mining Heritage.

Furthermore, the absence of Administrative policies and environmental strategies to recover mining legacy consist also a significant Weakness for the exploitation of Mining Heritage sites.

As for the Reopening of Mines, the dominant weakness seems to be the shrinkage of the sector. Even though there seems to be new businesses valorising territorial resources (strength indicating the health of the sector), there seems to be a decreasing number of registered companies, as well the small number of mines in Alentejo (apart from the high number of quarries, 2 major mines in activity (Neves-Corvo and Aljustrel), - 10 mines with concessions authorized (active), 4 mines with its concession in advertising, and 2 mines with concession areas requested). Another important weakness that deals with the industrial potential of the Region, is related to the fields of processing and metallurgy, where there are not developed, thus it is difficult to create value chains.

Furthermore, emphasizing on the environmental aspect for the Reopening of Mines, there are environmental issues in the region, related to the environmentally hazardous mining residues, despite the use of wastes from extractive industry / natural stone.

Concerning education and research potential, the distance of the Region from the strong educational institutes of the country further specialized in fields related to M&Q sector, can be considered as an important weakness due to consequent difficulties of interaction concerning R&D issues.

5.10.3 Opportunities/Region of Alentejo

According to the Table concerning the General Outline for the Region of Alentejo, the most significant opportunities for the development of Mining Heritage and the Reopening of Mines, are the funding opportunities, at a European, National and Regional level.

With respect to Human Capacities, a great opportunity for the Region can be the offer of graduates, specialized in the fields of engineering, manufacturing, and construction, at country level, that could potentially constitute the workforce for the reactivation of abandoned mines (on the orientation of Mining Heritage or the Reactivation of Mines).

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On the other hand, the economic development of the country, suggested by the constant to increasing National GDP and GDP per capita, seems to consist a great opportunity for the Region of Alentejo since it can provide a stable frame for the development of industrial or cultural/ touristic investments.

Emphasizing in the component of Mining Heritage, the main opportunities that can be identified are the cultural and mining background at country level and the intertwining sectors. For the first parameter, the presence of old mines, and monuments of global importance, as well the fact that the Mining heritage has been focused mainly in old mines, suggests a significant opportunity for the development of Mining sites as Heritage sites in the Region of Alentejo. Furthermore, the presence of intertwining sectors of wine, dairy, tourism and mining routes, are also an opportunity for the successful exploitation of monuments of Mining Heritage, since with the correct marketing strategy it would be possible to benefit from the relevant tourist streams.

Following the same logic, **Table 5.10.3** presents the main opportunities for the reactivation of mines, are related to the flourishing mining sector at country level (Strong industry around Cu, Zn – mining/metallurgy/processing, good position in a world scale for the specific minerals of Cu and Zn, and World class metallogenic province the Iberian Pyrite Belt). Furthermore, the:

- Current activity and Economic relevance of Iberian Pyrite Belt
- the existence of advanced projects and International companies interested in their potential,
- Growth of international metals market
- International discrimination for export activities), and
- The processing/metallurgy field, in which it has been detected the presence of companies for mining services,

all consist significant opportunities for the re-opening of mines in the Region of Alentejo. For processing in particular, the main opportunities are the promotion of RDI in the industrial sector and the new construction materials which indicates a good potential for the creation of value chains.

In terms of Social Acceptance, a great opportunity for re-opneing of mines in the exploitation of the prestige gained by the Sustainability of the Stone Sector.

Finally, other opportunities for the reactivation of mines constitute the presence of Associations and Institutions promoting R&D in MM (such as CEGMA), and the fact that companies are regional stakeholders in EU projects.

5.10.4 Threats/Region of Alentejo

According to the **Table 5.10.4**, the General Outline for the Region of Alentejo, harmful for the development of Mining Heritage and the Reopening of Mines in relation to the Human potential, the population migration to urban areas which renders the Region of Alentejo with a low capacity to fix the demography regression. The increasing unemployment rate, that has also been observed for the youth generation, in a country's level, is one of the main threats from the comparison of the country with the external environment which can result to a "brain drain" from Portugal to other counties. Therefore, the Human potential of the Region could be further depreciated.

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Focusing on the threats related to the Mining Heritage, the poor link between mining, tourism and culture can constitute a potential threat for the exploitation of areas of Mining Heritage.

For the case of re-opening of mines, one significant threat seems to be related to the reducing number of graduates and academic potential related to the field of interest (M&Q sector), and the low number of students enrolled in the specific courses. This fact has as consequence the reducing number of the specific courses in the universities, thus the reduction of personnel specialised for mining and metallurgical activities.

Furthermore, the neutral to negative social acceptance, mainly due to the environmental impact of those activities and the past mistakes, can create an unfavorable impression of mining which can lead to opposition of the public not only to activities such as the Reopening of Mines but also to the exploitation of those areas for their Mining Heritage.

Concerning the Reopening of Mines in particular, the lack of geological knowledge for the exploitation of existing deposits and the lack of new technologies and methodologies (for the exploitation of new deposits) can be considered as important threats. As other threat indicators can be the deficient diversification of exploited minerals, the deficient knowledge about the long run trends of prices and volatility, the undeveloped value chain, and the decreasing value of export of ores and other products.

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Strengths/General Framework:

1. Human capacity:
   - Population perspective - 6.94% of the country's population
   - Employment rate - stable values
2. Economy factor: Regional GDP and GDP per capita (Constant to Increasing)
3. Infrastructure:
   - Transport accessibility - road and railway network linking the main cities - ports creating infrastructure of international choice
   - Energy capacity - shift to sustainable use of the endogenous resources
4. Mining sector: Mineral differentiation – rich metallogenic province

Factors related to Mining Heritage:

1. Economy factor: GDP for tourist industry (Constant to Increasing)
2. Cultural and Mining heritage:
   5. Tourism activities – Number of tourists and visitors (Increase)
   6. Mining heritage - Mining tradition – high number, registration, known status of areas with abandoned/closed mines
   7. Cultural background - Diversity of cultural heritage
3. Environment factor:
   - Presence of Protected Natural areas - Closeness of abandoned mines to areas with naturalistic values
   - Good practice - concession for environ. remediation of abandoned mines

Factors related to Reopening of Mines:

1. Raw Materials Life Cycle: Exploration X
   Exploitation X
   Processing/Metallurgy X
2. Economy factor: Main job creator the metal industry and M&Q sector
3. Mining sector:
   - Sustainable exploration – Presence of unexplored areas
   - Sustainable production technologies
4. Processing:
   - Promotion of RDI in the industrial sector
   - New construction materials
5. Business:
   - New business valorising territorial resources
   - Mineral resources clustering
   - Strengthening of Reg. Techno. Transfer System
   - Closeness to logistic centres/harbours with strong export position
6. Waste: Use of wastes from extract. ind. / nat. stone – research on mining waste
7. Environmental factor: Mining I/D related to environmental issues
8. Education capacity: Existence of institutions and research centers providing professional training- Promotion of research and development activities

Table 5.10.1: Strengths for the Region of Alentejo

Weaknesses/General Framework:

1. Human capacity:
   - Number of residents (Decrease)
   - Density population (Low)
   - Ageing population (Increase)
   - Employment rate (Decrease)
   - Unemployment rate – Youth Unemployment (Increase)
2. Economy factor: Dependence on energy imports
3. Education capacity: Distant from the strong educational institutes on fields of interest

Factors related to Mining Heritage:

1. Cultural and Mining heritage: Mining heritage: Position – abandoned mines close to areas of concession granted or concession requested (northern part of the Region)
2. Administrative policies: No environmental strategies to recover mining legacy

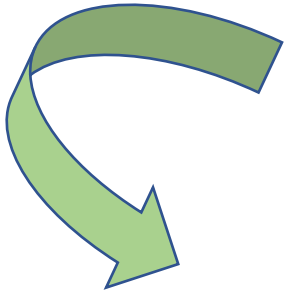
Factors related to Reopening of Mines:

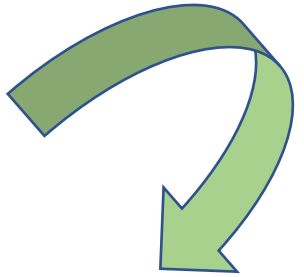
1. Mining sector:
   - Number of registered companies (Decrease)
   - Number of mines (Low)
2. Waste – Environ. Hazardous of mining residues

Table 5.10.2: Weaknesses for the Region of Alentejo

Opportunities/General Framework:

1. Infrastructure: Energy capacity – shift to sustainable use of renewable resources
2. Economy factor:
   - National GDP and GDP per capita (Constant to Increasing)
3. Education capacity: Fields of highest demand related to Engineering, manufacturing and construction
4. Funding: Erasmus+, Alentejo 2020 – Environment and Sustainability (European level, National level, Regional level)
5. Social acceptance: Prestige because of Sustainability of stone sector





Factors related to Mining Heritage:

1. Cultural and Mining heritage:
   Mining heritage:
   - Presence of old mines
   - Focus on the old mines

   Cultural background: Existence of monuments of global importance
2. Intertwining sector: Wine, dairy, tourism and mining routes

Factors related to Reopening of Mines:

1. Mining sector:
   - Strong industry around Cu, Zn - mining, metallurgy, processing
   - Good position in a world scale for the specific minerals (of Cu, Zn)
   - World class metallogenic province (Iberian Pyrite Belt)
2. Mining Resources:
   - Current activity - Economic relevance of Iberian Pyrite Belt
   - Advanced projects - International comp. interested in potential
   - Markets - Growth of international metals market - International discrimination for export activities
   - Processing: Presence of companies for mining services
3. Regional policies:
   - Institutions promoting R&D in MM (CEGMA)
   - Regional stakeholders in EU projects
4. Associations and clusters: Presence of associations
5. Education capacity: Mining co. and univ. cooperating in R&D

Table 5.10.3: Opportunities for the Region of Alentejo

Threats/General Framework:

1. Human capacity: Demography regression and low capacity to fix
2. Employment:
   - Employment rate (Decrease)
   - Unemployment rate – Youth Unemployment (Increase)
3. Education capacity:
   - Reduction of graduates/academic potential related to the field of interest
   - Low number of students enrolled in the specific courses/low number of the specific courses
4. Social acceptance: Neutral to negative – important factor environmental impact – Unfavorable impression of mining from social media

Factors related to Mining Heritage:

1. Social acceptance: Limited link of mining with tourism or culture

Factors related to Reopening of Mines:

1. Mining sector: Number of registered companies in general and non-financial companies of the extractive industry (Decrease)
2. Mining Resources:
   - Exploration activities - Improvement of geological knowledge (for existing deposits) - Development of new technologies and methodologies (for new deposits) – Exploration and exploration concessions
   - Potential resources – deficient diversification of exploited minerals
   - Markets – Deficient knowledge of long run trends of prices and volatility
   - Value chain – not well developed
3. Business: Value of export of ores and other products (Decrease)

Table 5.10.4: Threats for the Region of Alentejo

6. CONCLUSIONS

The present Deliverable investigates the **after-life possibilities** of currently inactive mines present in several European regions. There are **two ways** of exploiting an **inactive mine** (apart from the rehabilitation of the mining site): as a **mining heritage site** or, if suitable conditions are applicable, as a **re-opened mine**. It must be noted that the decision for the future of inactive mines responsibility exclusively of the Regions and the analysis included in this deliverable serves only as an **assistance** to the regions in assessing their potential.

Within the frame of this Deliverable, MIREU partners in collaboration with the Regions, have identified and provided data dealing with the **identification of inactive mines**, **the cultural and mining heritage of the regions, the regional educational and research capacity** along with **economic, demographic, geographic and infrastructure data**. All these data served as input for the evaluation of the potential of each Region individually, in the form of a SWOT analysis. Nevertheless, the elaboration of the SWOT analysis was based in 3 major pillars: i) the **Mining** and **Cultural Heritage** of the Regions ii) the **research** and **Education capacity** of the Regions and iii) the **funding possibilities**, **instruments** and **schemes** for the Regions.

The general **methodology** for the SWOT Analysis of each Region of interest included the **analysis of the examined factors** initially through the **general aspect**, which provided data for the general outline of the Region. The **specific data** on the other hand, provided a more detailed insight of the Regions **for both suggested exploitation routes** (Mining Heritage and Reopening of Mines). It must be noted that the two potential uses of the inactive mining sites are **antagonistic**, therefore the same indicators have a different impact and specific gravity on the respective SWOT analysis. Consequently, for each one of the four categories (Strength, Weakness, Opportunity, Threat), the selected approach was to list the **general indicators** as a first level and then present in different lists the **specific indicators** that affect each one of the **two potential uses** (Mining Heritage or re-opening of mines), as a second level.

It must be highlighted that the SWOTs were mainly built on **written answers** of the regions to the **questionnaires** and have not yet been reviewed/commented by the regional partners. Further **interviews with regional partners** should be expected after the submission of this Deliverable, and possible update of the Deliverable can be expected.

The described procedure provided the most important **strengths, weaknesses, opportunities**, and **threats**, related to Mining Heritage and Reopening of Mines and was helpful for the understanding of the framework conditions for each Region.

From all the collected data it appears that all the reviewed regions exhibit **significant mining heritage potential**. In all Regions there are inactive mining sites that could be exploited either as **mining heritage sites** or as **re-opened mines**. Actually, it was evident from the provided data that the future of inactive mines is a **great concern** for the Regions and abandoned mines is also cause for **disbelief** towards the mining industry and in some cases even for conflict.

Even though the analysis that is included in this deliverable is **case-specific** for each Region, during the elaboration and evaluation of the data, **common weaknesses** that could potentially inhibit the exploitation of inactive mines and should be taken into account emerged, such as:

- **Lack of systematic registry and mapping of inactive/abandoned mines**

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- **Competing land uses**
- **Unfavourable administrative processes**
- **Lack of regional research capacity**
- **Negative social acceptance**
- **Difficulties in securing finances**

The most important conclusion that arises from the SWOT analysis and the elaboration of all the data is that that not only there is **significant potential for exploitation of inactive mines** throughout the EU but there is also significant interest on behalf of Regions and local communities to find **solutions for their abandoned sites**. Solving the issue of inactive mines that are maybe abandoned or polluted, thus serving as a constant reminder of **"bad mining practices"**, might actually become the key and assist in changing the **public perception** of mining.

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ANNEXES

1. REGIONAL GENERAL BACKGROUND INFORMATION (STEREA ELLADA, GREECE)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

The following **Table 1.1** makes a summary of main characteristics of the Region:

Area (km²)	15,549 (11.8% of the total area of the country)
Capital	City of Lamia (capital of the prefecture Fthiotida.)
Peripheral units (5)	Viotia Evritania Fthiotida Fokida Evia (island)
Permanent population	547,390 inhabitants (5.1% of the country – census of Greece since 2011)
Mean elevation	538 m
Geomorphology	Mountainous (47.4%) or semi-mountainous (31.8%) plain (20.8%)

Table 1.1: General characteristics of Sterea Ellada. Sources the websites of European Commission, Hellenic Statistical Authority 2011 (ELSTAT) and Copernicus Land Monitoring Service.

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- **Capital**
  - City of Lamia

- **Area (km^2)**
  - The Region of Sterea Ellada is the second largest Greek region, occupying the eastern half of Central Greece, including the island of Evia. The Region is divided into five (5) peripheral units: Viotia, Evia, Evritania, Fthiotida and Fokida, with a total area of 15,549 sq. km. (11.8% of the total area of the country-30 km long and 95 km wide). About its geomorphological features, the most region is as mountainous or semi-mountainous while the plain is just 1/5 of the area.

  - Sterea Ellada is characterized as a region of contrasts both in term of geography and social and economic conditions with industrial and mining sectors co-existing with agricultural activities and dynamic tourism industry.

  - The Region of Sterea Ellada is located in the center of Greece and is bordering from the north with the Region of Thessalia, from the west with the Region of Western Greece, and on the south with the Region of Attica.

  - Sterea Ellada has access on both the Aegean and the Ionian seas from the east and west respectively. The combination of continental and island features makes this region extremely interesting in terms of geomorphological, socio-economic and cultural features, thus creating a set of significant advantages.

- **Population**
  - In 2011, Sterea Ellada had a population of 547,390 permanent residents, which accounted for 5.07% of the total population of the country. In 2015, the population increased by 1.44%, from 547,390 residents to 555,397.
  - The following **Tables 1.2 & 1.3** indicate the number of inhabitants, the population density, the age structure, the working age and the youth population percentage, for the Region of Sterea Ellada and for Greece, respectively.

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Sterea Ellada	2005	2010	2015	2016	2017	2018
Population[19]	549,955	554,791	555,397	553,514	551,895	549,901
Population Density[20]	35.37	35.68	35.72	35.60	35.49	35.37
Age Structure	In the Q4 for 2018: Below 20 years old **21**%; 20 to 29 years old **8**%; 30 to 44 years old **20**%; 45 to 64 years old **28**%; 65 years old and more **24**%					
Working Age Population Percentage[21]	65.9%	63.3%	62.4%	62.4%	62.8%	62.4%
Youth Population Percentage[22]	32.4%	30.4%	29.5%	29.0%	29.2%	28.4%

Greece	2005	2010	2015	2016	2017	2018
Population	10,963,297	11,028,769	10,831,748	10,783,201	10,730,661	10,673,443
Population Density	83.08	83.58	82.09	81.72	81.32	80.89
Age Structure	In the Q4 for 2018: Below 20 years old **19** %; 20 to 29 years old **10** %; 30 to 44 years old **21** %; 45 to 64 years old **28** %; 65 years old and more **22** %					
Working Age Population Percentage	67.4%	65.0%	63.8%	63.8%	63.8%	64.0%
Youth Population Percentage	34.7%	32.4%	30.3%	30.0%	29.7%	29.5%

Table 1.2 & 1.3: Population and characteristics of the Region of Sterea Ellada and Greece. Source: Hellenic Statistical Authority, 2018.

- **Optional: Urbanisation Rate**
  - One of the main directions of the Urban Planning of Regional Operational Program (ROP) for Sterea Ellada, 2015 is the strengthening of urbanization and tertiary sector, using the new opportunities arising from the interface of secondary sector and universities

[19] Number of inhabitants
[20] Persons/km^2
[21] 15-64 years
[22] 0-29 years

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(research centers etc.), the growth of decentralization, the collaboration between private and public sector etc.

• Short Description of Indigenous Group

- No indigenous people

• Industries based on Natural Resources, M&M

- Region of Sterea Ellada is traditionally one of the strongest mining regions of Greece holding the largest deposit of bauxite in the Europe. In addition, the subground of Sterea Ellada is rich in metal deposits such as magnesite, ferronickel, bauxite, and dolomite, in marble and chromite, which are not sufficiently utilized (**Figure 1.1**), which contributed to the creation of dynamic mining sites (Konsolas et al., 2012).

- There are strong mining companies active in the region with mining sites and minerals processing factories. Some of the large companies are Aluminium of Greece (AoG) as a mining and primary aluminium production and specialization in red mud (aluminium mining waste) valorization into marketable products and Larco Nickel Mining one of the dominant mining sites in Europe in nickel production.

- The **Figure 1.1** reflects the most important occurrences in a country' s level for mineral resources of Greece. As shown in the map, the region of Sterea Ellada includes the categories of Industrial Minerals and Rocks, Marbles and other Decorative Stones, as well as Metallic Rocks.

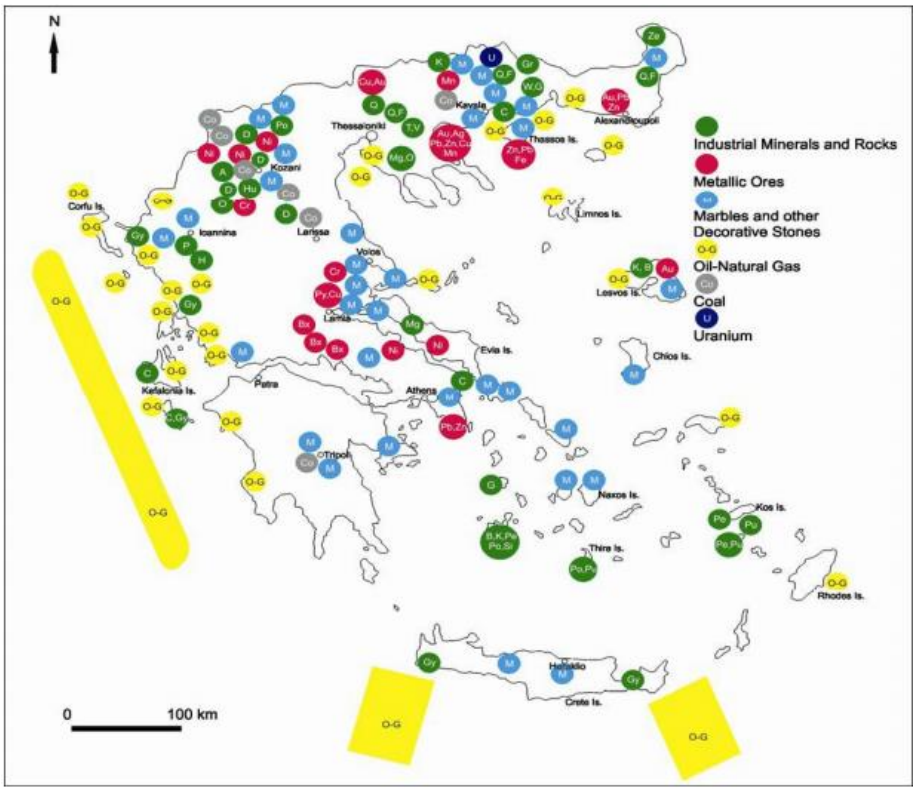

Figure 1.1: Mineral Resources of Greece (Tsirambides, A., & Filippidis, A., 2012).

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- **Infrastructure**

The Region of Sterea Ellada is neighbouring with the Metropolitan area of Athens, many of the prefectures of this Region are easily accessible and in close proximity to the capital of Greece, Athens and the harbour of Piraeus, the most important logistic points in Greece.
One of the main strengths for the region of Sterea Ellada is its central geographical position which covers the intermediate area between Athens and Thessaloniki (the second biggest logistics point in Greece), thus providing easy access to both of them. Furthermore, the location of Sterea Ellada provides easy connection to the emerging logistic locations Ioannina - Igoumenitsa of the Adriatiki axis (**Figure 1.2**).

Transportation System

Region has a strong transport infrastructure, having traversed along the International highway completion in Patra - Athens - Thessaloniki - Evzoni and the international railway line Athens - Thessaloniki, sections of the International European Transport Network. Finally, the transport network is supported by ports and small ferries, but with significant upgrading capabilities.

Road Network

The main roads of Greece are the roads with a significant value for road transport at national level: motorways (for short, "A / D") and national roads (for short "EAs"), also known as expressways.
The Greek motorway network numbering and state of completion – until May 2019. The major highways of the Region of Sterea Ellada are the Highway 1 (A1) and the Highway 3 (A3). Other important roads are the Motorway 11 Schimatari-Chalkida and the Motorway 13 Yliki-Thiva-Elefsina (Bypass of Attica).
The Highway 1 (A1, aka A.TH.E. (Athens - Thessaloniki - Evzoni) as previously PATH.E. (Patra - Athens - Thessaloniki - Evzoni) is a motorway in Greece, part of the European Route E75. With a length of 550 km, this road is the main road in Greece, crossing the country vertically. It runs through many regional units such as Attica, Viotia, Evia, Fthiotida, Magnisia , Larissa , Pieria , Imathia , Thessaloniki , Kilkis.
The Highway 3/ Central Greece Motorway (A3 aka E65) is a partially completed highway which connects the Eastern and Western Greece and in the future it may be part of European Roadway 65.
The Highway 11/ Schimatari - Chalkida Motorway (A11) is a branch of Motorway 1 which connects it to the city of Chalkida. It starts in Schimatari and ends at Psachna north of Chalkida.
The Highway 13, aka "Skip Attica" is one being planned motorway. When completed, it will start from Material at a hub with the ATHE Motorway and will end at Agios Loukas at a junction with Attiki Odos. The highway will help those who really want to travel, eg from Lamia to Corinth, since it bypasses important part of Attica and thus will not create major bottlenecks. (1)

Bus network

The long-distance buses and those on the islands are operated by KTEL (Koino Tamio Eis Praxeon Leoforion). There are buses from Athens to almost all towns in Greece. There are also regional bus stations that connect large towns with local villages and important towns of the area.

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Liossion Bus Station
These buses are green and they are served by KTEL, the company of suburban buses in Greece. Liossion Bus Station in Athens serves buses to the prefecture of Sterea (e.g. towns like Lamia, Agios Konstantinos, Kammena Vourla, Karpenisi, Delphi, Levadia, Arachova, etc), towns of Northern Greece (e.g. Volos, Katerini, etc) and the island of Evia.

Railway network

Trains in Greece are operated by Greek Railways Organisation (Organismos Sidirodromwn Ellados-OSE). The services are still improving and of a good standard. In **Figure 1.2** below, the existing rail network connects or predicts connection with the five major ports of Greece (yellow circles), ie Piraeus / Iconium, Thessaloniki, Patras, Volos and Alexandroupolis. The port of Patras is one of the most important gates between Greece and the West Europe. In addition, the ports of Thessaloniki and Piraeus / Ikonium are basic combined transport gates as they have an extensive and well-organized container handling infrastructure (well-sized piers, cranes, etc.) and, furthermore, are standardized unloaded gates for the SE. Europe. (2)

Ports

In the Region of Sterea Ellada, there are a lot of harbors usually connected with the road network. The ports of Arkitsa, Agios Konstadinos and Stylida are in the regional section of Fthiotida. In the Regional unit of Evia, there are the ports of Chalkis, Aidipsos, Eretria, Skyros, Kimi and Karistos. The Itea is the port of Amfissa in the Regional Unit of Fokida. (3)
The port of LARKO in Larymna in Fthiotida and the port of Aluminium of Greece in Agios Nikolaos in Viotia are of particular interest. High-purity, low-carbon, granulated ferronic, which is used exclusively in the production of stainless steel is stored at the port of LARKO in Larymna in order to promote it to customers. (4) In Agios Nikoloas, the port exclusively serves the plant of Aluminium of Greece for unloading raw materials (bauxite) and loading the company's products (alumina and aluminum). (5)

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Figure 1.2: Indicative map on network and infrastructure of Greece. Source: www.diva-gis.org/datadown; ec.europa.eu/eurostat; geodata.gov.gr

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Telecommunication

Telecommunication data for the Region of Sterea Ellada were not found. Nevertheless, it is necessary to provide some general information about the country (**Figure 1.3**) where the prevailing situation is understood. Greece ranks 26th out of the 28 EU Member States and belongs to the Low performing cluster of countries.

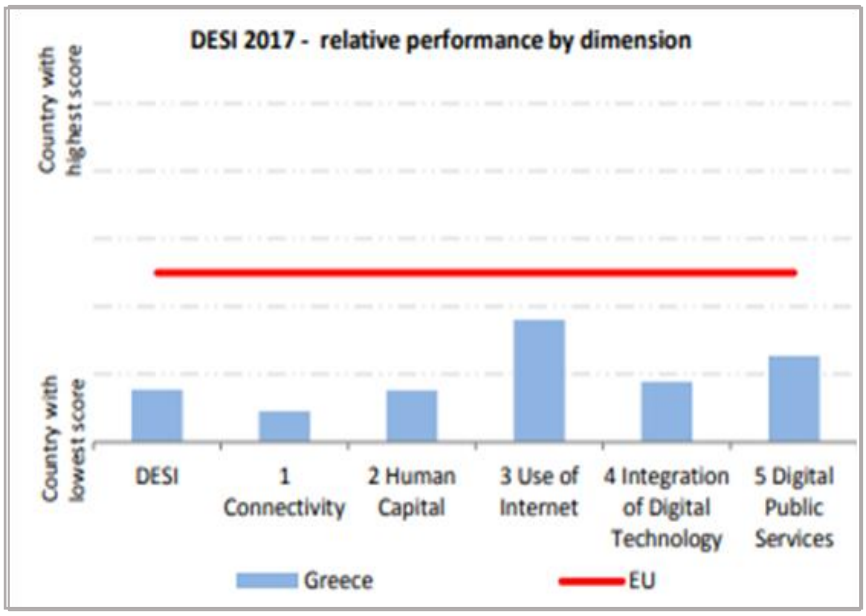

Figure 1.3: Profile of Greece

In Connectivity, Greece features wide availability of fixed broadband but take-up is progressing slowly. Price remains relatively high and the transition to fast broadband connections is slower than in other EU Member States.

- ✓ Mobile broadband take-up lies at 50 subscriptions per 100 people, well below the EU average of 84 subscriptions per 100 people.
- ✓ Fixed broadband take-up remained stable at 66% per household, below the EU average of 74%.
- ✓ Greece remains last amongst the Member States in NGA coverage per household, far from the EU average of 76%.
- ✓ The performance is better in terms of 4G. 4G coverage lies at 80% of households, close to the EU average of 84%.

Two projects are envisaged concerning the deployment of broadband infrastructure and more specifically for High Speed networks - access/local loop with capacity of 30 Mbps or more. (6)

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- **Energy Sources**

According to Eurostat, the share of renewable sources in Greece for 2016 was 15,2% of the total energy consumption.
Among the Greek Regions, the region of Sterea Ellada is one of the most active regions in engaging RES projects: more than 90 energy projects are currently operating, producing 577,8 MW, while another 63 projects have received license for installation and are close to receiving license for operation. Once, active they will contribute additional 620 KW.
At the Region level, Sterea Ellada remains at the top of wind farms, with 907 MW (32%), followed by Peloponnese with 550 MW (19%) and East Macedonia and Thrace with 375 MW (13%). (7)
According to the most recent data of ELSTAT, for the year of 2012, the energy consumed by the Region of Sterea Ellada, corresponds almost to the percentage of 42% of the consuming energy of Greece. Among the prefectures of the Region of Sterea Ellada, the prefecture consuming the highest quantities of energy, for industrial use is Viotia, and then follows the prefecture of Fthiotis and Evia (http://www.statistics.gr/el/statistics/-/publication/SIN03/2012).

NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

- **National and Regional GDP**

	2010	2011	2012	2013	2014	2015
Sterea Ellada[23]	9.903	9.273	8.628	8.075	7.912	7.860
Greece[24]	226.031	207.029	191.204	180.654	178.656	176.312

Table 1.4: National and Regional GDP

[23] GDP in million euros
[24] GDP in million euros

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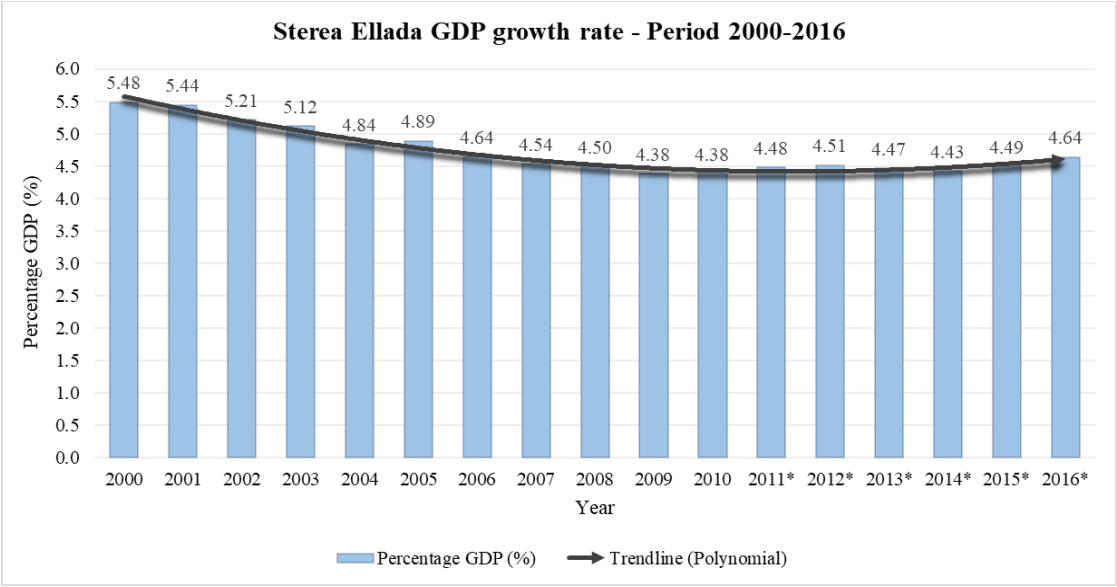

Figure 1.4: Sterea Ellada GDP growth rate for the period from 2000 to 2016. The asterisk is the symbol for ELSTAT' s latest provisional data. Source: own work on the basis of ELSTAT, 2016.

As regards to the Gross Domestic Product (GDP) of Sterea Ellada, estimated by Hellenic Statistical Authority' s (ELSTAT) data of 2016, it remained stable in the period of 2000 to 2016, contrary to the country's significant GDP growth which eventually led to the reduction of the Region's contribution to the production of national wealth (**Figure 1.4**).

	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Greece	19.908	18.134	17.426	16.455	16.513	16.367

Table 1.5: Gross national income at market process (per capita figures)

• National and Regional Employment Level

The following **Tables 1.6 & 1.7** present the number of employees for the country of Greece and the Region of Sterea Ellada

Number of employees	**Greece**	**Sterea Ellada**
Total	3,727,633	175,972
M&Q	**7,888**	**1,089**
Production of primary metals	13,824	3,733

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Production of non-metallic raw materials	15,093	1,386
Manufacturing of metallic products	40,228	3,143

Table 1.6: Number of employees at a National and Regional level.

Number of unemployed	**Greece**	**Sterea Ellada**
Total	**853,003**	**41,306**
Young unemployed	265,758	16,132

Table 1.7: Number of young unemployed at a National and Regional level.

- **National and Regional Economic Structure/Employment by Sector**
  - The employment rates in the region of Sterea Ellada, in the primary and secondary sector remain higher than the corresponding percentages for the whole country. On the other hand, employment in the tertiary sector remains at low levels compared to the average percentage of Greek territory, as can be seen on the charts below (**Figure 1.5 & 1.6**).

Figure 1.5: Greece - Labor Force by Occupation

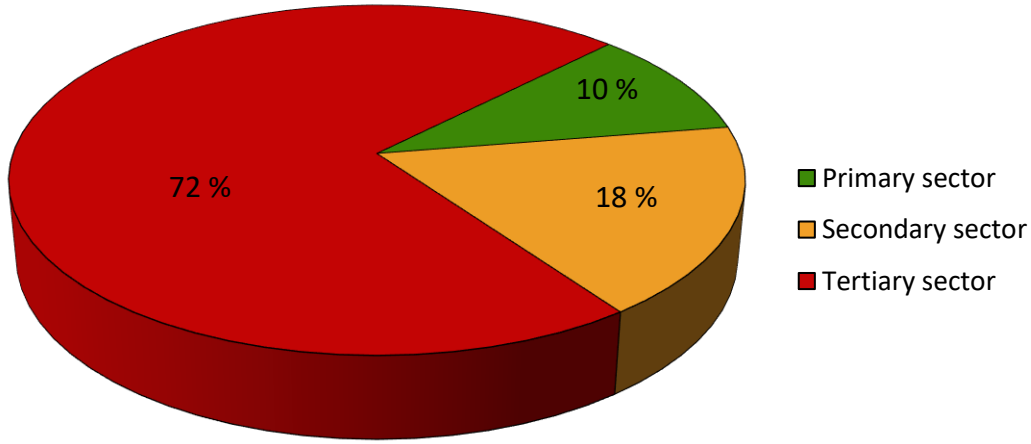

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Figure 1.6: Sterea Ellada - Labor Force by Occupation

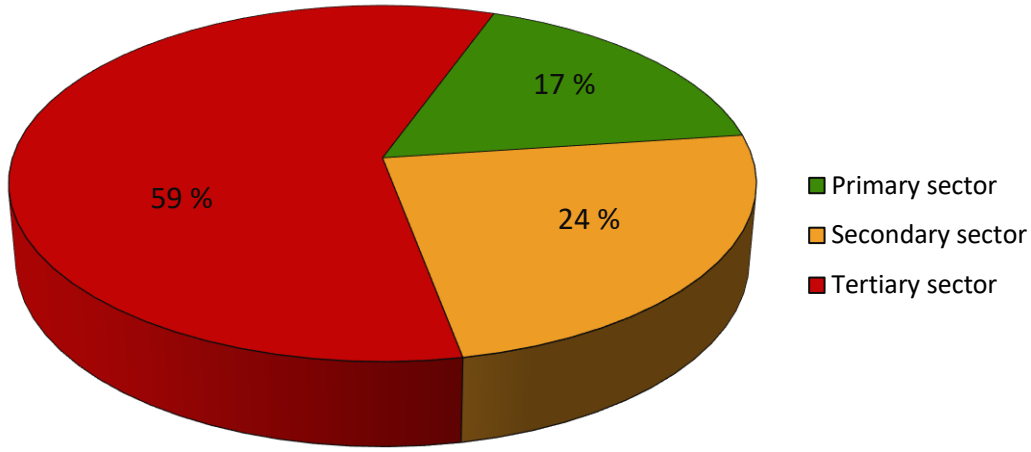

Figure 1.5 & 1.6: Figures indicate employment rates by sector (primary, secondary, tertiary) in a country' s level and in region' s level, for 2011. Source: own work on the basis of ELSTAT, 2011.

- The economically active population in the Region of Sterea Ellada was in 2011, 217.3 th people of which 176 th are employed according to an ELSTAT estimation. Specifically, most of the population was found to be occupied with trade (29%). Furthermore, a high percentage of the population was occupied with agriculture, forestry or fishing (18%) and the third sector recording a high percentage of employment was mining industries or industries in general (**Figure 1.7**).
- The **Table 1.8** that follows, represents the number of employees in a National and Regional level, related to the sector of activity.

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Number of employees	Greece	Sterea Ellada
Total	**3,727,633**	**175,972**
Agriculture, forestry and fishing	372,209	30,495
M&Q	**7,888**	**1,089**
Manufacturing	341,418	24,422
Electricity, gas, steam, airconditioning	31,335	1,498
Water supply, sewerage, waste management and remediation activities	19,665	1,268
Construction	254,081	14,186
Wholesale and retail trade, repair of motor vehicles	651,739	27,546
Transportation and storage	192,871	8,088
Accomodation and food service activities	291,589	11,568
Information and communication	90,743	1,867
Financial and insurance activities	102,307	2,875
Real estate activities	7,443	178
Professional, scientific and technical activities	200,963	6,470
Administrative and support service activities	102,192	3,469
Public administration and defence, compulsory social security	359,779	15,183
Education	294,359	12,214
Human health and social work activities	236,831	7,726
Arts, entertainment, recreation	47,401	1,335
Other service activities	70,721	2,971
Activities of households as employers, undifferenciated goods and services of households for own use	51,586	1,519
Activities of extraterritorial organisations and bodies	523	5

Table 1.8: Number of employees in regional and country level.

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Figure 1.7: Industry/Sector - Sterea Ellada, Greece

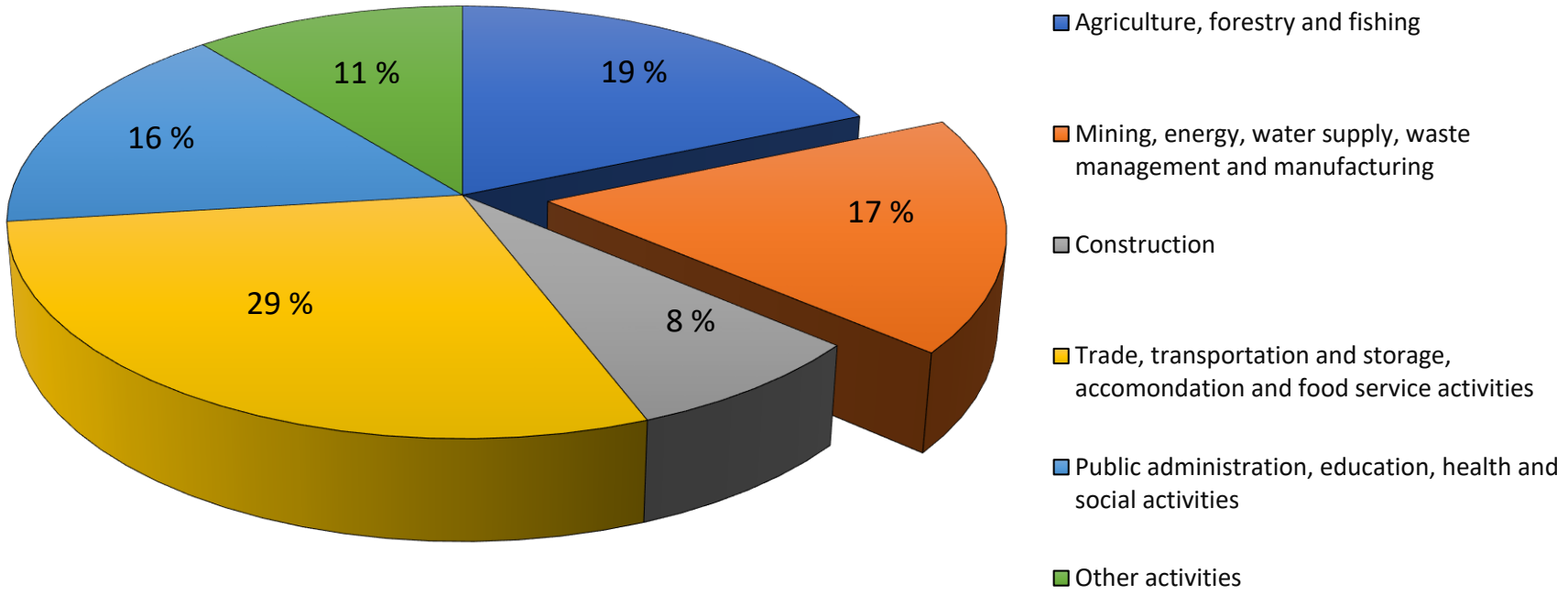

Figure 1.7: The employment rate in accordance with the industry/sector of occupation for the timeline 2000 to 2016. Source: own work on the basis of ELSTAT, 2016.

- **National and Regional Economic Structure/Unemployment**

  - The unemployment in Greece for the timeline 2004 to 2018, the highest rates recorded to 2012, 2013 and 2014 and the lowest in 2007, 2008 and 2009. As regards to the employment rates of inhabitants at Sterea Ellada follow the same trend (**Figure 1.8**).

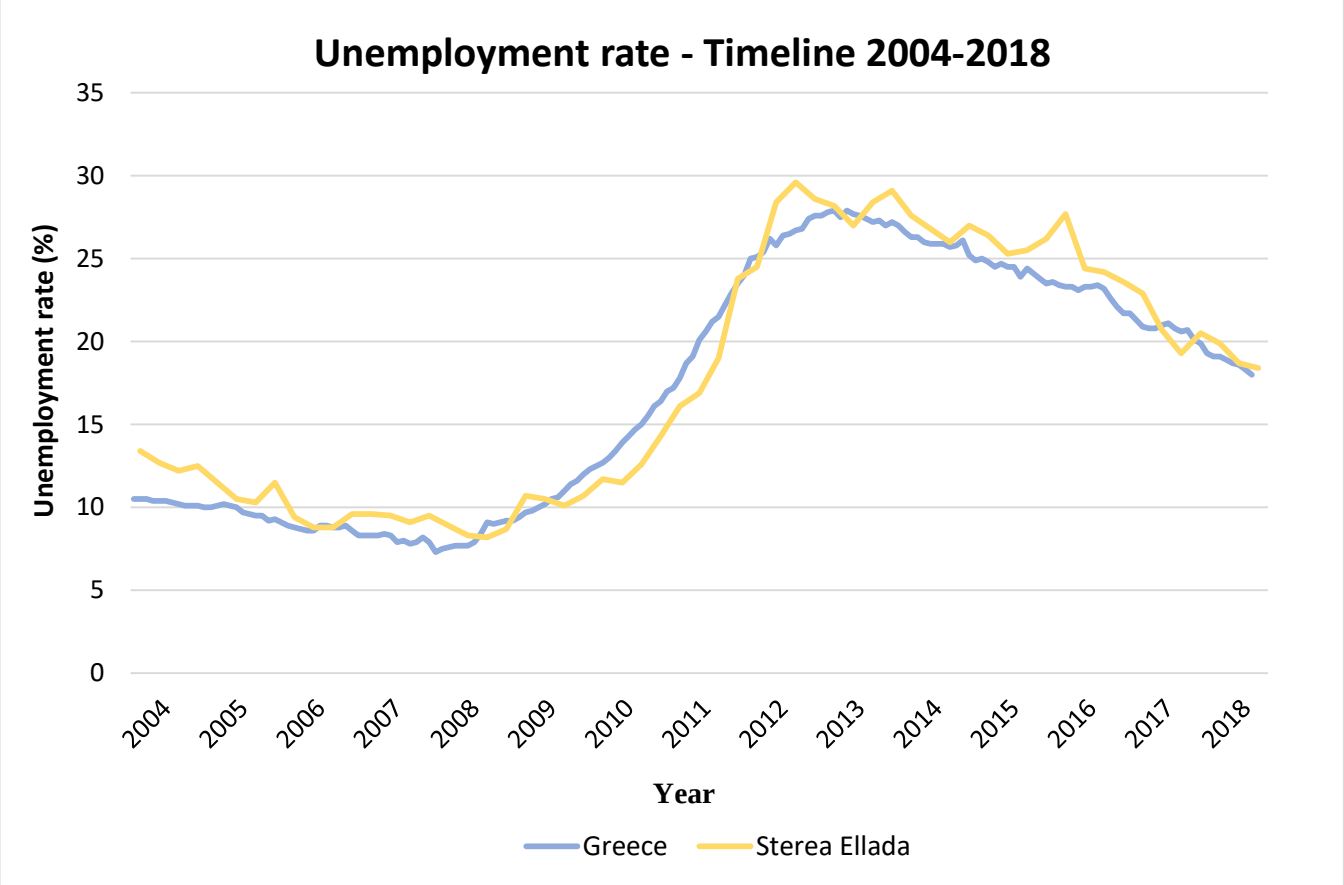

Figure 1.8: Unemployment rate for the period 2004 to 2018. Source: own work on the basis of ELSTAT, 2018.

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REGIONAL INFORMATION IN M&M INDUSTRY

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• Political landscape and legislative framework

As it is mentioned, the Region of Sterea Ellada is the second largest in Greece totaling and it is a geographically well-located region, as it is proximate to Athens, and enjoys a strong industrial sector, being first place in nickel and aluminium production. There are no indigenous people in the region and the main stakeholders are listed in Appendix 8.1.1. The term Social License to Operate is not used in Greece.

Greece's main mining legislation is the national-level Mining Code and the Ministry of Environment and Energy is responsible for issuing permits and licenses relevant to the non-energy extractives industry (NEEI) sector. There are also permits issued at the regional/local level, in which case it is the seven De-centralised Administrations and the 13 Administrative Regions who have jurisdiction.

Who issues what permit depends on the mineral type, size of the project/activity, any land use peculiarities of the area of intervention (i.e. frontier area, protected area), and/or the land ownership legal status. Mineral raw materials are separated into two broad categories, and these have important consequences for ownership - metallic minerals, (subsurface or underground) and these do not belong to the landowner or to the state, and quarry minerals, which do belong to the landowner. Exploration and/or exploitation rights for all metallic minerals, except the ones exempted by the State such as energy and radioactive minerals, can be conceded to any interested party.

• Short Description of Regional M&M Sector

(The following data have been included in the documents by Peter G. Tzeferis, Ministry of Environment and Energy)

The Region of Sterea Ellada has large industrial plants for the treatment of mineral resources and a large number of manufacturing plants located mainly in peripheral units Fokida, Evia and Viotia. It is traditionally one of the strongest mining regions of Greece, holding the largest deposit of bauxite in Europe. Besides, the region has significant deposits of mineral raw materials, such as nickel, magnesite, and chromite, which contributed to the creation of dynamic mining sites.

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There are strong mining companies active in the region with mining sites and minerals processing factories. Some of the largest companies are Aluminium of Greece (AoG) as a mining and primary aluminum production and specialization in red mud (aluminum mining waste) valorization into marketable products and Larco Nickel Mining one of the dominant mining sites in Europe in nickel production. The presence of Terna Magnesite S.A. (TERNA MAG, the GEK Terna) a magnesite and magnesia producer, which exploits the world-class magnesite deposits in the northern part of Euboea island and Heracles General Cement Company (Heracles GCCo), one of the most important cement Greece's producer including two manufacturing plants in peripheral unit of Evia, also play a critical role in region's economy. Finally, another company of great importance in the region of Sterea Ellada and specifically in the peripheral unit of Viotia is TITAN S.A. producing significant quantities of cement (Figure).

Bauxite deposits

As regards to Greek bauxite, the basic raw material for the production of alumina and aluminum, bauxites are originated from serpentinites as well as from metamorphic and magmatic rocks and it is considered as a product of lateritic weathering (Valeton, I. et al., 1987). Apart from the lateritic weathering of parent rocks, another necessity for the deposition of bauxites is karstic voids on the surface of limestones. As a result, Greek bauxite is classified as karst-type deposited in limestone rocks and is of the monohydrate type (diaspor 70%, boehmite 30%).

According to 2014 Mineral Yearbook by USGS, Greece ranks 12th largest bauxite mine producer worldwide, but it is a leading bauxite producer in the EU[25] with an annual production of 1,800 thousand metric dry tons in 2017 (**Table 1.9)**. The measured deposits of bauxites are estimated 250,000 thousand metric dry t, while localization of the major bauxite deposits is in central Greece, within the Parnassos-Ghiona geotectonic zone and on Evia Island (Αναγνώστου, Χ., 2010).

The leading bauxite producer and trading company S&B, Delphi Distomon, SA and ELMIN S.A. use the greater part of bauxite as a raw material, in order to produce aluminum and alumina. The domestic production uses bauxites in cement, steel, and foundries and the rest of bauxite is exported. The most important consumer of Greek bauxite is Aluminum S.A. ("Aluminum of Greece"), the sole producer of hydrated alumina (800 thousand t per year, **Figure 1.9**) and aluminum (150 thousand t per year, **Figure 1.9**). Another important consumer of Greek bauxite is Viochalco, including a great number of subsidiary companies in the Region of Sterea Ellada (viohalco.com).

In 2009 the production of aluminum was reduced by 18% and as a result, the domestic production of bauxite was also reduced by 10%. On the contrary, the next year the production and the exportation of aluminum were increased to 140 thousand t (**Figure 1.9**). In 2011 the production of aluminum, hydrated and anhydrous alumina was increased as can be seen on the chart (Figure). The next years (2012 - 2017), it is recorded the same tending to augment while 2017 was the most productive year for aluminum and hydrated alumina (**Figure 1.9**).

[25] First place in the EU

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Countries	Mine Production of Aluminum			Mine Production of Alumina			Mine Production of Bauxite			Reserves	
	2016	2017	Change (%)	2016	2017	Change (%)	2016	2017	Change (%)	Total	% of Total
United States	841	740	0.19	2,360	1,500	0.80	W[26]	W	ND[27]	20,000	0.1%
Australia	1,630	1,490	0.28	20,900	20,600	1.43	82,000	83,000	2.15	6,000,000	20.0%
Bahrain	971	960	0.05	ND	ND	ND	ND	ND	ND	ND	ND
Brazil	793	800	0.01	10,900	11,000	0.55	34,400	36,000	0.51	2,600,000	8.7%
Canada	3,210	3,210	0.10	1,570	1,570	0.09	ND	ND	ND	ND	ND
China	31,900	32,600	-0.17	60,900	72,300	-5.28	65,000	68,000	0.97	1,000,000	3.3%
Germany	ND	ND	ND	1,900	1,900	0.11	ND	ND	ND	ND	ND
Greece	**ND**	**ND**	**ND**	**821**	**820**	**0.05**	**1,800**	**1,800**	**0.05**	**250,000**	**0.8%**
Guinea	ND	ND	ND	ND	ND	ND	31,500	45,000	-3.55	7,400,000	24.7%
Guyana	ND	ND	ND	ND	ND	ND	1,700	1,500	0.12	850,000	2.8%
Iceland	855	870	0.00	ND	ND	ND	ND	ND	ND	ND	ND
India	2,720	3,200	-0.72	6,030	6,170	0.24	23,900	27,000	-0.31	830,000	2.8%
Indonesia	ND	ND	ND	600	1,500	-0.66	1,400	3,600	-0.69	1,000,000	3.3%
Ireland	ND	ND	ND	1,970	1,930	0.14	ND	ND	ND	ND	ND
Jamaica	ND	ND	ND	1,870	1,980	0.02	8,540	8,100	0.41	2,000,000	6.7%
Kazakhstan	ND	ND	ND	1,500	1,500	0.09	5,000	5,000	0.15	160,000	0.5%
Malaysia	620	760	-0.21	ND	ND	ND	1,000	1,000	0.03	110,000	0.4%
Norway	1,220	1,220	0.04	ND	ND	ND	ND	ND	ND	ND	ND
Russia	3,560	3,600	0.04	2,680	2,800	0.06	5,430	5,600	0.11	500,000	1.7%
Saudi Arabia	ND	ND	ND	1,430	1,450	0.07	3,840	3,900	0.10	210,000	0.7%
Spain	ND	ND	ND	1,580	1,570	0.10	ND	ND	ND	ND	ND
Ukraine	ND	ND	ND	1,510	1,660	-0.03	ND	ND	ND	ND	ND
Other countries	8,100	7,900	0.59	2,160	2,130	0.15	7,820	9,030	-0.17	3,200,000	10.7%
World Total (rounded)	58,900	60,000		121,000	130,000		275,000	300,000		30,000,000	

Table 1.9: It represents the mine production for bauxites and their products at a world level for the period 2016 – 2017 and their reserves. Source: Ober, J. A., 2018.

[26] W: Withheld to avoid disclosing company proprietary data

[27] No available data

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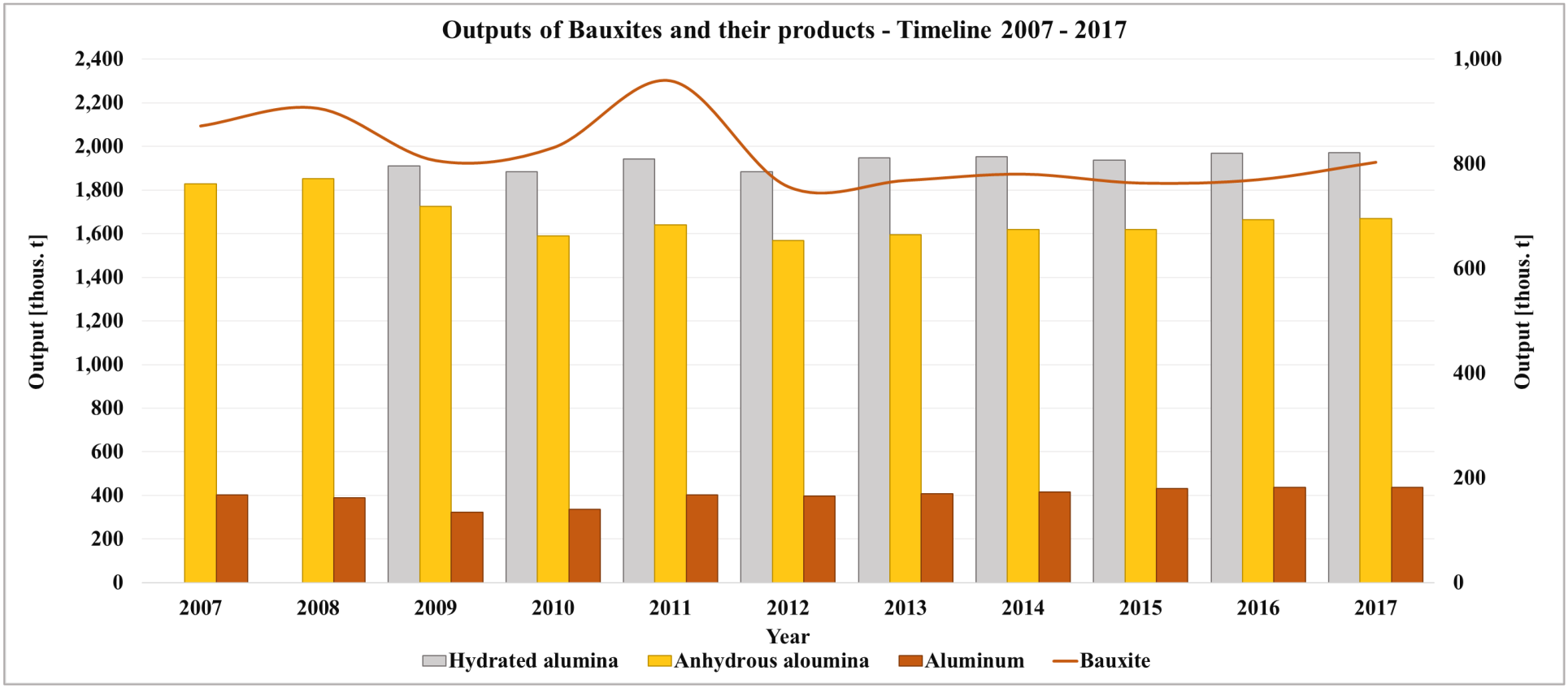

Figure 1.9: Diagram of the Outputs of Bauxites and their products for the period 2007 to 2017. Source: own work on the basis of Tzeferis, P. G., YPAPEN.

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Fe-Ni Laterite deposits

Besides the bauxite deposits, in the Region of Sterea Ellada are located nickeliferous laterites. Greece is the only EU country with extensive but lowgrade nickeliferous laterites, which mainly occur as limonitic laterites and to a lesser extent, as serpentinic laterites. According to World Mining Data 2018, Greece ranks worldwide in the seventh place and the creation of laterites happened because of the erosion of their ultramafic parent rocks. Specifically, the ultrabasic rocks were eroded and transported. Finally, they were deposited in neritic limestones paleokarsts (Jurassic period). Apart from that case, if the ultrabasic ophiolites laterites are the footwall, the laterites are classified as in situ. Finally, the metalliferous layers are covered with limestones (Cretaceous period) (βιβλίο Κοιτασματολογίας; Tzeferis, P.G., 2015).

According to Mineral Yearbook 2014 of USGS (**Table 1.10)**, the Greek laterites are exploited by the nickel-producing company LARCO G.M.M.S.A., which is the most important metallurgical company in producing Fe-Ni alloy in Greece. Moreover, LARCO G.M.M.S.A. was a leading producer of nickel and ferronickel in Europe and the only European consumer of Greece's nickel ore output, mined sedimentary - type nickel laterite deposits by surface (open pit) and underground mining methods. The company mines the domestic deposits of Agios Ioannis (peripheral unit of Voiotia) and Evia. Furthermore, the company exploits deposits of Ni in Kastoria, located out of Sterea Ellada (Tzeferis, P.G., 2013).

[1] In addition, LARCO G.M.M.S.A. is today the only Ferronickel producer in the European Union from local deposits, covering 5 % of the European market's annual demand in nickel. It is a 100% exporting company and is considered among the most reliable producers in the global nickel market. The three nickel mines of Euboea, Agios Ioannis and Kastoria, together have an annual production exceeding two million tonnes. Metallurgy is also present with the Larymna smelter, which has an annual production of 19.000 tonnes of Ferro Nickel Alloy.

As regards the facilities of LARCO G.M.M.S.A, it owns tens of thousands of hectares of land in its portfolio, including a small town where the majority of its workers reside. There are five operational surface mines at Evia, that have modern surface earthmoving equipment, two ore grinding units, two ore beneficiation units, separation using heavy media and one magnetic separator, a homogenization yard and ship loading installations. Transportation of ore from the grinding unit to the enrichment and homogenization installations is by an integral 7.5 km conveyor belt system, which also takes advantage of the altitude difference to produce electrical energy. Finally, the company' s private port can accommodate vessels up to 150,000 t in size (Tzeferis, P.G.,2015; www.larco.gr).

The production of the Greek companies that exploit Fe – Ni laterites and their products can be seen on the chart (Figure…). The rate of production for Fe – Ni laterite remains stable, excluding the timeline 2009 - 2010. Specifically, in 2009 primary metallurgies with the main product the Ni, reduced their production to 50% by decreasing domestic production of Fe -Ni ores (38%). The production contraction of nickel (Ni in Fe – Ni alloy) reached the historically low level of 8,269 t. Compared to the previous year, there was a downturn of 50.3%, mainly due to a decrease in the demand for stainless steel.

In 2010 the primary production of Ni increased about 14,000 t (40%), as the production of Fe – Ni ores (approximately 30%), due to an increase in demand for stainless steel and the restarting of the factory's electric furnaces. Moreover, the export activity in all individual products was also raised. The increase in the production of Ni and the export activity were continued during the next year.

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The exploitation of Fe-Ni laterite is about 98% through open pits. The percentage of 2% is underground exploitation. The Fe-Ni ore is estimated about 160 million t, with an average content of 0.87% Ni.

According to USGS (Ober, J. A., 2018), the highest number of reserves of nickel are situated in Australia (25.7%), Brazil (16.2%), and Russia (10.3%). For the timeline 2016 – 2017, those regions have also very high mine production whereas in 2017 the mine production was decreased. Despite the fact countries such as the Philippines and Indonesia have lower quantities of reserves – 4.8 and 4.5 million t respectively - the recorded mine production for 2016 and 2017 was higher than countries with high quantities of reserves. For example, in 2017 the recorded mine production of Indonesia was 400 thousand t of nickel while the mine production of Australia was 190 thousand t. The recorded change for the timeline 2016 - 2017 for the Philippines and Indonesia was also negative (**Figure 1.10**).

Countries	Mine Production of Nickel			Reserves	
	2016	2017	Change (%)	Total	% of Total
United states	24,100	23,000	-0.06	130,000	0.2%
Australia	204,000	190,000	-0.71	19,000,000	25.7%
Brazil	160,000	140,000	-0.99	12,000,000	16.2%
Canada	236,000	210,000	-1.29	2,700,000	3.6%
China	98,000	98,000	-0.02	2,900,000	3.9%
Colombia	41,600	49,000	0.34	1,100,000	1.5%
Cuba	51,600	51,000	-0.04	5,500,000	7.4%
Guatemala	54,000	68,000	0.65	1,800,000	2.4%
Indonesia	199,000	400,000	9.53	4,500,000	6.1%
Madagascar	49,000	45,000	-0.20	1,600,000	2.2%
New Caledonia	207,000	210,000	0.10	ND	ND
Philippines	347,000	230,000	-5.65	4,800,000	6.5%
Russia	222,000	180,000	-2.05	7,600,000	10.3%
South Africa	49,000	49,000	-0.01	3,700,000	5.0%
Other countries	150,000	150,000	-0.03	6,500,000	8.8%
World Total (rounded)	2,090,000	2,100,000		74,000,000	

Table 1.10: It represents the mine production for nickel at a world level for the period 2016 – 2017 and their reserves. Source: Ober, J. A., 2018.

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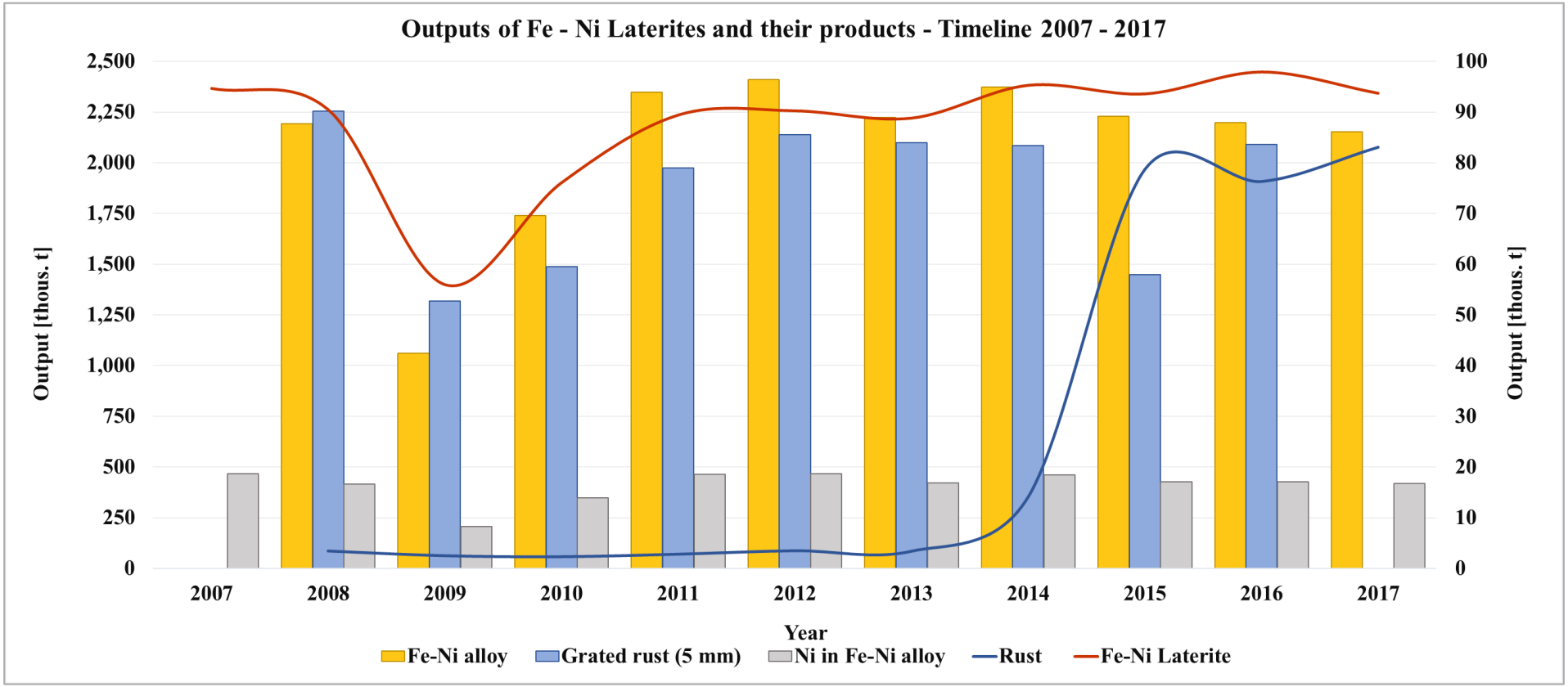

Figure 1.10: Diagram of the Outputs of Fe – Ni Laterites and their products for the period 2007 to 2017. Source: own work on the basis of Tzeferis P. G., YPAPEN.

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Magnesite deposits

Apart from the nickel, the Region of Sterea Ellada includes deposits of magnesite. During 2014, European Union included magnesium/ magnesite in the list of critical metals and minerals and according to World Mining Data 2018, Greece ranks worldwide in the eighth place for the deposits of magnesite mineral resources.

One of the companies that are occupied with the exploitation of magnesite is Terna Magnesite S.A. (TERNA MAG, the GEK Terna). It is a recently established mining company that began mining activities during 2013 and it is situated in North Evia. Terna Magnesite S.A. took over the old «Biomagn», in order to exploit the old magnesite deposits of Gerorema and Kakkavos and the further utilization for production of magnesium compounds on the premises of Fournace's Mantoudi old establishments. In the first phase, the purpose of TERNA MAG was the annual production of 170 thousand t of magnesite.

In 2008 «BIOMAGN» company went out of business and as can be seen in the chart (Figure), the lower values of magnesite and magnesite's products were recorded in 2009, because of declination in those products 20 – 50%. Finally, in the period of 2011, «BIOMAGN» is reactivated and in during 2013, the company is being sold to TERNA MAG.

In 2013 the production of magnesite at the plant of Gerorema amounted 23.6 thousand t of magnesite while the total country' s amount was 383 thousand t (**Figure 1.11**). At the same period, the company began underground mining activities (region of Plakaria – Mourtsitsa).

In 2014 the amount of magnesite production was 86.3 thousand t (after the enrichment) and the total country's amount of magnesite was about 360 thousand t. It was the first year, with a production of 9.3 thousand t of caustic magnesia. At the same period, the reconstruction of the old enrichment plant at the region Kakavos was started by TERNA MAG.

In terms of the resources of magnesite, it is very important to refer that the measured deposits for the region Gerorema – Kakavos are estimated to 9 million t, according to Tzeferis Peter G., 2008.

Countries	Mine Production of Magnesite			Reserves	
	2016	2017	Change (%)	Total	% of Total
United States	W	W	ND	35,000	0.4%
Australia	425	450	-0.14	320,000	4.1%
Austria	710	730	-0.16	50,000	0.6%
Brazil	1,100	1,200	-0.50	390,000	5.0%
China	18,600	18,000	0.00	1,000,000	12.8%
Greece	**400**	**400**	**-0.05**	**280,000**	**3.6%**
India	317	300	0.03	90,000	1.2%
North Korea	700	300	1.40	1,500,000	19.2%
Russia	1,300	1,300	-0.16	2,300,000	29.5%
Slovakia	560	570	-0.10	120,000	1.5%
Spain	300	310	-0.07	35,000	0.4%
Turkey	2,700	2,700	-0.32	230,000	2.9%
Other countries	770	770	-0.09	1,400,000	17.9%
World Total (rounded)	27,900	27,000		7,800,000	

Table 1.11: It represents the world mine production for magnesite for the period 2016 – 2017 and their reserves. Source: Ober, J. A., 2018.

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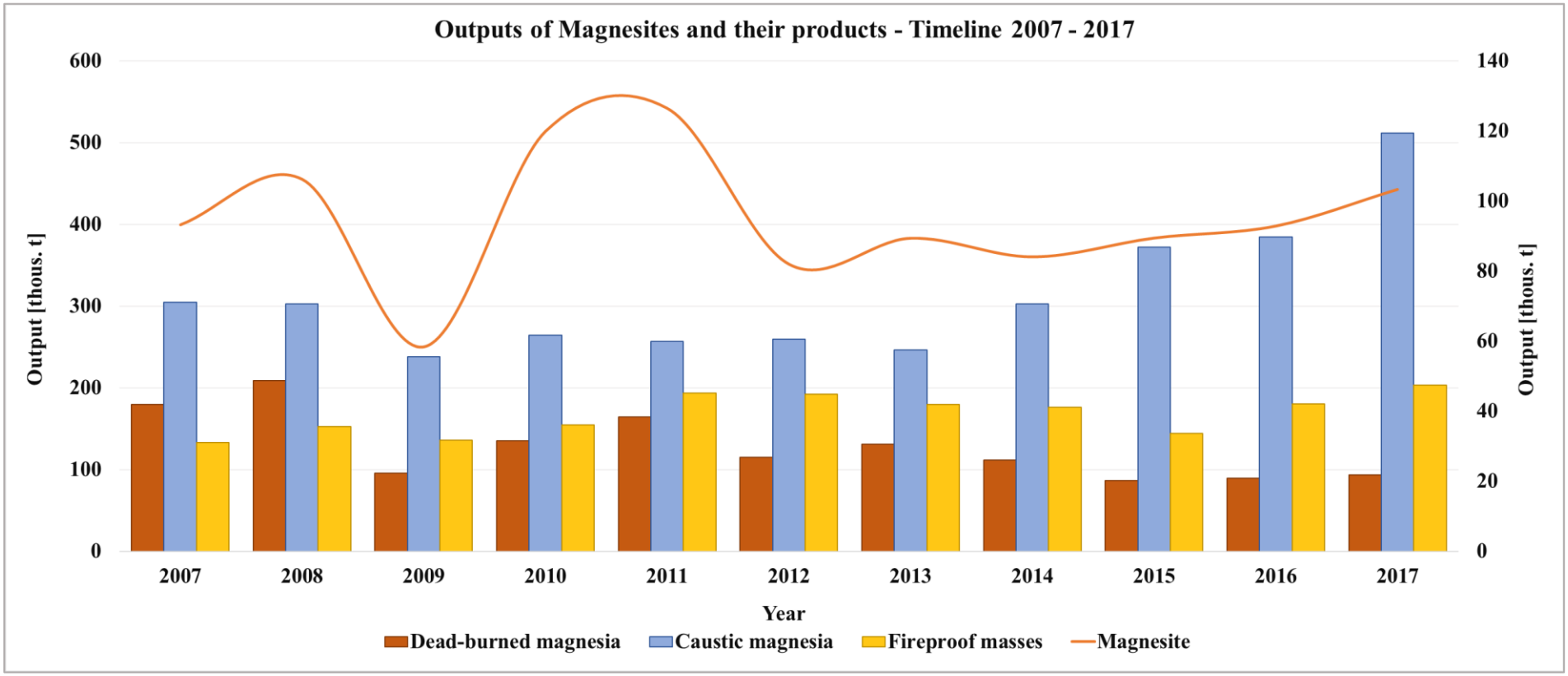

Figure 1.11: Diagram of the Outputs of Magnesites and their products for the period 2007 to 2017. Source: own work on the basis of Tzeferis P. G., YPAPEN

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The following chart represents the outputs of Bauxites, Fe-Ni Laterite and Magnesite for the timeline 1997 to 2017.

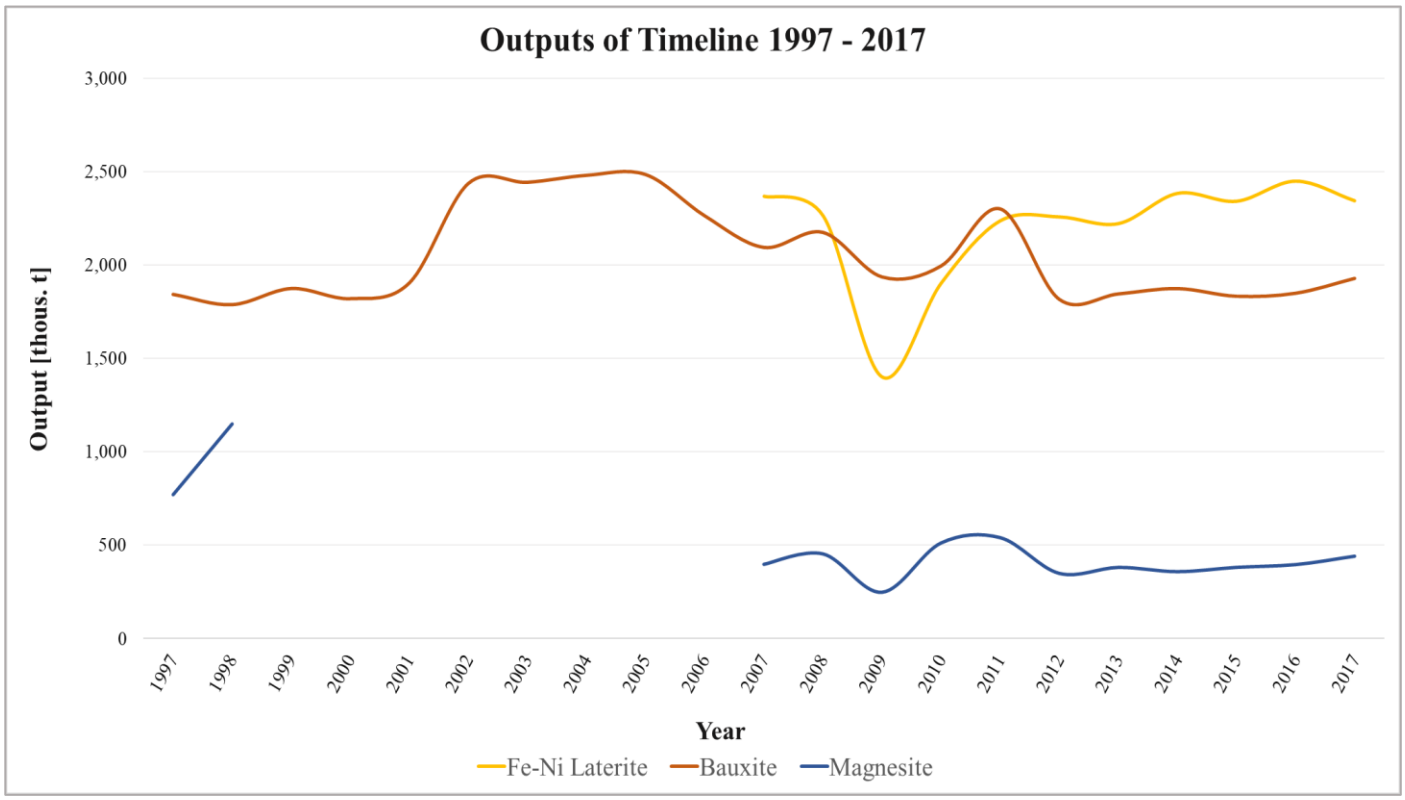

Figure 1.12: Outputs of Fe – Ni Laterite, Bauxite and Magnesite for the period 1997 – 2017. Source: own work on the basis of Tzeferis, P. G., YPAPEN.

- ## Regional GDP of M&M Industry

	2010	2011	2012	2013	2014	2015
Sterea Ellada[28]	2.473	2.494	2.398	2.417	2.321	2.289
Greece	22.368	22.016	21.571	21.791	21.493	21.047

Table 1.12: Gross Value added by industry[29]

[28] In M €

[29] M&Q, manufacturing, electricity, gas, steam, air conditioning and water supply, sewerage, waste management and remediation activities

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- According to ELSTAT, the employment rate measures the number of people aged 15 to 74 who have a job. It corresponds to the percentage of the labor force from the same age group. In the chart below, the recorded employment rate in the field of mining, energy, waste supply, and waste management in the Region of Sterea Ellada estimated about 5 - 8 % greater than country's employment rate in the same field. Additionally, the lines that represent employment rates of Sterea Ellada and Greece, follow the same trend for the period 2000 to 2016 (tradingeconomics.com).

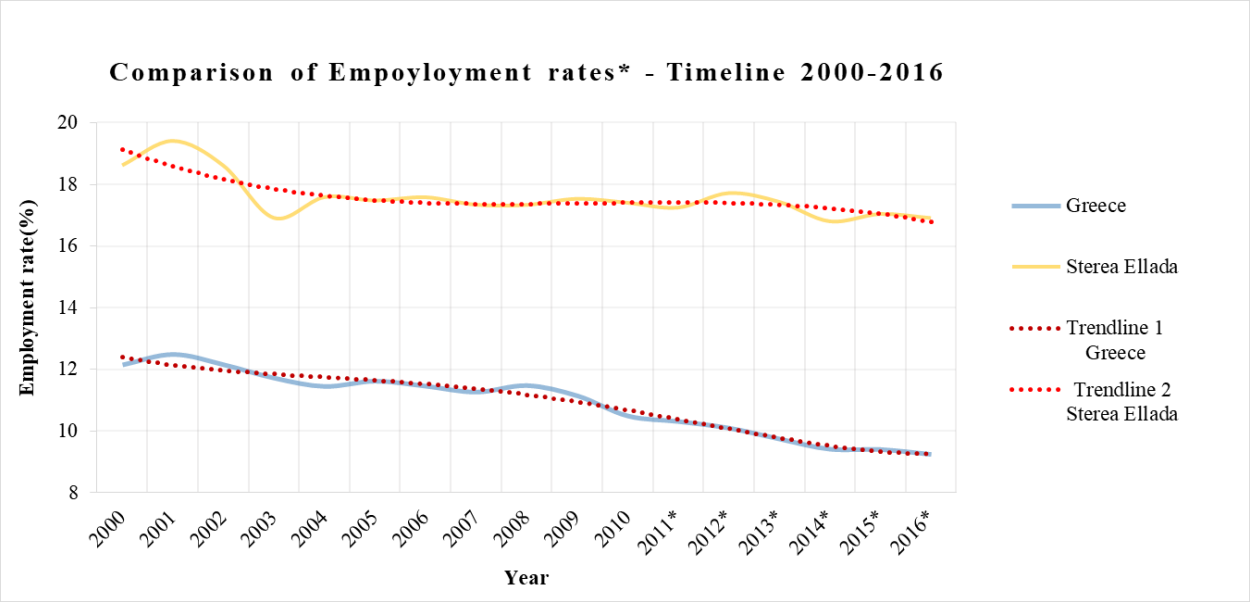

Figure 1.13: Comparison of Employment rates in Mining, Energy, Waste Supply and Waste Management between Sterea Ellada and Greece, for the period 2000 to 2016. The asterisk is the symbol for provisional data.

• Support from Regional and/or National Government

- The relevant administrative, private companies and research institutes (excluding cluster organisations and associations.

• Number of Registered M&M Company

- According to the report on aggregate data on the activity of mineral RM in Greece Ministry of Environment and Energy, the number of active mines, related to metallic raw materials in the Region of Sterea Ellada is greater than the other active categories, such as active quarries of marble, aggregates etc. (**Figures 1.14 & 1.15**). As regards to the percentages of Mines and Quarries, the number of them is characterized as stable, for the period 2015 to 2016, with the exception of the distribution of marble quarries, recording the highest increasement of the active quarries (Tzeferis, P.G., 2015; 2016).

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- The following image from Google Earth, represents some examples from the M&Q activities at the Region of Sterea Ellada, and specifically quarrying activities related to schists, clays and sandstone.
- Finally, the **Figures 1.16 & 1.17**, represent data for the distribution of active and inactive M&Q industries in Sterea Ellada for 2015 & 2016 respectively.

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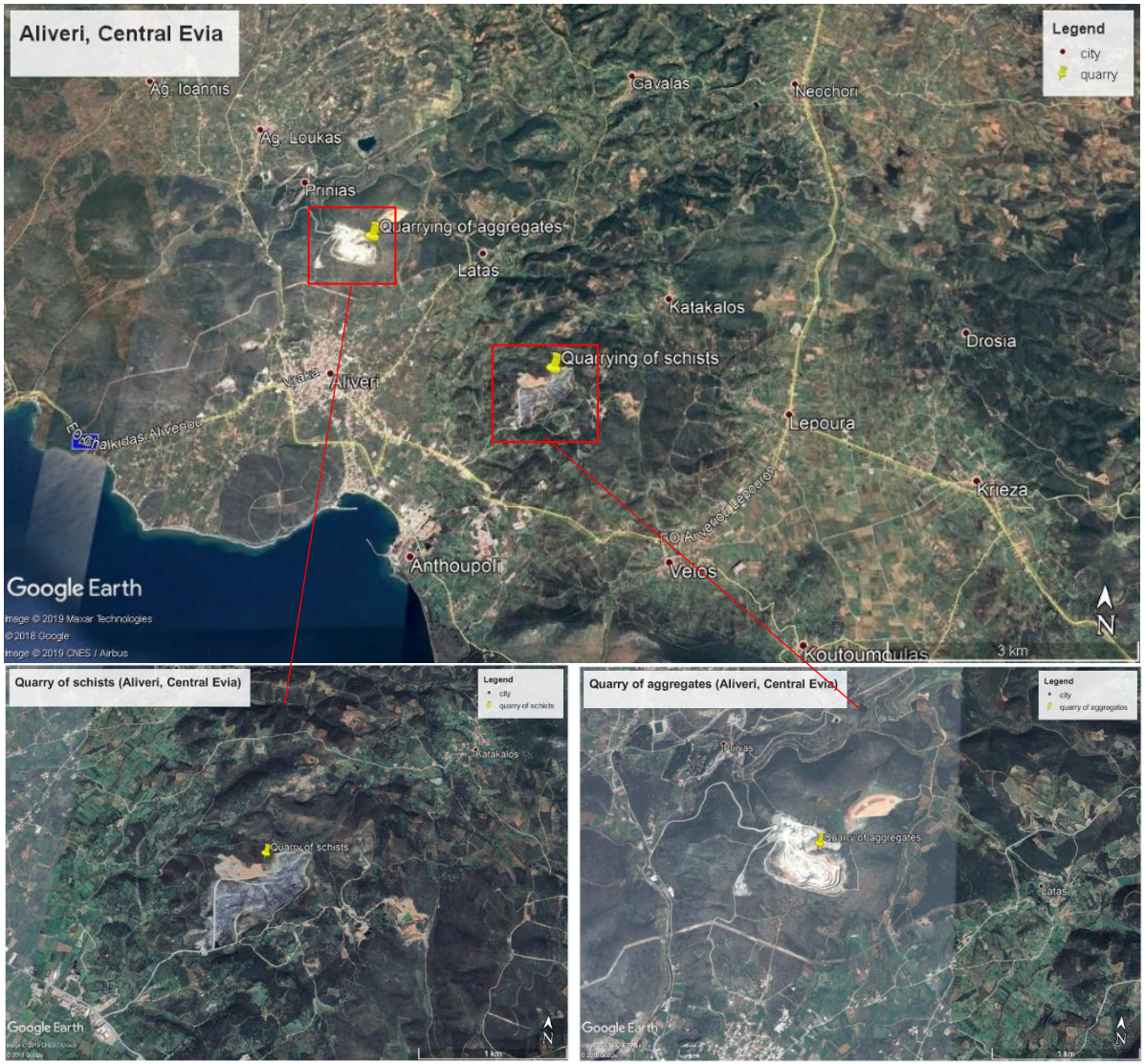

Figures 1.14: Examples of the Quarrying activities at Aliveri, Central Evia. Quarries of schists and aggregates. Source:

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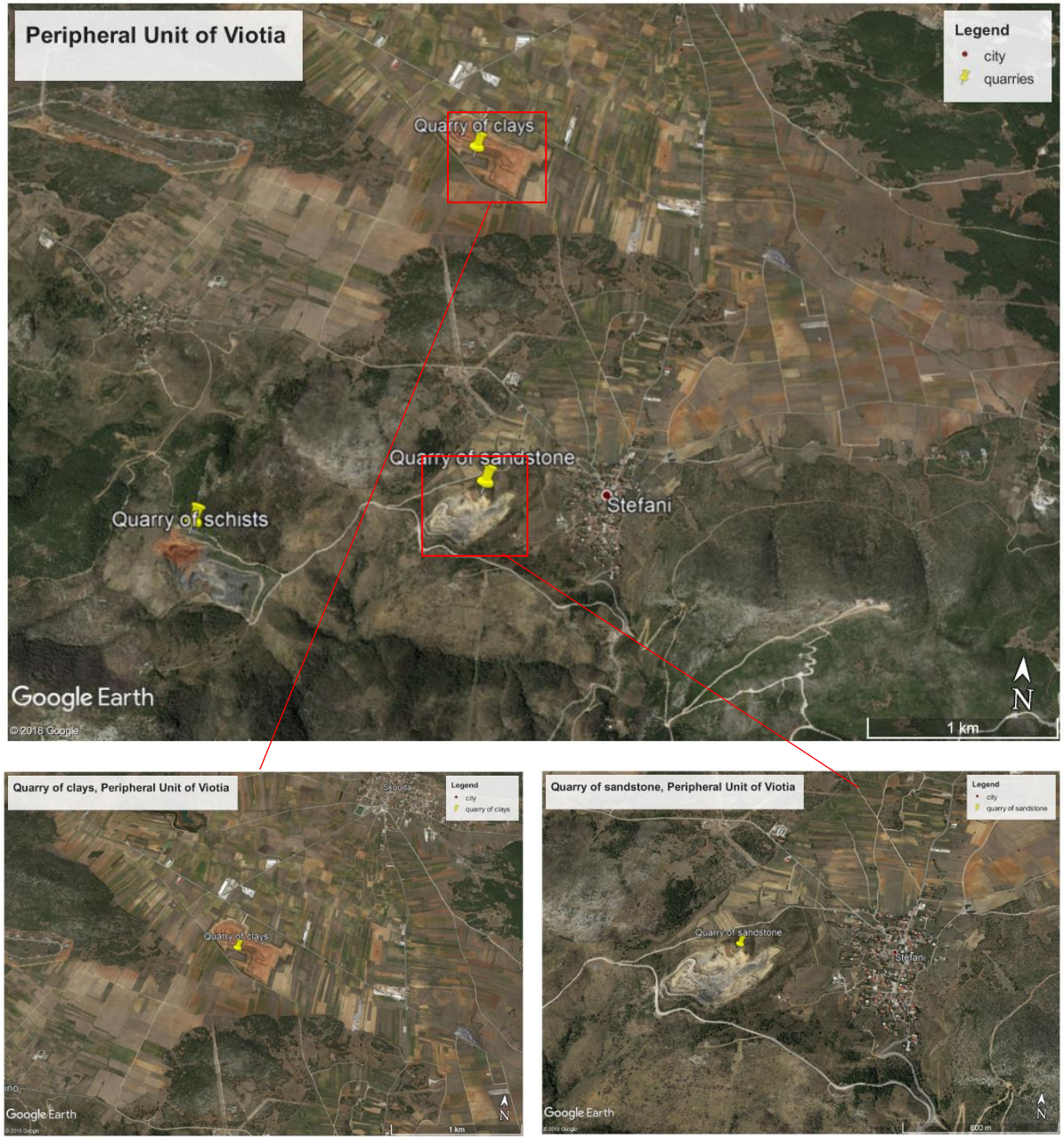

Figures 1.15: Examples of the Quarrying activities at the peripheral unit of Viotia. Quarries of schists, clays and sandstone. Source: Google Earth.

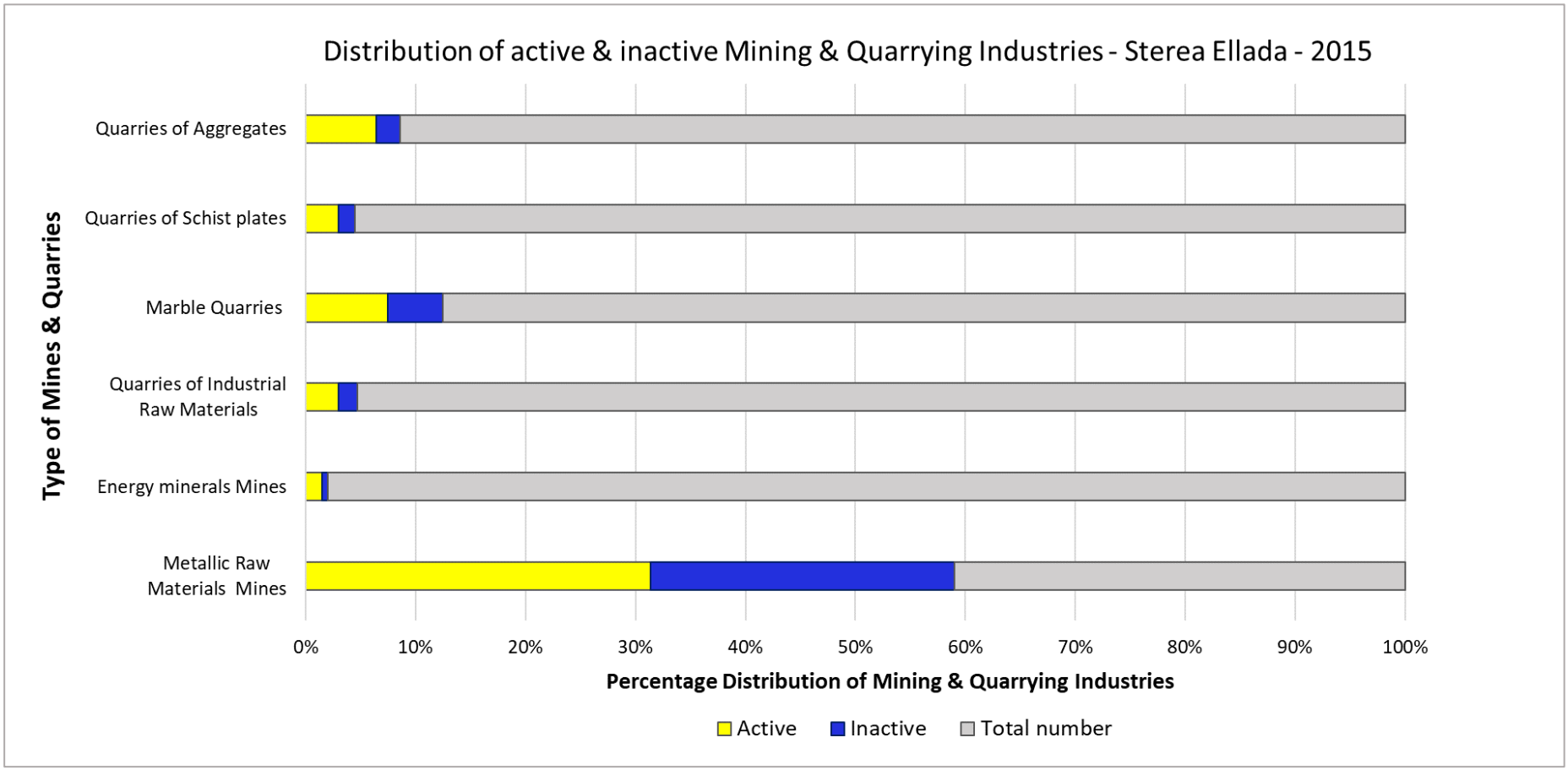

Figure 1.16: This figure represents the distribution of active and inactive M&Q industries in Sterea Ellada for 2015. Source: own work on the basis of Tzeferis, P.G., 2015.

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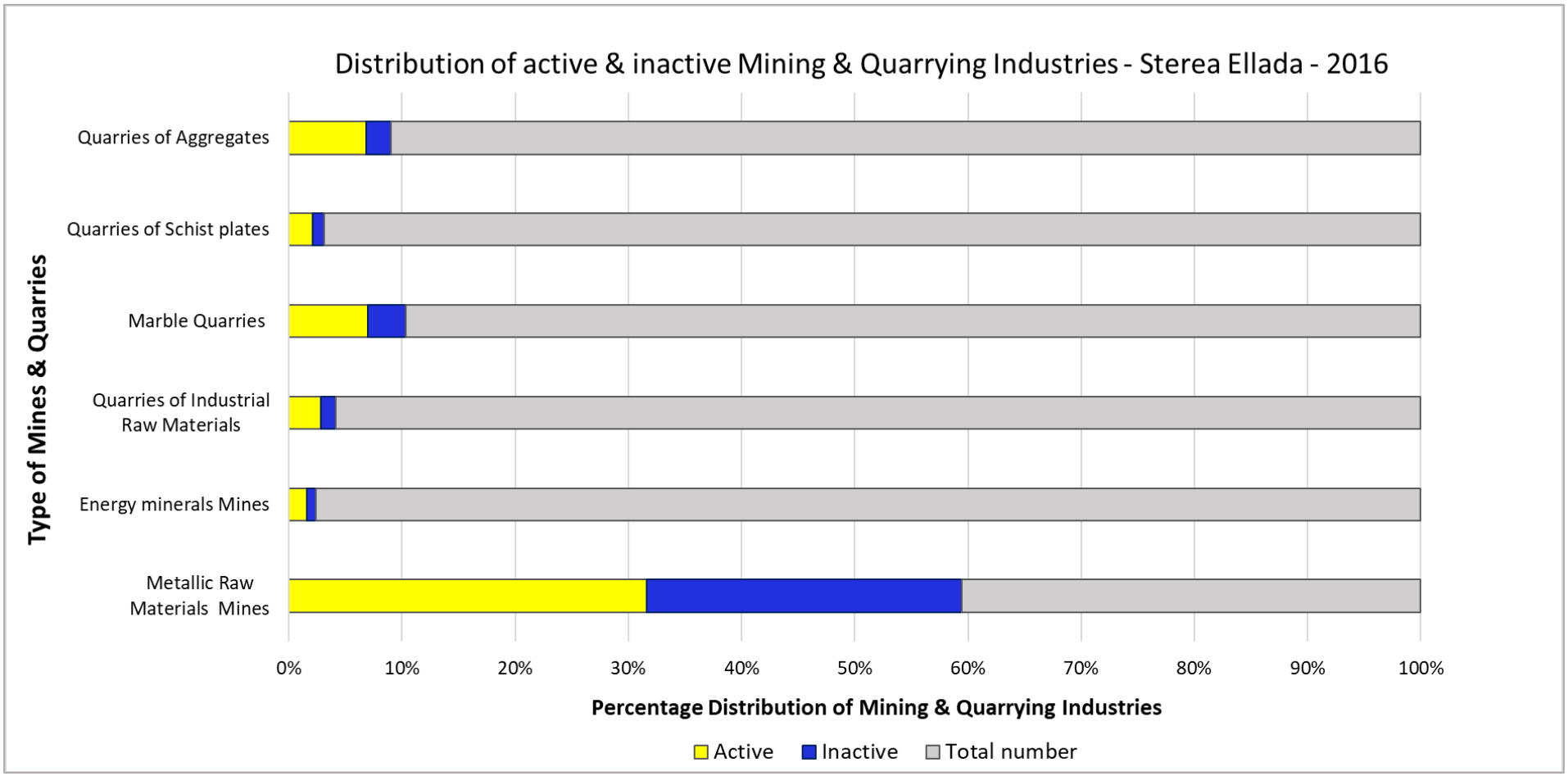

Figure 1.17: This figure represents the distribution of active and inactive M&Q industries in Sterea Ellada for 2016. Source: own work on the basis of Tzeferis, P.G., 2016.

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• Short Description of M&M Cluster and Association

Greek Mining Enterprises Association (http://www.sme.gr**)**

- The Greek Mining Enterprises Association is a professional association of Greek mining enterprises since 1924, and their main offices are located in Athens. The total number of people listed in this association is 9,300 and it includes all of the industries/members.
- The main targets of the association are the promotion of Greek mining sector as a nucleus for regional and national development as well as the cultivation of good relations between the employees and the local communities in the regions where its members are active.

• Short Description of Promotion of M&M Industry

- Promotion in terms of certain schemes, events and activities to raise awareness and relevant programme.

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2. REGIONAL GENERAL BACKGROUND INFORMATION (NORTH KARELIA, FINLAND)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

- **Capital**
  - Joensuu
- **Area (km^2)**
  - 21,583.67 km^2
- **Population**
  - Age Structure 0-14yrs 14.1%, 15-64yrs 60.3%, 65+yrs 25.6%

	2005	2010	2016	2017
Number of Inhabitants	168,322	165,866	164,085	162,986
Net Migration Rate	-37	+287	-28	-273

Table 2.1: Number of inhabitants and net migration rate from 2005 to 2017, region of N. Karelia

Figure 2.1: Inhabitants in North Karelia between 2005 and 2018 (Official Statistics of Finland 2019)

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• Short Description of Indigenous Group

- Not applicable, no Indigenous Groups in the region.

• Industries based on Natural Resources, M&M

- The region's traditionally strong industries include the **forest, metal** and **extractive industries**. Lumber, wood, food, plastic, metal, stone, and travel are region's leading industrial fields. The region has **strong mining history** as opening of the Outokumpu mine was a launch also for the Outokumpu Ltd as well as Outotec Ltd.
- **M&M**: Operating mines Pampalo mine (Au), Kylylahti mine (Zn, Cu, Ni, Co). Vuonos processing plant (Co); Hammaslahti mine re-opening plans (Cu), Liperi claims for copper (Cu), Pampalo research for gold (Au). Outotec mine machine manufacturing plant in city of Outokumpu. Mining % of the turnover, machinery.
- The **main job creator**: Forestry (1,675 persons), metal industry (2,217) machinery (1,343), M&Q (524)

• Infrastructure

- **Transport Accessibility**: Access to capital cities, harbours or other important logistic points. Specifically:
  - **Road network**: Connects the region to capital city of Helsinki (harbour), as well as cities of Kuopio, Kajaani, Lappeenranta, Savonlinna and Hamina-Kotka (harbour) and to Russia. The importance of the road for transportation also between Scandinavia (Norway and Sweden) to Russia has been increasing. The region is included in Trans European transport network (TEN-T) network.
  - **Railway system**: Direct towards south and north, with transfer to west and to Russia. Connection to major cities and harbours, and airports.
  - **Public transport system**: bus and railway.
  - Also, **airport** and the **waterways** of Saimaa, both included in TEN-T network
- **Telecommunication**: Comprehensive coverage of telecommunication in the region.

• Energy Sources

Energy consumption in North Karelia (including heating, electricity and transport) has been a little over 10 TWh in recent years. The share of **renewable energy** of the total consumption is high, about 63%. About 75% of thermal energy and electricity is produced by renewable energy sources. The renewable energy sources in use in North Karelia are **bioenergy** (84%), **hydropowe**r (15%) and **others** (1%). North Karelia is **self-sufficient** in heating and the heating power is produced almost entirely by renewable energy sources. Also, electricity is produced by renewable energy sources over and above the region's own needs. Bioenergy consists almost entirely of wood energy, industrial by-products and forest energy. The aim is to increase the share of the renewable energy source up to 80% by the end of 2020 by decreasing the fossil fuels, oil and peat in energy production and to keep energy consumption in 10 TWh (North Karelia 2012).

Other key climate and energy figures in North Karelia are:

- Forests and forestland in North Karelia absorb a total of 3 M t of CO2 -eq.
- About 84% of the total land area of the region is covered in forest, of which one third is swamp.
- Total emissions decreased by almost 7% between 1990 and 2007.

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• Greenhouse gas emissions in North Karelia totalled 9.4 t of CO2-eq. per person in 2007. The corresponding figure for Finland was 14.8 t.

• The share of renewable energy from the total energy use of the region is about 63%, of which the share of wood energy is 82%.

• Employment in the renewable energy cluster was about 1,100 persons (fulltime equivalent) in 2008 and turnover was about 120 million euros. The growth in both employment and turnover was about 30% from 2004.

• Research, development and educational institutions invest about 5 M € per year in renewable energy.

• In 2011 there was roughly 30 regional, national or international ongoing renewable energy-related projects in the region.

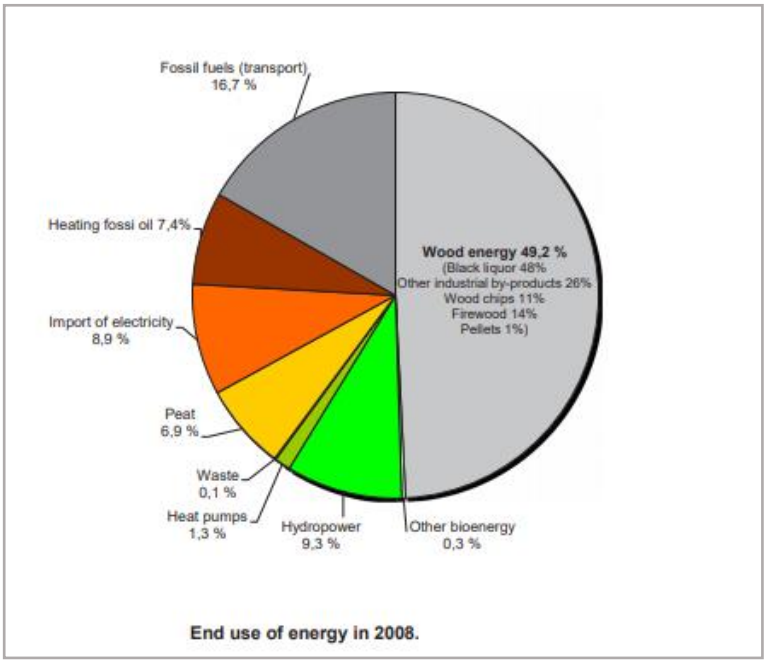

Figure 2.2: Greenhouse gas emissions in North Karelia from the energy, transport, agriculture and waste sectors amounted to 1.6 million tonnes of carbon dioxide equivalent (CO2-eq.) in 2007. (North Karelia 2012)

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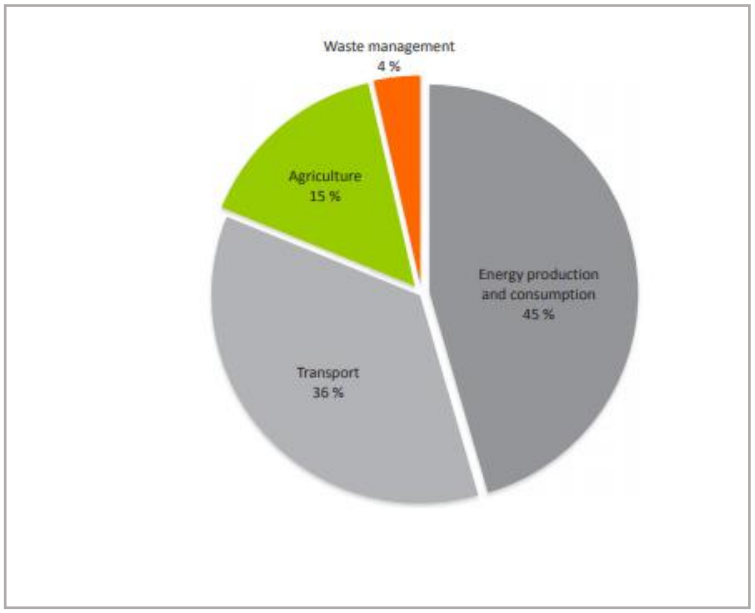

Figure 2.3: Greenhouse gas emissions per sector in North Karelia in 2007. (North Karelia 2012)

NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

National and Regional GDP

GDP	2005	2010	2016	2017
Finland	180 bil €	187 bil €	216,1 bil €	223,9 bil €
Finland per capita	39,514 €	40,254 €	40,460 €	41,436 €
North-Karelia	3,89 bil €	4,13 bil €	ND	4,35 bil €
North-Karelia per capita	23,093 €	24,888 €	30,469 €	31,500 €*

*preliminary data

Table 2.2: The National and Regional GDP in 2005, 2010, 2016 and 2017. (Official Statistics of Finland 2019)

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National and Regional Employment Level

	2005	2010	2016	2017
Finland em. (15-64yrs.)	68%	68%	69%	69,6%
Finland unem. (15-64yrs.)	7,9%	7,6%	7,9%	8,4%
Finland em. youth (15-24yrs)	39%	38 %	40,5%	41,4%
North-Karelia em. (15-64yrs.)	56,7%	58,5%	58,4%	ND
North-Karelia unem. (15-64yrs.)	16,9%	14,6%	18%	16%

Table 2.3: The employment and unemployment rates in Finland and in North Karelia in 2005, 2010, 2016 and 2017. (Official Statistics of Finland 2019)

National and Regional Economic Structure/Employment by Sector

Finland's economic structure is based on its manufacturing sector. Electronics and high technology gadgets are the highlight of the economy and each year Finnish trade proves this even further. Finland, as an economy, is well industrialized and has a large free market. The economy depends on imports of energy and raw materials, since a chunk of the economic sector is industrialized. The agriculture sector is self-sufficient. Forestry, besides the manufacturing segment, is an important segment for the Finnish economy. The largest sector of the economy is services at 72.7 percent, followed by manufacturing and refining at 31.4 percent. Primary production is 2.9 percent. The largest industries are electronics (21.6 percent), machinery, vehicles and other engineered metal products (21.1 percent), forest industry (13.1 percent), and chemicals (10.9 percent).

Year	2005	2010	2016	2017
Finland/Employer sector, th people				
Private	1 660	1 774	1 680	1 794
Local government	490	510	516	533
Central government	147	153	122	141

Table 2.4: Employment by the sector in Finland in 2005, 2010, 2016 and 2017. (Official Statistics of Finland 2019)

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Year	2000	2010	2017	2018
Finland/th people				
Agriculture, forestry and fishing; M&Q	**146**	**115**	**99**	**101**
Manufacturing; electricity, gas, steam and air conditioning and water supply; sewerage and waste management	473	388	355	361
Construction	147	172	187	198
Wholesale and retail trade; repair of motor vehicles and motorcycles	277	298	282	292
Transportation and storage	152	156	139	143
Accommodation and food service activities	77	83	85	86
Information and communication	89	95	106	114
Financial, insurance and real estate activities	70	71	81	77
Professional, scientific and technical activities; administrative and support service activities	184	250	283	291
Public administration and defence; compulsory social security	115	117	115	116
Education	165	174	181	184
Human health and social work activities	326	379	404	417
Arts, entertainment and recreation; other service activities	109	139	152	153
Industry unknown	6	12	5	7
Total	**2,335**	**2,447**	**2,473**	**2,540**

Table 2.5: Employment by the industry in Finland in 2000, 2010, 2017 and 2018. (Official Statistics of Finland 2019)

North Karelia: Lumber, wood, food, plastic, metal, stone, and travel are region's leading industrial fields. More than 500 companies whose operations involve bioeconomy can be found in the region. The turnover of these companies is 2 billion euros, and they employ more than 6,000 people. In addition, there are more than 600 experts employed in this field in the region: researchers, developers, trainers and administrative employees. The main job creator: Forestry (1675 persons), metal industry (2217) machinery (1343), M&Q (524). 53% of all RDI activities are conducted in technology industry.

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Year	2005	2010	2016
N. Karelia/Employer sector			
Private	40442	40021	38063 (63,7%)
Local government	15918	16984	16245 (27,6%)
Central government	4167	4082	3578 (6,1%)

Table 2.6: Employer by the sector in North Karelia in 2005, 2010 and 2016. (Official Statistics of Finland 2019)

Year	2000	2010	2016	2018
N. Karelia/th people				
Agriculture, forestry and fishing;	ND	4722	3530	ND
M&Q	**ND**	**197**	**294**	**ND**
Industrial	ND	9457	294	ND
Manufacturing; electricity, gas, steam and air	ND	234	216	ND
Conditioning and water supply; sewerage and waste management	ND	272	284	ND
Construction	ND	4159	3772	ND
Wholesale and retail trade; repair of motor vehicles and motorcycles	ND	6029	5738	ND
Transportation and storage	ND	2904	2684	ND
Accommodation and food service activities	ND	2025	1962	ND
Information and communication	ND	1078	1176	ND
Financial, insurance and real estate activities	ND	750	641	ND
Real estate	ND	440	472	ND
Human health and social work activities	ND	11425	12055	ND

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Professional, scientific and technical activities; administrative and support service activities	ND	2441	2031	ND
Public administration and defence; compulsory social security	ND	6597	6619	ND
Education	ND	5513	4815	ND
Arts, entertainment and recreation; other service activities	ND	1078	1036	ND
Other sevices	ND	2070	1760	ND
Unknown	ND	1068	734	ND
Total	**ND**	**73926**	**60681**	**ND**

Table 2.7: Employment by the industry in North Karelia in 2000, 2010, 2016 and 2018. (Official Statistics of Finland 2019)

National and Regional Export Rate and Trading Partners

National level, Finland

Exports

In 2017 Finland exported $70.7B, making it the 40th largest exporter in the world. During the last five years the exports of Finland have decreased at an annualized rate of -1.5%, from $75.7B in 2012 to $70.7B in 2017. The most recent exports are led by Refined Petroleum which represent 7.41% of the total exports of Finland, followed by Kaolin Coated Paper, which account for 6.65%.

Imports

In 2017 Finland imported $65.4B, making it the 43rd largest importer in the world. During the last five years the imports of Finland have decreased at an annualized rate of -1.7%, from $71.3B in 2012 to $65.4B in 2017. The most recent imports are led by Crude Petroleum which represent 7.07% of the total imports of Finland, followed by Cars, which account for 4.68%.

Trade Balance

As of 2017 Finland had a positive trade balance of $5.26B in net exports. As compared to their trade balance in 1995 when they still had a positive trade balance of $11.6B in net exports. Trade Balance/GDP: 0.7%

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Volume index of sales in trade, 100=2015

	Wholesale and retail trade and repair of motor vechiles and motorcycles	Wholesale trade	Retail trade
2000	74.2	89.6	70.2
2001	71.1	93.1	74.0
2002	76.3	94.9	76.7
2003	90.0	97.5	80.4
2004	97.3	102.0	84.5
2005	103.1	104.7	88.5
2006	112.9	108.8	92.6
2007	119.6	112.9	97.4
2008	133.2	115.0	98.6
2009	94.8	102.0	95.9
2010	105.5	104.3	98.0
2011	121.5	105.3	100.6
2012	112.9	104.9	101.7
2013	95.8	102.3	100.7
2014	98.0	102.1	99.5
2015	100.0	100.0	100.0
2016	108.5	102.6	102.0
2017	112.6	106.0	104.6
2018*	116.3	106.3	106.6

Imports, exports and trade balance

	Import	Export	Trade balance
	Bil. €	Bil. €	Bil. €
2000	36,837	49,484	12,647
2001	35,891	47,800	11,910
2002	35,611	47,245	11,634
2003	36,775	46,378	9,604
2004	40,730	48,917	8,187
2005	47,027	52,453	5,426
2006	55,253	61,489	6,237
2007	59,616	65,688	6,072
2008	62,402	65,580	3,178
2009	43,655	45,063	1,409
2010	51,899	52,439	0,539
2011	60,535	56,855	-3,680
2012	59,517	56,878	-2,639
2013	58,407	56,048	-2,359
2014	57,769	55,973	-1,796
2015	54,493	53,880	-0,613
2016	55,003	51,878	-3,125

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2017	62,469	59,711	-2,758
2018*	66,470	63,843	-2,627

Table 2.8: National wholesale and retail rates and trades. (Official Statistics of Finland 2019)

	Imports by country of origin			Exports by country of destination	
	M €	**%**		**M €**	**%**
Germany	10,310	15.5	Germany	9,649	15.1
Russia	9,298	14.0	Russia	6,591	10.3
Sweden	7,210	10.8	Sweden	4,309	6.7
China	4,636	7.0	China	4,305	6.7
Netherlands	3,639	5.5	Netherlands	3,532	5.5
USA	2,198	3.3	USA	3,328	5.2
Poland	2,032	3.1	Poland	2,836	4.4
France	1,998	3.0	France	1,947	3.0
Estonia	1,977	3.0	Estonia	1,791	2.8
Norway	1,895	2.9	Norway	1,744	2.7
Other	21,277	32.0	Other	23,813	37.3
Total	66,470	100	Total	63,843	100

Table 2.9: Imports and exports in Finland by production category 2018. (Official Statistics of Finland 2019)

Imports	**M €**	**%**
Chemical industry products	11,588	17.4
Electric and electronics industry products	9,525	14.3
Products from M&Q	8,570	12.9
Transport equipment	7,189	10.8
Machinery and equipment	5,696	8.6
Other	23,903	36.0
Total	**66,470**	**100**

Exports	**M €**	**%**
Forest industry products	13,096	20.5
Chemical industry products	12,331	19.3
Metal and metal products	9,883	15.5
Machinery and equipment	8,196	12.8
Electric and electronics industry products	7,449	11.7
Other	12,889	20.2
Total	**63,843**	**100**

Table 2.10: Biggest import and export countries, 2018. (Official Statistics of Finland 2019)

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Trading related to mining

While the mines operating in Finland are investing to improve their self-sufficiency for raw materials, the metal refining industry in Finland is strongly dependent on the imports of raw materials. In 2017, the imports of metallic ore concentrates totalled 4.3 Mt and the exports 0.415 Mt. Since 2015, enterprises' turnover growth has been fairly strong and the growth trend is expected to continue still. Among the main industries, turnover growth in M&Q was among the slowest by 1.8 per cent in January 2019 compared to previous year. In contrast, the export turnover in M&Q grew by 18.4 per cent.

		2010	2011	2012	2013	2014	2015	2016	2017
Metallic ore concentrate	Import	1,722,831	1,948,152	1,920,588	1,575,520	1,694,901	1,528,794	1,328,328	1,677,134
	Export	31,915	57,221	88,611	126,528	112,231	118,559	188,122	416,879

Table 2.11: Export and import of the metallic ore concentrates in Finland between 2010 and 2017. (Official Statistics of Finland 2019)

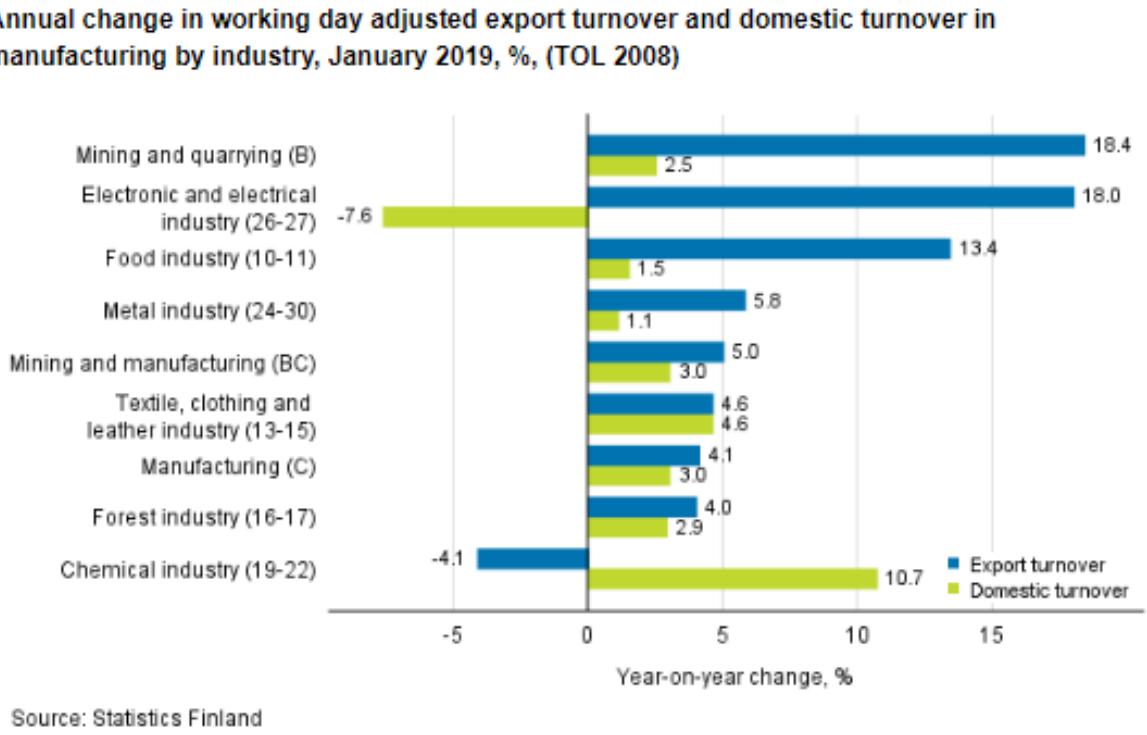

Figure 2.4: Annual change in export turnover and domestic turnover in 2019 in Finland (Official Statistics of Finland 2019)

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Regional Level, North Karelia

International trading

The International trade of North Karelia is highly based on industrial products, of which export is the highest in Finland, whereas the trade of commercial products is the lowest in Finland. The export is done mainly by Finnish private companies (78,1% in 2017 and 74,8% in 2018) and the rest by foreign companies. Import shares were 77,3% by Finnish companies, 0,9% government, 21,8% foreign companies in 2017 and 737,7%, 0,8% and 25,5% in 2018. Main export industry sectors in North Karelia in 2017 were Forest 45 %, metal 37 % and mining industry 2 %.

Most important export destinations of North Karelia in 2016 were:

1. Germany (13.9 %)
2. Sweden (12.7 %)
3. China (11.6 %)
4. Russia (7.2 %).
5. Other important export countries include the UK (5.9 %) and France (4.9 %).

2017			**2017 (Jan-June)**			**2018 (Jan-June)**		
Import M €	**Share %**		**Import M €**	**Share %**		**Import M €**	**Share %**	**Change %**
899	1.5		440	1.5		473	1.5	7
2017 (Share %)			**2017 (Jan-June) (Share %)**			**2018 (Jan-June) (Share %)**		
Industry	Commerce	Other	Industry	Commerce	Other	Industry	Commerce	Other
98.6	0.7	0.7	98.7	0.6	0.7	98	0.4	7

Table 2.12: Imports in North Karelia in 2017 and 2018 by million euros, share and industry. (Official Statistics of Finland 2019)

2017			**2017 (Jan-June)**			**2018 (Jan-June)**		
Export M €	**Share %**		**Export M €**	**Share %**		**Export M €**	**Share %**	**Change %**
326	0.5		165	0.5		174	0.5	5
2017 (Share %)			**2017 (Jan-June) (Share %)**			**2018 (Jan-June) (Share %)**		
Industry	Commerce	Other	Industry	Commerce	Other	Industry	Commerce	Other
57.9	34.6	7.5	56.4	36.4	7.2	66.2	28	5.7

Table 2.13: Exports in North Karelia in 2017 and 2018 by million euros, share and industry. (Official Statistics of Finland 2019)

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National and Regional Number of Registered Company

- Finland:
  - In 2016 388,483 of which 970 M&Q and 180 metal refinery
  - In 2017 397,882 of which 1069 M&Q and 177 metal refinery
  - In 2019 365,000 registered companies

- North-Karelia:
  - In 2016 10,859 of which 29 mining, quarrying and 3 metal refinery
  - In 2017 11,358 of which 37 mining, quarrying and 2 metal refinery

- SME percentage: There are 267 447 companies which have personnel of 10 people or less which makes 93,2 % of all companies in Finland. The rest are: 15 989 (5,6%) small sized (personnel of 10-50 people), 2883 (1,0 %) medium sized (50-249 people) and 615 (0,2 %) larger companies (personnel over 250 people). The SMEs share of the Finnish turnover was 59% in 2017 and 40% of BKT.

REGIONAL INFORMATION IN M&M INDUSTRY

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

Short Description of Regional M&M Sector

There are many economically significant and different types of ore deposits known in North Karelia region. The region's raw material resources have also been used for a relatively long time and its M&Q has had great influence on Finnish mining industry. The metallic ore commodities include Cu, Zn, Co, Au, U and Ni. The industrial mineral includes talc and dolomite and natural stone especially soapstone and granite.

There are three mines in operation in the Joensuu region in North Karelia. Boliden metals company produces copper, nickel, cobalt and gold. Endomines gold mine is located in Ilomantsi. Both mines are in final stage, but Endomines continues exploration in the region. In addition, various new projects of mineral prospecting and development are taking place in the region. The already closed mines include e.g Outokumpu (Cu, Zn, Co, Au, S), Vuonos (Cu, Ni, Zn, Co) and Hammaslahti (Cu, Zn).

Located in Outokumpu, Mondo Minerals produces talc and nickel. Dolomite is mined in North Karelia at the quarries of Matara.

Businesses in North Karelia know how to productize and refine other stone materials, too. Mining mineral, soapstone classified as industrial stone, are mined at the quarries of Nunnalahti, Koskela and Vaaralampi. The Vuonos enrichment plant and a talc factory is located in Outokumpu. Tulikivi and Nunnauuni are well-known producers of fireplaces and stoves, and half of their products are exported internationally. In addition, there are smaller stone companies in the area, such as Ilomantsin Kivituote which mines and refines black diabase for gravestones and kitchen surfaces in Ilomantsi.

Outokumpu is home to the mineral laboratory and test factory of internationally well-known Geological Survey of Finland GTK. FinnCobalt is also located in Outokumpu. As part of the Finnish battery cluster, its objective is to produce battery chemicals for, for instance, the electric car industry.

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There is still strong mining related industry and research facilities located in the city of Outokumpu, former mining town. The Outotec machinery factory exports most of its products to abroad.

Short Description of Obstacles for Establishing Mining Industry

- The ore commodities are low grade and the most promising commodities have been exhausted during last 80 years. Mining of low-grade ores and critical minerals require more advanced technology and the commodity prices influence more than earlier. There were difficulties gaining social license to operate and acceptability related to uranium mining in the vicinity of National Park of Koli.

Short Description of Chances for Establishing Mining Industry

There is a regional development program and mining cluster is one of its economic development cluster. In addition, we have more detailed program implementing plans (2 years period) to find solutions to go forward. Organization for regional development program and its implementing plans is Regional Council of North Karelia. The organization has made also strategic development plans for mining industry 2015-2017. Extractive industry and processing expertise have been chosen for one of the smart specialization focus points in North Karelia.

Regional development program is continuous process being updated once per 4 years. At that moment, we have POKAT 2021 program with target years 2018-2021. There are active mining industry, exploration and many potential mining sites. Copper mine in Polvijärvi (Boliden) is in final stage and gold mine in Ilomantsi (Endomines) cancelled mining and focused to exploration. For the future there are many new potential mining sites for metals and industrial minerals (e.g. Pampalo exploration for gold, Keretti for Cobalt).

As the region has long mining history especially around city of Outokumpu, the public perception towards mining is rather positive. However, there has been issues related to uranium mining in the vicinity of National Park of Koli and the mining company decided to withdraw from the project.

Regional GVA of M&M Industry

Regional gross value of M&M industry: in 2016 11,3 M € (27,7%), in 2017 10,3 M €

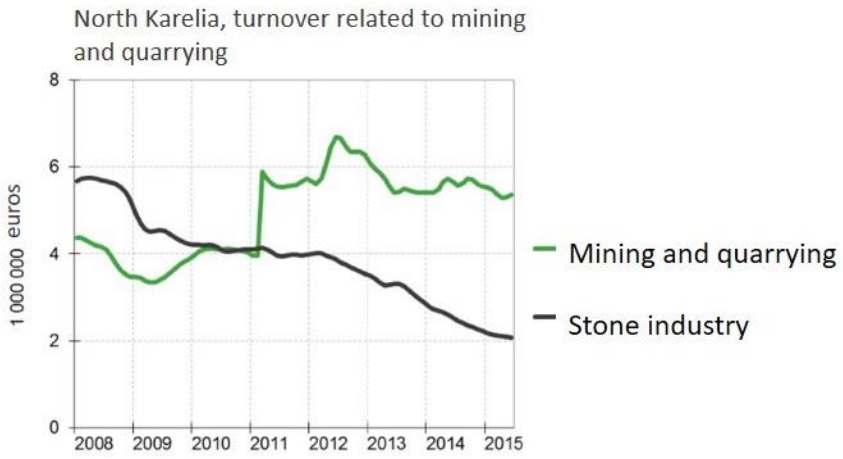

Figure 2.5: Turnover related to M&Q sector, North Karelia

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Number of Registered M&M Company

- Number of registered M&M company: 29 in 2016, 37 in 2017
- SME percentage in the registered M&M company: almost 100% as only Tulikivi Oyj has personnel of over 250 people.
- Giant M&M company in region: Boliden Mining Ab, Outotec Ltd (personnel at the region only 180)
- Categorising the companies by types, for instance, production service (consulting):
  - Mining, exploration or minerals processing companies (Endomines, Kylylahti Copper/Boliden, FinnCobalt, FinnAustMiningFinland Oy and Mineral Exploration Network Ltd)
  - Stone or industrial minerals quarrying companies (Ilomantsin Kivituote Oy, Juuan Dolomiittikalkki Oy, Kuukivi Design Oy, Mondo Minerals Nickel Oy, Nunnalahden Uuni Oy, Tulikivi Oyj, Hukka Design Oy)
  - Mining machinery companies (e.g. Outotec Ltd)

Support from Regional and/or National Government

- Strong support from the regional government as mining and extractive industry has been pointed as one of the main, development and smart specialization areas.

Short Description of M&M Cluster and Association

- The business development company Business Joensuu has strong involvement in developing and promoting mining in the region. Business Joensuu offers services for businesses, entrepreneurs and investors (business consulting company). They also provide assistance in setting up a business, growth and internationalization. Business Joensuu is involved in the largest European network of mining cooperation. The network is formed by partners of the REMIX and MIREU projects from sixteen different countries. Business Joensuu leads the European Industrial Modernization platform – Mining industry and global value chains expert network resulting from the cooperation.

Industries Closely Related to M&M

- Several mining related companies (eg. welding, logistics, construction, consulting, research, laboratory)

Short Description of Promotion of M&M Industry

- The mining and extractive industry has been picked as one of the main development and smart specialization areas of North Karelia region and the Business Joensuu leads the European Industrial Modernization platform – Mining industry and global value chains expert network resulting from the cooperation.

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The Role of Metallurgy Plays in the Regional Circular Economy

- The Pilot Plant and Mineral Processing Laboratory of internationally well-known Geological Survey of Finland GTK is located in Outokumpu. GTK's Mineral Processing Laboratory provides a wide range of ore beneficiation research services for the mining industry. It offers a unique platform for the development and testing of energy-saving, low-environmental-impact crushing, grinding and concentration processes. The lab is equipped to develop mineral processing methods anywhere along the beneficiation chain from mineralogical analysis to dealing with process waste. Moreover, testing of promising methods can readily be ramped up from bench-scale to pilot-scale test campaigns – a capability virtually unmatched elsewhere in the world. The pilot plant allows study of many aspects of ore handling and concentration, including crushing, grinding, classification, gravity separation, dense media separation and magnetic separation, foam flotation and dewatering. GTK Mintec has customers all around the world. In addition to customer work, GTK Mintec does publicly funded scientific research. The applicability of mineral processing to environmental remediation and recycling has been demonstrated on numerous occasions, e.g. remediation of contaminated soils and separation and recycling of metallurgical slags. GTK is part of the Metnet pilot plant network.
- Additionally, the Mondo Minerals Oy has its processing plant and talc factory located in former Vuonos mine.

Short Description of Networking Potential

- The regions have potential to network in future e.g. in exporting minerals processing and mining machinery expertise. Also, the leading role of Business Joensuu and the region in European Industrial Modernization platform – Mining industry and global value chains will enhance further the cooperation internationally.

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3. REGIONAL GENERAL BACKGROUND INFORMATION (LAPLAND, FINLAND)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

Capital

- Rovaniemi

Area (Km^2)

- 179,223 km^2

Population

- Age Structure 0-14yrs 15,2%, 15-64yrs 61,5%, 65+yrs 23,2 %

	2005	2010	2016	2017
Number of Inhabitants	185,800	183,488	180,207	179,223
Net Migration Rate	-791	-312	-68	-472

Table 3.1: Number of Inhabitants and net migration rate in Lapland in 2005, 2010, 2016 and 2017 (Official Statistics of Finland 2019)

Urbanisation Rate

- Lapland is sparsely populated area (1,8 citizen/km^2), covering 30% of the Finnish Land area but only 3.4% of the population. The population density varies from 34.9 inhabitants/km^2 in city of Kemi to 0.2 inhabitants/km^2 in Savukoski and Enontekiö. There are 21 municipalities in Lapland of which only 3 are growing.

Short Description of Indigenous Group

The Sámi are the only indigenous people of the EU, living in northern parts of Finland, Norway, Sweden and Russia. They are descendants of the people, who first inhabited the northern regions of Fennoscandia shortly after the end of the last ice age, approximately 10,000 years ago. Ethnically, the Sámi people was formed when the Sámi language and Finnish became two distinct languages around 2,000 BC due to differences in livelihoods and culture. The total Sámi population is estimated to be over 75,000-100,000, of which the majority living in Norway. There are about 10,000 Sámi in Finland, of which more than 60 per cent of them now live outside the Sámi Homeland. The Sámi Homeland is legally defined and covers the municipalities of Enontekiö, Inari and Utsjoki as well as the Lappi reindeer-herding district in the municipality of Sodankylä.

The status of the Sámi was written into the Finnish constitution in 1995 and since 1996 they have had the constitutional self-government as an indigenous people, the right to maintain and develop their

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own language, culture and traditional livelihoods in the Sámi Homeland. The self-government is managed by the Sámi Parliament, which is elected by the Sámi and located in Inari, Finland. The Skolt Sámi also maintain their tradition of village administration, under the Skolt Act, within the area reserved for the Skolt Sámi in the Sámi Homeland. In Finland, the definition of a Sámi is laid down in the Act on the Sámi Parliament and is mainly based on the Sámi language. According to the definition, a Sámi is a person who considers him- or herself a Sámi, provided that this person has learnt Sámi as his or her first language or has at least one parent or grandparent whose first language is Sámi.

Reindeer herding is a central part of the Sámi culture. The traditional Sámi livelihoods are fishing, gathering, handicrafts, hunting and reindeer herding and the modern ways of practising them. Out of the traditional Sámi livelihoods, reindeer herding still functions as one of the important cornerstones of the Sámi culture by offering both language arena as well as material for, among others, clothing, other Sámi handicrafts and food culture (Saamelaiskäräjät 2019).

Industries based on Natural Resources, M&M

- The most significant industry sectors in Lapland are the following: forest industry, metal industry, tourism, trade and mining industry. Most of the heavy industry in Lapland, is located in Kemi-Tornio, including the Outokumpu steel plant, Stora Enso paper plant, Metsä Botnia cellulose plant and Metsä Board cardboard plant, whereas Finland's largest terminal for rough wood is located in Kemijärvi. The largest mines in Lapland are the Kevitsa nickel and copper mine and Pahtavaara gold mine in Sodankylä and the Suurkuusikko gold mine in Kittilä. Kittilä mine is currently the biggest operating gold mine in Europe. In addition to these, there is the only chromium mine of Europe that serves the Tornio steel plant.

Infrastructure

The most important logistics hubs in Lapland are the region's largest centers: Rovaniemi, Kemi-Tornio and Kemijärvi. Rovaniemi, is also the centre of administration and education in Lapland, and the primary transport hub for goods and passengers in northern Lapland.

Transportation System

Airlines

Flight connections: airports in Kittilä, Rovaniemi, Ivalo, (Kemi and Enontekiö). 1,2 million people/yr, national and international connections. 249 t of cargo and mail by air within the country, 1 t internationally. In addition to regular airline services, Lapland has non-stop flights to several destinations, which has enabled the growth of tourism in the region. In December 2016 alone, nearly 300,000 tourists and 500 charter flights landed on the airports of Lapland. Passenger numbers grew by 19.8% from the previous year, which is reflected positively on the construction sector, among other sectors. Around 19% of all tourists to Finland visit Lapland, and the continuous development of transport connections by air, railway and road is vital for the growing tourism sector.

Ports

The ports of Lapland offer maritime links to every corner of the world. Every year, 5 million t of goods travel through the ports of Tornio and Kemi. In 2016, Tornio was the eighth largest port in Finland in terms of imports and exports. The ports in the northern part of the Gulf of Bothnia are vital for the exports and imports of Arctic industries. They offer a fast route to the northern parts of Finland, Sweden and Norway, and to Murmansk, Russia. Deepening the port of Kemi would improve the competitiveness of the port immensely.

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Road network

The EU Trans-European transport network (TEN-T), the North Sea–Baltic and the Scandinavian–Mediterranean corridor. Class I main roads 1,265 km. Class II main roads 1141 km. Highway total 9,077 km in 1.1. 2017. 500,000 people by bus, 12 million people by car per year (not including intra-regional trips). Cargo by road: 2,9 million t of good between Lapland and rest of the country, 10,4 million t within Lapland by lorries.

Railway

The transport of goods and passengers by railway plays an important role in the development of Lapland. A total of 4.5 million gross t of goods were transported between Rovaniemi and Kemi in 2016. The total number of journeys along the railway is 700,000 per year. The railway links from Kemi to Kolari and from Rovaniemi to Kemijärvi are crucial for both goods and passenger traffic. At that moment, Lapland is subject to several major infrastructure development plans. The Northeast Passage is a new potential shipping passage between Europe and Asia, but Finland does not have efficient connections to ports in the Arctic Ocean. The Arctic railway would have a notable impact on the geography of Lapland; it would make Lapland an important commercial passage. The Arctic railway could promote further investments in wood processing and mining. It would also make the tourism services of Lapland more accessible and create prerequisites for new tourism services and business in the entire region. However, while the line would not be profitable in itself, the report suggested that it could be used to transport minerals, fish and forestry products and would be expected to bring an increase in trade in the region. It could also offer security benefits, providing Finland with an alternative to trade via the Baltic Sea. However subsequent analysis by the working group concluded that the line would need to carry 2.4 million t of freight a year to cover its maintenance costs, which was not realistic unless there were significant changes to the regional economy. In addition, indigenous Sámi had expressed concern about the potential impact on reindeer herding.

Telecommunication

- Geographical coverage of mobile network by region, 4G Basic coverage 68%, 4G 30 Mbps 25%, 4G 100 Mbps 4% of area (12/2018)
- Availability of fixed network 31.12.2018: download >2 Mbit/s 92%, download >100 Mbit/s 55%, download >1000 Mbit/s 35%

Energy Sources

Currently, Lapland uses water, power, local wood and forestry side-streams in energy production. The carbon emissions of Lapland were: 3,047 th t in 2013, 2,914 th t in 2015 and 2,909 th to in 2017. With abundant energy sources, Lapland have long enabled to produce energy for its own needs and for the rest of Finland. Lapland utilizes a plenty of hydropower, local wood fuels, peat and waste liquor from forest industry. In industry, heat generated is used for its own production and in population centers, it is supplied to the district heat networks.

- Energy production is 12 TWh/180,000 inhabitants.
- Energy intensive industry (steel and paper), 70% of all use
- Electricity production >104%.
- Renewable energy enough for own use (in 2009 is 91%).

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	The usage of electricity by the industry, GWh		
	2010	**2016**	**2017**
All	3,998	5,236	5,103
Mining	178	644	647
Metallurgy	2,001	2,911	2,703

Table 3.2: The usage of electricity by the industry in Lapland in 2010, 2016 and 2017. (Official Statistics of Finland 2019)

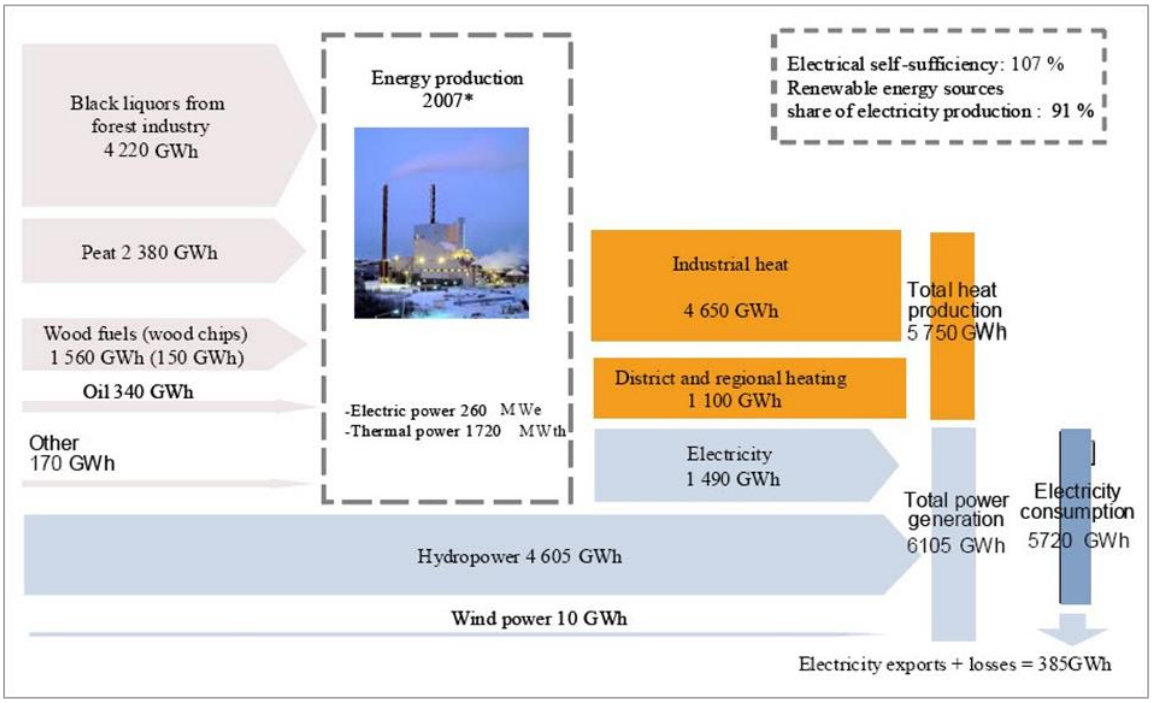

Figure 3.1: Energy balance in power and heat production in Lapland, 2007 (Regional Council of Lapland).

NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

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National and Regional GDP

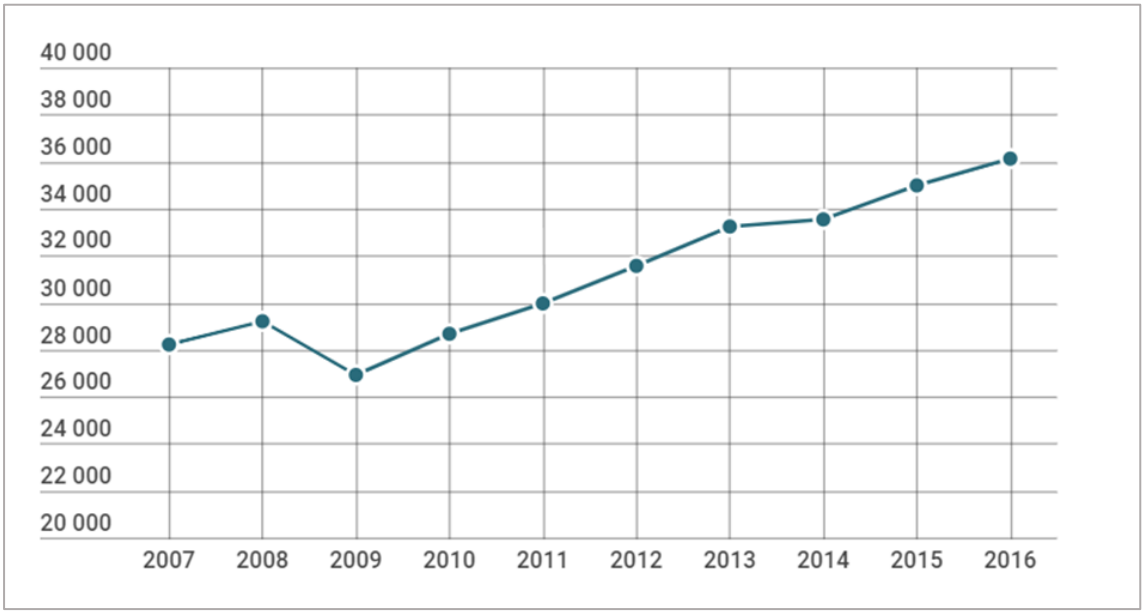

Figure 3.2: Regional GDP per capita in Lapland between 2007 and 2016 (www.luotsi.lappi.fi)

GDP	2005	2010	2016	2017
Finland	180 bil €	187 bil €	216,1 bil €	223,9 bil €
Finland per capita	39,514 €	40,254 €	40,460 €	41,436 €
Lapland	4,662 M €	5,258 M €	6,527 M €	ND
Lapland per capita	2,5052 €	2,8638€	3,6157 €	ND

Table 3.3: The National and Regional GDP in 2005, 2010, 2016 and 2017. (Official Statistics of Finland 2019)

National and Regional Employment Level

Percent (%)	2005	2010	2016	2017
Finland employment (15-64yrs.)	68%	68%	69%	69,6%
Finland unemployment (15-64yrs.)	7,9%	7,6%	7,9%	8,4%

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Finland employment youth (15-24yrs)	39%	38 %	40,5%	41,4%
Lapland employment (15-64yrs.)	60,1 %	62,4 %	65,3 %	63,9 %
Lapland unemployment (15-64yrs.)	16,8 %	13,8 %	10,7 %	10,5 %

Table 3.4: The employment and unemployment rates in Finland and in Lapland in 2005, 2010, 2016 and 2017. (Official Statistics of Finland 2019)

National and Regional Economic Structure/Employment by Sector

Finland's economic structure is based on its manufacturing sector. Electronics and high technology gadgets are the highlight of the economy and each year Finnish trade proves this even further. Finland, as an economy, is well industrialized and has a large free market. The economy depends on imports of energy and raw materials, since a chunk of the economic sector is industrialized. The agriculture sector is self-sufficient. Forestry, besides the manufacturing segment, is an important segment for the Finnish economy. The largest sector of the economy is services at 72.7%, followed by manufacturing and refining at 31.4%. Primary production is 2.9%. The largest industries are electronics (21.6%), machinery, vehicles and other engineered metal products (21.1%), forest industry (13.1%), and chemicals (10.9%).

Finland/ Employer sector, th	**2005**	**2010**	**2016**	**2017**
Private	1,660	1,774	1,680	1,794
Local government	490	510	516	533
Central government	147	153	122	141

Table 3.5: Employment by the sector in Finland in 2005, 2010, 2016 and 2017. (Official Statistics of Finland 2019).

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Year	2000	2010	2017	2018
Finland/th people				
Agriculture, forestry and fishing; M&Q	**146**	**115**	**99**	**101**
Manufacturing; electricity, gas, steam and air conditioning and water supply; sewerage and waste management	473	388	355	361
Construction	147	172	187	198
Wholesale and retail trade; repair of motor vehicles and motorcycles	277	298	282	292
Transportation and storage	152	156	139	143
Accommodation and food service activities	77	83	85	86
Information and communication	89	95	106	114
Financial, insurance and real estate activities	70	71	81	77
Professional, scientific and technical activities; administrative and support service activities	184	250	283	291
Public administration and defence; compulsory social security	115	117	115	116
Education	165	174	181	184
Human health and social work activities	326	379	404	417
Arts, entertainment and recreation; other service activities	109	139	152	153
Industry unknown	6	12	5	7
Total	**2,335**	**2,447**	**2,473**	**2,540**

Table 3.6: Employment by the industry in Finland in 2000, 2010, 2017 and 2018. (Official Statistics of Finland 2019)

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As for Lapland, the most significant industry sectors are: forest industry, metal industry, tourism, trade and mining industry. About 70%, of Lapland's turnover and 24% of jobs come from industry. Further, the turnover of Lapland's mining covers 54% of the Finnish total turnover coming from mining. Whereas, the mining support service activities cover 53% and manufacture of basic metals 38% of the Finnish total. Social and health services and refining (including mining) industry are the biggest employers in the region of Lapland. Furthermore, in comparison to rest of the country Lapland can be seen specialized in M&M as the work force employed directly or indirectly to M&M in relation to other industries is high (Uusipaavalniemi et al. 2018. TEM 2018b).

According to the Lapland business review report of 2017, turnover from all sectors apart from industry grew in 2016. Mining and tourism presented the largest growth. The turnover of mining industry in Lapland grew by 28% in 2017. All the mines in Lapland are increasing their production volume. In 2016, the turnover of the mining industry in Lapland amounted to 460 M €, and the mines provided employment for 1,410 people directly and for up to 3,000 people indirectly. However, the turnover of the mining sector in Lapland was the only sector increasing (by 1.5 %, 560 M €) in 2018, while the employment of the sector grew by 1.8 %.

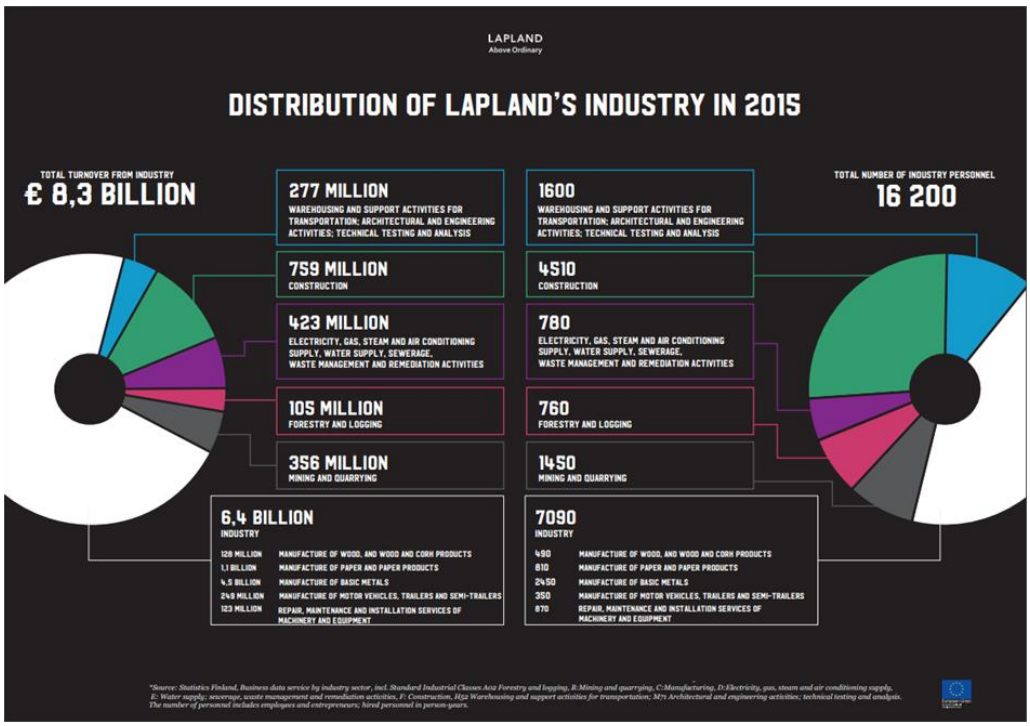

Figure 3.3: Distribution of Lapland's Industry in 2015

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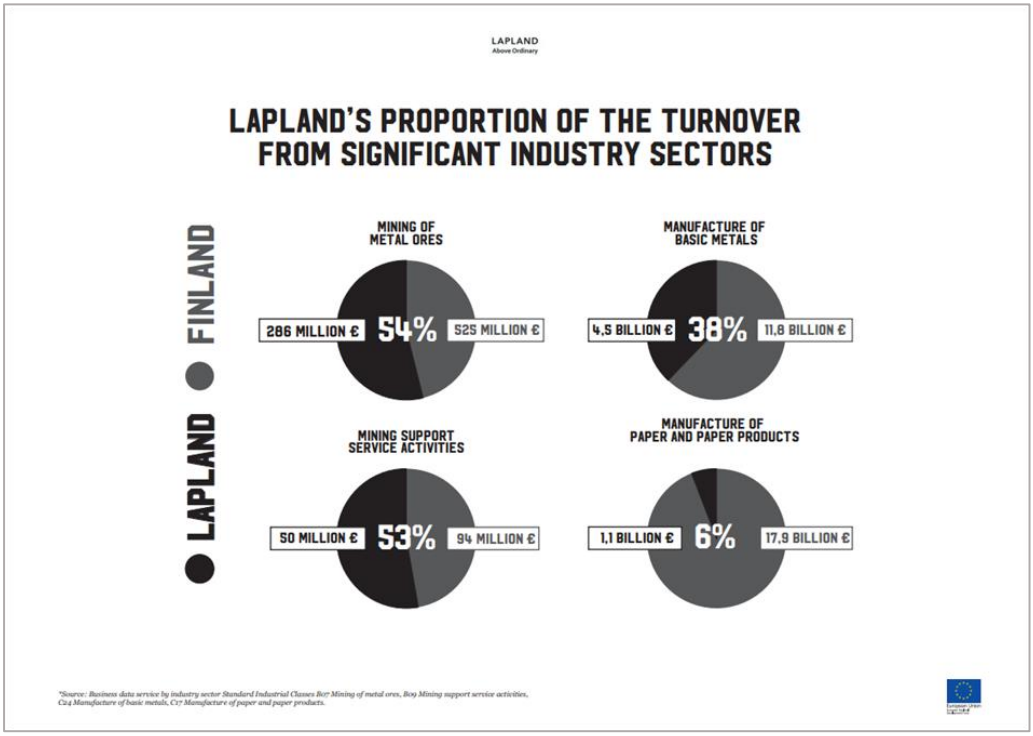

Figure 3.4: The proportion of the turnover from significant industries in Lapland in 2015

Lapland/Employer sector	2005	2010	2016
Private	43,211	35,285	36,867 (62,1 %)
Local government	8,050	7,695	18,193 (9,8 %)
Central government	18,721	19,755	4,330 (28,82 %)

Table 3.7: Employer by the sector in Lapland in 2005, 2010 and 2016. (Official Statistics of Finland 2019)

Year	2000	2010	2016	2017
Lapland				
Agriculture, forestry and fishing	ND	3,893	3,134	1,781
M&Q	**ND**	**854**	**1,486**	**1,486**
Industrial	ND	7,691	6534	6,917

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Manufacturing; electricity, gas, steam and air	ND	694	542	542
Conditioning and water supply; sewerage and waste management	ND	367	347	347
Construction	ND	4,613	4359	4,657
Wholesale and retail trade; repair of motor vehicles and motorcycles	ND	7,271	6782	5,912
Transportation and storage	ND	4,335	3886	3,706
Accommodation and food service activities	ND	3,312	3487	2,921
Information and communication	ND	1,208	892	615
Financial, insurance and real estate activities	ND	725	549	
Real estate	ND	686	756	657
Human health and social work activities	ND	12,532	13,566	
Professional, scientific and technical activities; administrative and support service activities	ND	2,999	2,706	1,901
Public administration and defense; compulsory social security	ND	4,375	5,105	3,484
Education	ND	5,744	4,867	4,867
Arts, entertainment and recreation; other service activities	ND	1,505	1,585	1,585
Other services	ND	1,881	1,784	1,784
Unknown	ND	1,265	1,840	1,250
Total	**68,592**	**70,990**	**68,934**	**ND**

Table 3.8: Employment by the industry in Lapland in 2000, 2010, 2016 and 2018. (Official Statistics of Finland 2019)

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National and Regional Export Rate and Trading Partners

National level, Finland

Exports

In 2017 Finland exported $70.7B, making it the 40th largest exporter in the world. During the last five years the exports of Finland have decreased at an annualized rate of -1.5%, from $75.7B in 2012 to $70.7B in 2017. The most recent exports are led by Refined Petroleum which represent 7.41% of the total exports of Finland, followed by Kaolin Coated Paper, which account for 6.65%.

Imports

In 2017 Finland imported $65.4B, making it the 43rd largest importer in the world. During the last five years the imports of Finland have decreased at an annualized rate of -1.7%, from $71.3B in 2012 to $65.4B in 2017. The most recent imports are led by Crude Petroleum which represent 7.07% of the total imports of Finland, followed by Cars, which account for 4.68%.

Trade Balance

As of 2017 Finland had a positive trade balance of $5.26B in net exports. As compared to their trade balance in 1995 when they still had a positive trade balance of $11.6B in net exports. Trade Balance/GDP: 0.7%

Volume index of sales in trade, 100=2015

	Wholesale and retail trade and repair of motor vehicles and motorcycles	Wholesale trade	Retail trade
2000	74.2	89.6	70.2
2001	71.1	93.1	74.0
2002	76.3	94.9	76.7
2003	90.0	97.5	80.4
2004	97.3	102.0	84.5
2005	103.1	104.7	88.5
2006	112.9	108.8	92.6
2007	119.6	112.9	97.4
2008	133.2	115.0	98.6
2009	94.8	102.0	95.9
2010	105.5	104.3	98.0
2011	121.5	105.3	100.6
2012	112.9	104.9	101.7
2013	95.8	102.3	100.7
2014	98.0	102.1	99.5
2015	100.0	100.0	100.0
2016	108.5	102.6	102.0
2017	112.6	106.0	104.6
2018*	116.3	106.3	106.6

Imports, exports and trade balance

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	Import (Bil. €)	Export (Bil. €)	Trade balance (Bil. €)
2000	36,837	49,484	12,647
2001	35,891	47,800	11,910
2002	35,611	47,245	11,634
2003	36,775	46,378	9,604
2004	40,730	48,917	8,187
2005	47,027	52,453	5,426
2006	55,253	61,489	6,237
2007	59,616	65,688	6,072
2008	62,402	65,580	3,178
2009	43,655	45,063	1,409
2010	51,899	52,439	0,539
2011	60,535	56,855	-3,680
2012	59,517	56,878	-2,639
2013	58,407	56,048	-2,359
2014	57,769	55,973	-1,796
2015	54,493	53,880	-0,613
2016	55,003	51,878	-3,125
2017	62,469	59,711	-2,758
2018*	66,470	63,843	-2,627

Table 3.9: National wholesale and retail rates and trades. (Official Statistics of Finland 2019)

	Imports by country of origin			Exports by country of destination	
	M €	%		M €	%
Germany	10,310	15.5	Germany	9,649	15.1
Russia	9,298	14.0	Russia	6,591	10.3
Sweden	7,210	10.8	Sweden	4,309	6.7
China	4,636	7.0	China	4,305	6.7
Netherlands	3,639	5.5	Netherlands	3,532	5.5
USA	2,198	3.3	USA	3,328	5.2
Poland	2,032	3.1	Poland	2,836	4.4
France	1,998	3.0	France	1,947	3.0
Estonia	1,977	3.0	Estonia	1,791	2.8
Norway	1,895	2.9	Norway	1,744	2.7
Other	21,277	32.0	Other	23,813	37.3
Total	66,470	100	Total	63,843	100

Table 3.10: Biggest import and export countries, 2018. (Official Statistics of Finland 2019)

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Imports	M €	%
Chemical industry products	11,588	17.4
Electric and electronics industry products	9,525	14.3
Products from M&Q	8,570	12.9
Transport equipment	7,189	10.8
Machinery and equipment	5,696	8.6
Other	23,903	36.0
Total	66,470	100

Export	M €	%
Forest industry products	13,096	20.5
Chemical industry products	12,331	19.3
Metal,and metal products	9,883	15.5
Machinery and equipment	8,196	12.8
Electric and electronics industry products	7,449	11.7
Other	12,889	20.2
Total	63,843	100

Table 3.11: Imports and exports in Finland by production category 2018 (Official Statistics of Finland 2019).

Trading related to mining

While the mines operating in Finland are investing to improve their self-sufficiency for raw materials, the metal refining industry in Finland is strongly dependent on the imports of raw materials. In 2017, the imports of metallic ore concentrates totalled 4.3 Mt and the exports 0.415 Mt. Since 2015, enterprises' turnover growth has been fairly strong and the growth trend is expected to continue still. Among the main industries, turnover growth in M&Q was among the slowest by 1.8% in January 2019 compared to previous year. In contrast, the export turnover in M&Q grew by 18.4%.

		2010	2011	2012	2013	2014	2015	2016	2017
Metallic ore concentrate	Import	1,722,831	1,948,152	1,920,588	1,575,520	1,694,901	1,528,794	1,328,328	1,677,134
	Export	31,915	57,221	88,611	126,528	112,231	118,559	188,122	416,879

Table 3.12: Export and import of the metallic ore concentrations in Finland between 2010 and 2017. (Official Statistics of Finland 2019).

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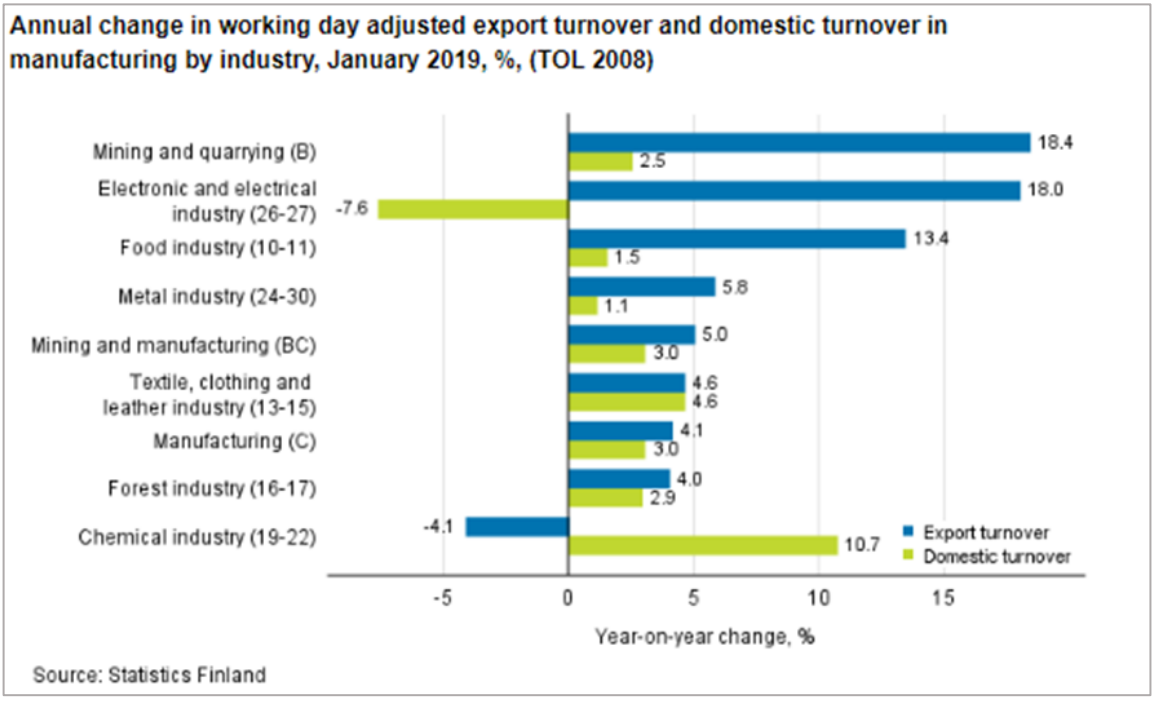

Figure 3.5: Annual change in export turnover and domestic turnover in 2019 in Finland (Official Statistics of Finland 2019)

International trading

The value of Lapland's exports is 3.6 Bil. €, which is seven per cent of the total exports of Finland. The share of industry in the exports of Lapland is 91%. In 2017 the export in Lapland grew by 359 M € (+20 %). The share of exports by industrial companies was highest in the region of Lapland (95,8 %). The share of exports and imports of the national private companies was 80% and foreign companies 15%, which is the lowest in Finland. The exports from Lapland were mainly within EU, and only 37,9% was outside Europe.

2016			2017 (Jan-June)			2018 (Jan-June)		
Import M €	**Share (%)**		**Import M €**	**Share (%)**	**Change (%)**	**Import M €**	**Share (%)**	**Change (%)**
1,595	2.9 %		876	2.9 %	-1 %	957	2,9 %	10 %
Industry	Commerce	Other	Industry	Commerce	Commerce	Industry	Commerce	Other
94.6 %	3.0 %	2.4 %	95.8 %	2.7%	2.6 %	95.3 %	2.6 %	2.0 %

Table 3.13: Imports in Lapland in 2016, 2017 and 2018 by million euros, share and industry (Tulli 2018 and Official Statistics of Finland 2019).

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2016			2017 (Jan-June)			2018 (Jan-June)		
Export M €	**Share (%)**		**Export M €**	**Share (%)**		**Export M €**	**Share (%)**	**Change (%)**
3,553	6.8 %		2,111	7.1 %		2,115	6.6 %	7 %
Industry	Commerce	Other	Industry	Commerce	Other	Industry	Commerce	Other
89.7 %	1.8 %	8.6 %	90.1 %	0.6 %	9.4 %	91.0 %	0.6 %	8.5 %

Table 3.14: Exports in Lapland in 2016, 2017 and 2018 by million euros, share and industry. (Tulli 2018 and Official Statistics of Finland 2019)

National and Regional Number of Registered Company

Finland:

- In 2016 388,483 of which 32 metal mining, 882 other M&Q, 56 mining support service activities and 180 metal refinery.
- In 2017 397,882 of which 34 metal mining, 974 other M&Q, 61 mining support service activities and 177 metal refinery.
- In 2019 365,000 registered companies.

Lapland:

- In 2016 12,235 of which 8 metal mining and 47 other M&Q, 13 mining support service activities, 7 metal refinery.
- In 2017 12,711 of which 9 metal mining and 48 other M&Q, 11 mining support service activities, 7 metal refinery.

SME percentage: There are 267,447 companies which have personnel of 10 people or less which makes 93.2 % of all companies in Finland. The rest are: 15,989 (5.6%) small sized (personnel of 10-50 people), 2,883 (1.0 %) medium sized (50-249 people) and 615 (0.2 %) larger companies (personnel over 250 people). The SMEs share of the Finnish turnover was 59% in 2017 and 40% of BKT. In 2015 almost 100% of the companies were SME in Lapland, only 9 companies regarded large.

REGIONAL INFORMATION IN M&M INDUSTRY

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

Short Description of Regional M&M Sector

The largest mines in Lapland are the **Kevitsa** nickel and copper mine and **Pahtavaara** gold mine in Sodankylä and the **Suurkuusikko** gold mine in Kittilä. In addition to these, there is a **chromium mine** that serves the Tornio steel plant.

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The mineral resources of Lapland Region include Au, Ni, Cu, PGM, Cr, Industrial minerals, Li, Fe, Nb, Ti and gemstones. There are **three operating metal mines** in Lapland. Currently the largest operating gold mine of EU is located in Kittilä municipality, whereas the Kemi chromium mine is the only operating chromium mine in EU. Kevitsa mine in Sodankylä extracts Ni, Cu, Au, Pt and Pa. The total production of the mines are Kittilä 1,564 Mt, Kemi 1.93 Mt and Kevitsa 7.7 Mt (Viinamäki et al. 2015). The **Sakatti** (Cu, Ni, PGM), **Hannuvaara** (Fe), **Pahtavaara** (Au), **Suhanko** (PGM, Ni, Cu, Au) and **Sokli** (apatite) mine development projects are already at permit application stage. The Sakatti located in Sodankylä is new mining project. Its proven resources are 121,000 t of copper, 87,000 t of nickel and estimated resources 724,000 t of copper and 337,000 t of nickel. The Hannukainen mine operated between 1978 and 1985. The ore reserve of Hannukainen is estimated to be 136 M t, and the estimated annual productions are 2 M t for iron concentrate and 40,000 t for gold-copper concentrate. Its planning and permitting processes will last until 2020. Pahtavaara mine operated between 1996 and 2014 with daily mill capacity of 1,400 t and total gold production 10.76 t. Suhanko is located close to City of Rovaniemi. Currently the estimated ore resources of Suhanko are 208.5 M t. The Sokli deposit represents one of the largest phosphate reserves in Finland, but the operator Yara Finland Ltd decided to halt the development of the project due to the anticipated profitability of the project. However, the company decided to continue the environmental and water permit application that were approved in 2018 (Viinamäki et al. 2015).
There are also several exploration projects going on throughout Lapland. One of the most promising is the Rompas-Palokas exploration project for gold and uranium located in the municipality of Ylitornio with (MIREU webpage 2019).

Short Description of Obstacles for Establishing Mining Industry

The greatest obstacles for establishing mining in Lapland are **environmental concerns** (e.g. Sakatti project next to Natura 2000 Viikinkiaapa wetland area) and **conflicts** with tourism (e.g. Hannukainen mine in Äkäslompolo next to Ylläs ski resort).
Further, there are ongoing discussions going on with the neighboring countries about building an Arctic Ocean Railway. This would most likely have an effect also on the planned mining projects **Hannukainen** iron ore mine (Kolari), **Sokli** phosphate mine (Savukoski), **Suhanko** mine (Ranua), **Kevitsa** mine expansion (Sodankylä), and **Mustavaara** mine (Taivalkoski). For instance, the apatite mine project Sokli (Yara Finland Oy) was halted partly due to lack of infrastructure for transportation and the unwillingness of the state to cover the costs of the railway. Finland's Ministry of Transport & Communications published a report in 2018 into route options which concluded that a 465 km line from Rovaniemi to Kirkenes via Sodankylä would be the best option. However, subsequent analysis by the working group concluded that the line would need to carry 2.4 M t of freight a year to cover its maintenance costs, which was not realistic unless there were significant changes to the regional economy. In addition, indigenous Sámi had expressed concern about the potential impact on reindeer herding.

Short Description of Chances for Establishing Mining Industry

The main advantages for the establishment of Mining Industry in Lapland are two: the dimension of **employment** and the **education capacity** of the region.

Specifically, for the first dimension, mining operations have developed the demographic structure of the areas in Lapland. For instance, in Kittilä the employment rate (77%) is among the highest in Finland, while in addition to mining, also touristic activities play an important role in the employment rate.
Furthermore, during the period of the operation of mines such as Pahtavara (region of Kittilä, operated until 2014) and the Kevitsa (region of Sodankylä, opened in 2007), employment of the total population of Sodankylä decreased by 5%, whereas the labor force of the M&Q, Electricity, gas, steam and air

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conditioning supply, Water supply; sewerage, waste management and remediation activities, increased 2,6% (Viinamäki et al. 2015).

As for the parameter of education capacity, for the whole Lapland the percentages were 16,4%, 20,2% and 12,6% for higher education and 0%, -3% and 2,8% for the upper secondary education (Viinamäki et al 2015). Other available data for the region of Sodankylä, indicate that for the period from 1990 to 2011, the percentage of people aged 15 or older with higher education qualifications has increased in total by 14,1%, by 19,1% among women and by 9,7% among men, whereas the higher secondary education the percentages were -4,4%, 5% and 0,5%.

Regional GDP of M&M Industry

In 2017 for the region of Lapland, the mining industry's direct effect on employment was around 1,610 man-years and the turnover around 539 M €, being 5% of the Lapland's' total turnover. The turnover of mining industry in Lapland grew by 23.3 % and the personnel by 3.7 % in 2017, whereas the turnover growth for the whole country was 16.3 %. The outlook for the industry is also most positive in Lapland, as most of the exploration permits are applied for the region (Uusipaavalniemi et al. 2018. TEM 2018b). The GRP[30] of Lapland has been below the EU average. The GVA per capita was 84 in 2000, 80 in 2005, 82 in 2005 and 92 in 2015.

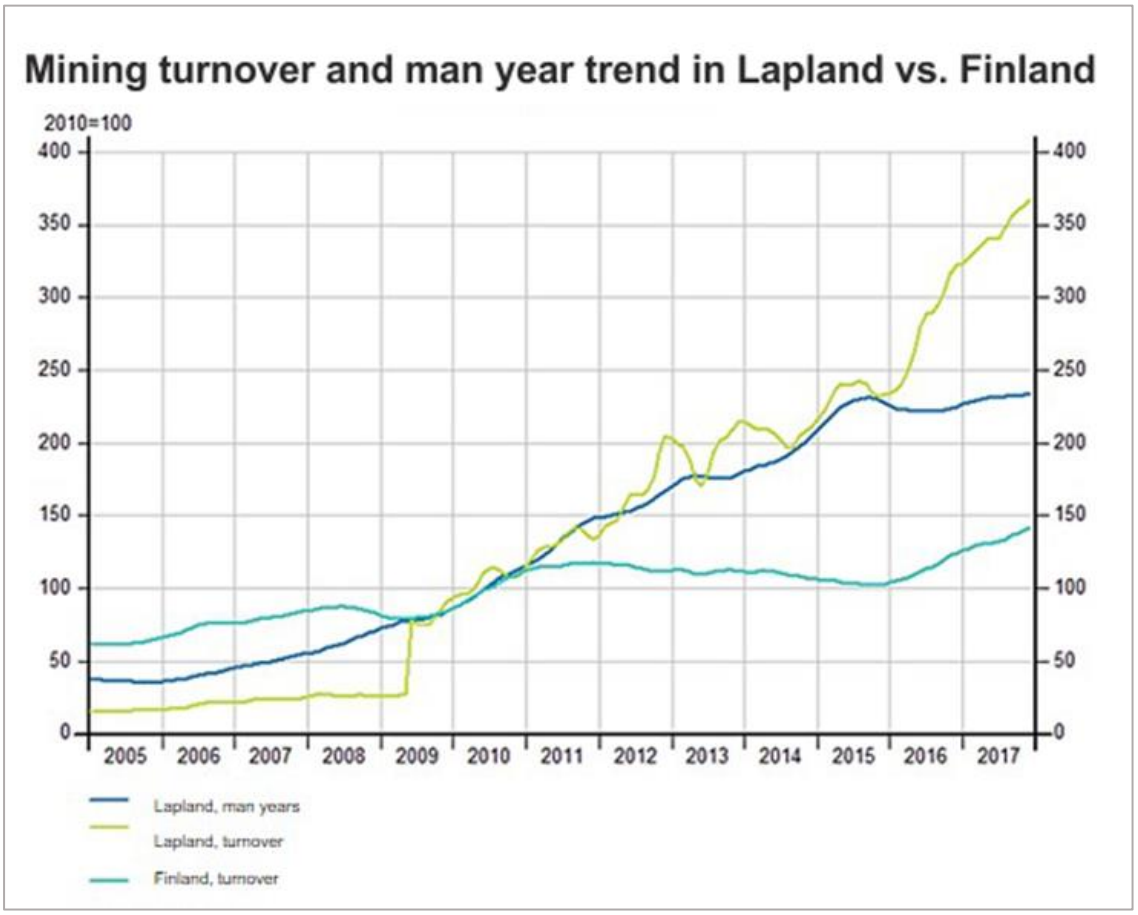

Figure 3.6: The mining turnover and man year trend in Lapland vs. Finland. (Modified from Uuspaavalniemi et al. 2018)

[30] Gross Regional Product

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Support from Regional and/or National Government

- **Strong support** from the regional government as mining and extractive industry has been pointed as one of the main development and smart specialization areas.

Number of Registered M&M Company

Table 3.15 that follows includes in more detail, the number of registered M&M companies, for the region of Lapland, as well the personnel and the turnover.

Year/2016	Enterprises	Personnel (staff year)	Turnover (Eur 1,000)
Mining of metal ores	8	1,000	354,098
Other M&Q	47	97	19,985
Mining supporting services	13	457	62,681
Manufacture of basic metals	7	2,291	3,957,002
Year/2017			
Mining of metal ores	9	1,029	464,876
Other M&Q	48	96	20,981
Mining supporting services	11	509	80,928
Manufacture of basic metals	7	2,203	4,548,393

Table 3.15: Data for the number of enterprises, personnel and turnover

Short Description of M&M Cluster and Association

Arctic Industry and **Circular Economy Cluster** connects processing and mining industry companies, SMEs serving industry, universities, research institutions, funding and regional authorities to a same co-operation network. Common goal for Lapland is to be a **frontrunner** in sustainable utilization of natural resources and sustainable industry and circular economy activities. The work in progress for sustainable industrial refining has been notified on national, Nordic and EU levels.

Systematic cluster development started in 2014, when Lapland was chosen as one of the **model regions of European cluster initiative** with six other regions. With the establishment of this cluster hosted by the regionally operating development agency **Digipolis Oy**, the Region of Lapland has taken a very important step in contributing to the development and strengthening of the circular economy related activities.

During 2013 Lapland started an active communication with European commission and other international stakeholders. As a result, and most developed example, the **Regional Council of Lapland** took a leading position on initiative of building a network of mining regions in the EU and invited other interested regions and partners on board. The network was launched together with European commission DG GROW unit of Raw Materials and Resource Efficiency. Process was supported by East

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& North Finland EU Office, ERRIN (European Regions Research and Innovation Network) and European Committee of the Regions.

The Region of Lapland is involved in the **largest European network of mining cooperation**. The network is formed by partners of the REMIX and MIREU projects from sixteen different countries. Lapland leads together with the Region of Joensuu (FI) the European Industrial Modernization platform – Mining industry and global value chains expert network resulting from the cooperation.

Furthermore, as for the **research institutes** related to mining operating in Lapland are the three following: Geological Survey of Finland (GTK), Natural Resources Institute (LUKE) and Finnish Environmental Institute (SYKE).

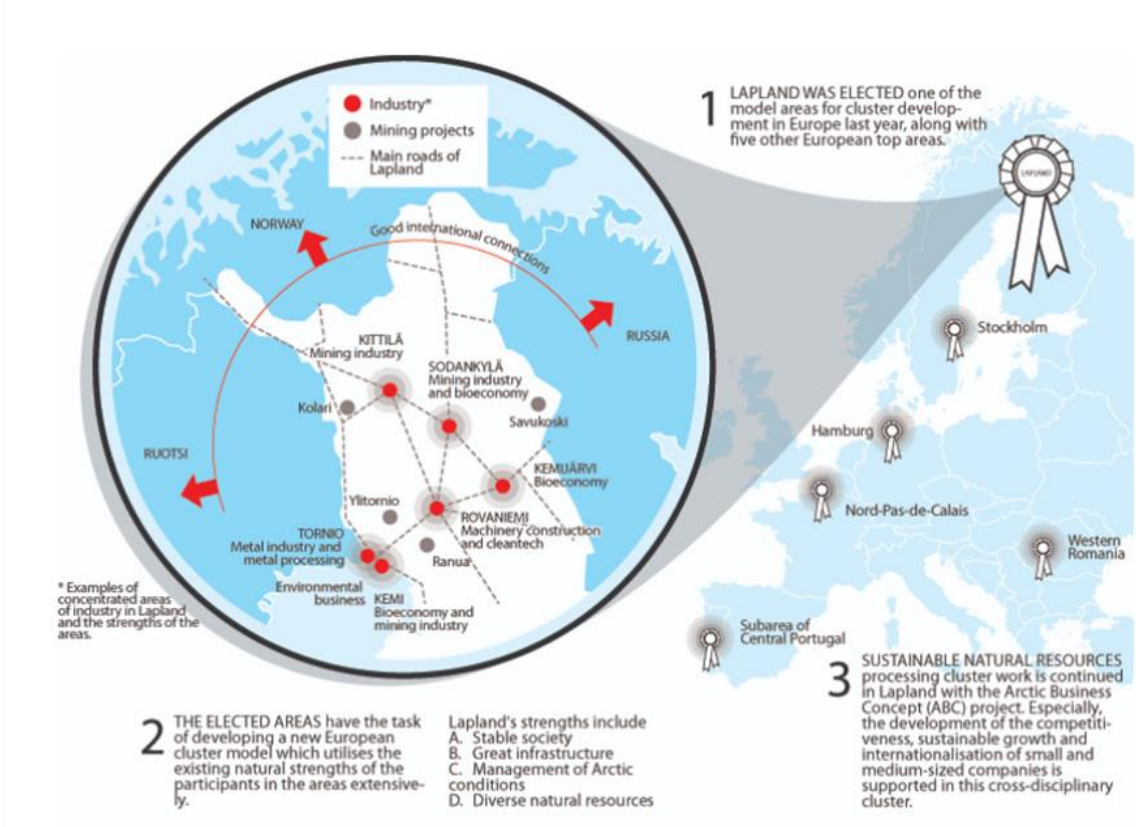

Figure 3.7: Lapland, Europe's model region in the sustainable processing in natural resources

Industries Closely Related to M&M

- **Several** mining related companies (e.g. welding, logistics, construction, consulting, research, laboratory).

Short Description of Promotion of M&M Industry

- The mining and extractive industry has been picked **as one of the main development and smart specialization areas of Lapland region** and together with the Region of North Karelia the Region of Lapland leads the **European Industrial Modernization platform – Mining industry** and **global value chains** expert network resulting from the cooperation.

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4. REGIONAL GENERAL BACKGROUND INFORMATION (STYRIA, AUSTRIA)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

Capital

- Leoben

Area (km²)

- 1,536 km²

Population

- Number of Inhabitants: 60,451 (1.1.2018)

Year	2005	2010	2014	2015	2016	2017	2018
Population district Leoben	65,094	62,683	61,041	60,949	61,558	60,943	60,451

Table 4.1: Data for the population at the district of Leoben

- Age Structure

Year	2005	2010	2014	2015	2016	2017	2018
< 20 years	18.0%	16.9%	15.9%	15.6%	16.0%	15.9%	15.7%
20 - 65 years	60.2%	58.9%	59.3%	59.5%	59.3%	59.4%	59.3%
> 65years	21.8%	24.3%	24.8%	24.9%	24.6%	24.7%	25.0%

Table 4.2: Data for the age structure

- Net Migration Rate

Year	2005	2010	2013	2014	2015	2016	2017

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Immigration	ND	1,824	2,029	2,335	3,580	3,726	2,606
Emigration	ND	1,969	1,898	2,033	2,678	3,965	2,798
Net migration rate	ND	-145	131	302	902	-239	-192

Table 4.3: Data for immigration, emigration and net migration rate

Short Description of Indigenous Group

- Not applicable. no Indigenous Groups in the region

Industries based on Natural Resources. M&M

The most important mines and plants at the Region of Saxony, are the following:

- **VA Erzberg GmbH**: last large iron ore mine in Central Europe. 230 employees. Extracted rock per year: 12 mio t; annual fine ore production: 3 mio t (www.vaerzberg.at)
- **Kaisersberg** (Grafitbergbau Kaisersberg): graphite mine (www.grafit.at)
- **STYROMAG**: magnesite open-cast mine in Wald am Schoberpass (www.styromag.at)
- **Voestalpine**: steel plant in Leoben, with approx. 2,500 employees; in the Mur-Mürz valley (40 km east and west) further steel industry related plants with approx. 10,000 employees. (www.voestalpine.com)
- Various **minor quarries** for locally used construction materials.

All are **well accepted** in the public – due to the history (deep "roots", strong identification); **Erzberg** is largest employer in the town of Eisenerz; **Voestalpine** the major employer in Leoben (important not only because of the number of jobs, but because of high wages which support other branches of regional economy as well.

Infrastructure

Styrian Iron Route/district of Leoben is situated in the center of the tetragon of the 4 major Austrian cities: **Graz – Salzburg – Linz– Wien/Vienna**. Leoben is connected by **highway** S6. S36 & A9 with Vienna, Graz, Linz & Salzburg. It is also a **major railway hub** on the "Südbahn" (the major southern Austrian railway connection between Vienna & Italy), and well connected to **all major Austrian and Central European cites**.

Energy Sources

The above data are only available for the state of Styria:

- Share of **renewable energy** in the state of Styria: **28.2 %** (2015)

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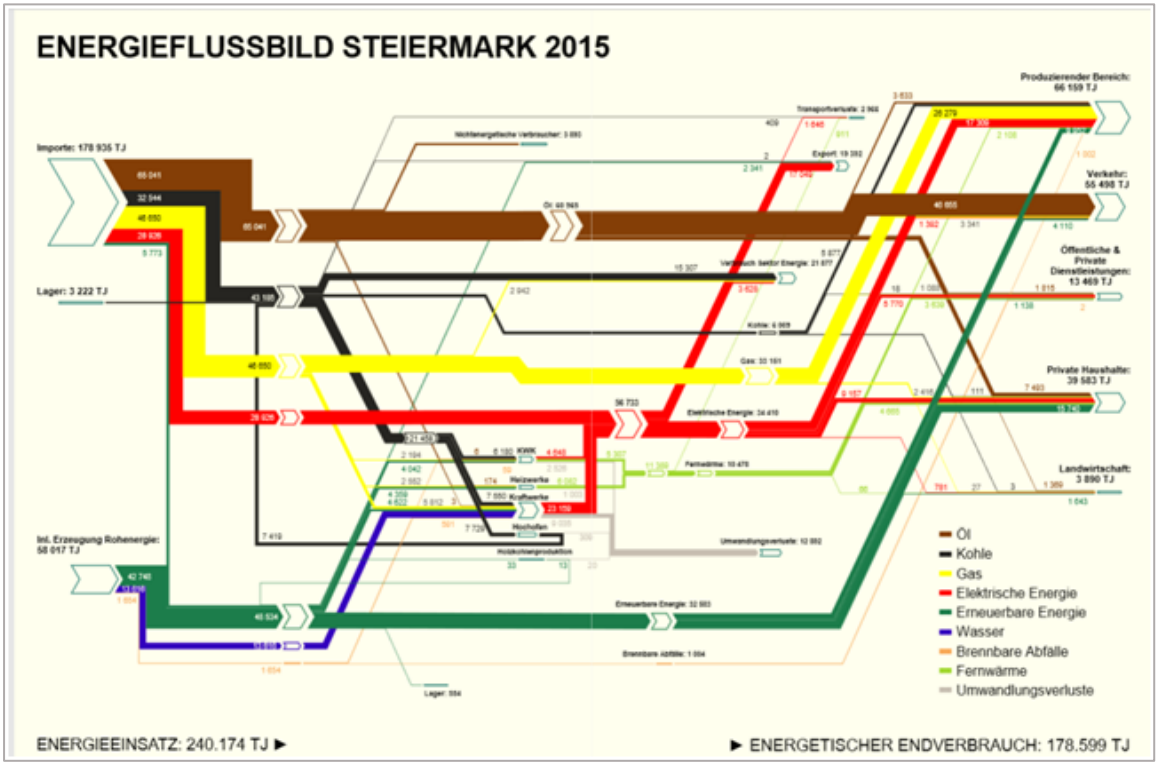

Figure 4.1: Energy flow for different sectors (at top: industry with the main resource "natural gas").

NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

National and Regional GDP

- National GDP; 369 Bil. **€** (end of 2017) (Statistik, Austria)

Year	1995	2015
District of Leoben	ND	35,800
Eastern Upper Styria	16,200	36,200
State of Styria	18,500	35,500
Austria	22,000	39,900

Table 4.4: GDP per capita in €

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- Eisenstrasse is Nr. 2 in the Styrian ranking (behind Graz)

Year	1995	2015
Eastern Upper Styria	3,141	5,846
State of Styria	21,936	43,463
Austria	174,613	344,493

Table 4.5: GDP in Mio €

National and Regional Employment Level

- Employment rate: National: 91.5 % (National 2017); Styria 92.7 %; Region: 92.9 %
- Unemployment rate: 8.5 % (National 2017); Styria: 7.3 %; Region: 7.1 %
- Youth unemployment rate: 9.8 % (National 2017)

National and Regional Economic Structure/Employment by Sector

- For instance: agriculture, industry, construction, and service sectors

NUTS3-Region	Primary sector		Secondary sector		Tertiary sector	
	1995	2015	1995	2015	1995	2015
Eastern Upper Styria	**3.4**	**2.3**	**49.1**	**49.1**	**47.5**	**48.6**
State of Styria	3.9	2.1	34.7	33.5	61.4	64.4
Austria	2.6	1.2	30.8	28.1	66.6	70.7

Table 4.6: GVA of economic sectors in % (Statistik Austria)

- **Primary sector**: Agriculture, forestry, fishing and fish farming

- **Secondary sector**: Mining, material production, energy and water supply, construction.

- **Tertiary sector**: Wholesale and retail trade, repair of motor vehicles and personal and household goods, hotels and restaurants, transport, storage and communication, financial intermediation, real estate, renting of movable property, business services, education, health, veterinary and social work, other public and personal service activities, private households

National and Regional Export Rate and Trading Partners

Austria:

- Export: 141,900 Mio € (2017)
- Import: 147,600 Mio € (2017)

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Country	Export 2017 (%) (www.statistik.at)
Germany (1)	30.1
USA (2)	6.8
Italy (3)	6.4
France (5)	5.0
Switzerland (4)	4.9
Tschechische Republik (6)	3.7
Ungarn (7)	3.4
Polen (9)	3.1
Vereinigtes Königreich (8)	2.8
China (10)	2.6
Slowenien (12)	2.1
Slowakei (11)	2.1

Table 4.7: Export activities for the year of 2017 (%)

Short description regarding export and import situation of regional MM industry

No export of **iron ore** has been detected. All the amount of iron ore is used in the **steel industry** within Austria. Other **metal inputs** for the steel industry and related industries are imported. Regarding the metallurgy industry, and specifically the **steel**, it has been recorded a high percentage of **export** (voestalpine is a world market player). As for **magnesite** and **graphite**, they are partially exported. Finally, **construction materials** are used locally.

National and Regional Number of Registered Company

Number of companies (2017) (www.wko.at):

- Austria: 506,145
- Styria: 75,609
- District of Leoben: 3,293

The percentage of SME Austria's companies corresponds to 99.7 %

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REGIONAL INFORMATION IN M&M INDUSTRY

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Short Description of Obstacles for Establishing Mining Industry

- The limited **geological potential**, and the dependence on **global market prices**, are two of the major obstacles for establishing mining industry.
- Furthermore, the fact that the region used to be a **coal mining region**, but due to high costs of mining and environmental matters all mines were closed after the 1960's constitutes one more obstacle, for the coal mining, recorded in the Region of Styria.

Short Description of Chances for Establishing Mining Industry

- Existing iron ore and graphite mines need to be demanded, so as RM can be extracted at **reasonable costs**. If the **transport distances** to the refining industry are not far (in the case of Styrian Iron Route particularly for iron ore), the prices are competitive to world market prices. This means there is a **strong dependency** on the industry – if the large regional players such as Voestalpine keep on their activities, the mine has an attractive costumer.
- There are **limited chances** for further mining in the region, but high potential for further **mining-related** (e.g. R&D) and **metallurgical/downstream** activities, given the history and connection to Montanuniversität (e.g. R&D capacity, availability of well-trained labor, established industry SLO).

Support from Regional and/or National Government

- **Montanuniversität of Leoben** (mining University of Leoben): University in Leoben, based on resources with about 4,000 students and spin-offs in Leoben and the region (e.g. ZAB).

Number of Registered M&M Company

- 1 iron ore mine; 1 graphite mine (SME companies); 1 magnesite mine; Voestalpine as giant company; Some minor quarries

Industries Closely Related to M&M

- **FLSmith GmbH** in Leoben (former Sandvik): **market - leading supplier** of engineering. equipment and service solutions to customers in the global mining and cement industries (www.flsmidth.com/).
- **ÖSTU Stettin** in Leoben: construct the necessary **infrastructure** and carry out all preparatory work for the mining companies (http://www.oestu-stettin.at/index.php?id=15&L=1&cat=14).
- **RHI Magnesita**: F&E center in Leoben: https://www.rhimagnesita.com/about/research-development/
- **Metallurgic Recycling**: Mayer Entsorgung / St. Michael (http://www.mayer-entsorgung.at/) Primaras (Eisenerz).

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Short Description of Promotion of M&M Industry

- **Events**: Industrial Culture festival, regular visitor tours through industrial plants & mines, touristic USP: tours through active open-cast mine + visitor mine at Erzberg; sport events at mine (Erzberg rodeo: toughest offroad motorbike event of the world. Erzberg mountain run etc.)
- Preservation of **Mining heritage** (among others: application for immaterial UNESCO heritage for the costumes of miners & steel workers of Styrian Iron route; museums association Styrian Iron Route /"Museumsverbund Steirische Eisenstrasse (www.eisenstrassenmuseen.at).

The Role of Metallurgy Plays in the Regional Circular Economy

- Voestalpine has blast **furnaces** and a **steel plant** in Leoben.

Short Description of Networking Potential

- **Networking** potential on R&D (MUL. ZAB) - establishment of **SME clusters**.

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5. REGIONAL GENERAL BACKGROUND INFORMATION (SAXONY, GERMANY)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

Capital

- Dresden

Area (km^2)

- 18,450 km^2

Population

The following **Tables 5.1 & 5.2,** indicate the number of inhabitants, the population density, the age structure, the working age and the percentage of youth population.

Saxony	2005	2010	2016	2017
Population	4,273,754	4,149,477	4,081,783	ND
Population Density	232	225	221	221
Age Structure	Below 20 years old 16%; 20 to 64 years old 59%; 65 years old and more 25%			
Working Age Population Percentage	ND	ND	48.5% - 51%	ND
Youth Population Percentage	ND	23.90%	26.90%	ND
Net Migration Number	ND	ND	11,054	ND

Table 5.1: Data for the population, the population density, the age structure, the working age and the percentage of youth population of Saxony[31]

[31] Statistisches Landesamt des Freistaates Sachsen

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Germany	2005	2010	2015*	2016	2017
Population	82,500,849	81,802,257	81,197,537	82,175,684	82,521,653
Population Density	230.85	228.90	ND	229.94	230.91
Age Structure	Below 15 years old 13%; between 15 to 64 years old 66%; Equals to 65 years old or above 21%				
Working Age Population Percentage (15-64y)	67%	66%	ND	66%	65%
Youth Population Percentage	14%	13%	ND	13%	13%
Net Migration Rate	0.10%	0.19%	1.47%	0.60%	ND
Population: Recorded in January **Net migration rate: Net migration number of the year/population** **2015*: Data collected from 2015 when no data from 2017 available**					

Table 5.2: Data for the population, the population density, the age structure, the working age and the percentage of youth population of Germany[32]

Optional: Urbanisation Rate

The following **Table 5.3** represents data for the urbanisation rate of Germany.

Germany	2005	2010	2015	2016	2017
Urbanisation Rate	73,36%	74,29%	75,30%	75,51%	ND

Table 5.3: Urbanisation rate of Germany[33]

Regarding the Region of Saxony, there are no official data for the urbanization rate of the region. For Saxony, regarding the year of 2011, the dense populated area accounts for 1,119.56 km^2 (6.07% of total area) and in total 1,576,081 habitants (38.61% of total population), with the ratio of 1,408 habitants/km^2. The medium populated area is 6,148.36 km^2 (33.32% of total area) with 1,627,996 habitants (39.88% of total population), and the ratio of 265 habitants/km^2. Finally, for the sparse populated area is 11,182.07

[32] Eurostat
[33] The World Bank, https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=DE

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km^2 (60.61% of total area) with 877,706 habitants (21.5% of total population), the ratio recorder to 78 habitants/km^2.

Short Description of Indigenous Group

It is not applicable as **Sorbian people**, recognized as national minorities, do not have a special influence on the M&M industry. However, data for the introduction of Sorbian people is provided below.

Saxony has a recognized **national minority**, the Sorbian people, who are protected by the Charter of Fundamental Rights of the European Union (EU), Article 21 (1), which prohibits any discrimination based on language or membership of a national minority. Since 1990, the Sorbs have also enjoyed special protections in Germany - the protocol note to the Unification Treaty, the Brandenburg Sorbs/Wends Act of 1994 (last updated in 2014), and the Act on the Sorbs' Rights in the Free State of Saxony of 1999. It should be noted that this is a different status than the legal definition of indigenous peoples. The Sorbian people live in Upper Lusatia within the Free State of Saxony and Lower Lusatia in the federal state of Brandenburg. These regions are dominated by the brown open-cast mining industry.

Due to the enlargement of lignite exploitation, there have been forced resettlements of Sorb villages. If there are complaints against these forced resettlements, it is not found at this stage of research.

Industries based on Regional Natural Resources, M&M

Short description on regional M&M (pyro- and hydro- metallurgy) industries

Metal mining of **polymetallic ores** has been shut down by 1967 with the depletion of the resources. The last tin mines (Altenberg, Ehrenfriedersdorf) closed by 1990 due to the establishment of a market economy in East Germany and new challenges by global competition. Other operations, especially in the **smelting** and **refining sector**, had to be shut down due to substantial **ecological risks** and **difficulties** to adjust the technology in an economic way. In turn, the remaining smelters adjusted their operations to scrap feed and reduced production significantly. Niche markets in ore refining and metal processing were developed producing alloys and base materials. Hydrometallurgy is quite frequently associated with pyrometallurgy in terms of electrochemical refining.

The circular economy opened many opportunities to apply **hydrometallurgical technologies**, especially in the recycling of end-of-life goods. The sector is dominated by SME, and R&D is closely associated with regional research institutions. The present development of metallurgy is driven by raising the complexity of the feed and declining scrap quality. A new focal point is the carrier elements of many CRM which become more apparent in the scrap feed and the challenges in adjusting the kiln operations accordingly. To secure RM supply many smelters focus on the substitution of scrap feed also by primary materials. In this regard, backward integration is being regarded as a crucial necessity to secure RM supply. This gave rise to new mining projects in Saxony with the aim to take profit of a still existing metallurgical know-how and (still) closed value chain.

- **M&M industry**
    - **Lignite mining companies**[34]
        - **Mitteldeutsche Braunkohlengesellschaft** (MIBRAG)

[34] https://www.epholding.cz/en/business-areas/#mining

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- Production in 2017: 18.4 Mio. t
- The sole shareholder: Energetický a průmyslový holding, a.s. (EPH) from Czech Republic
- Activities of the company have been focused in the south of Saxony-Anhalt – the company's headquarters are located at the city of Zeitz – and in the region south of Leipzig.
- MIBRAG offers a wide range of services from energy generation, landscaping to civil engineering, disposal, mine engineering services and the operation of a wind farm at the border of United Schleenhain mine in Saxony.
- A total up to 20 M t of raw lignite are mined at both mines in Profen (Saxony-Anhalt) and United Schleenhain (Saxony) each year. The modern Lippendorf (Saxony) and Schkopau (Saxony-Anhalt) power plants are major customers of the domestic fuel.
- The MIBRAG group currently employs 3,000 people, including nearly 160 trainees.

▪ LEAG (joint brand of Lausitz Energie Bergbau AG and Lausitz Energie Kraftwerke AG)
- Production in 2017: 70.2 Mio. t
- Main shareholders: the Energetický a Průmyslový Holding (EPH) and the PPF Investments
- LEAG is the fourth largest power plant operator in Germany and the biggest East German energy company. With 8,000 employees LEAG is also among the biggest private employers in this area.
- The portfolio comprises mining, refining and generating electricity and heat from lignite. For this LEAG operates four mines, four power plants and one refining plant.
- Lausitz Energie Bergbau AG is responsible for the four Lusatian opencast mines Jänschwalde, Welzow-Süd, Nochten and Reichwalde. They produce around 60 M t of lignite per year to supply the power plants Jänschwalde, Schwarze Pumpe and Boxberg as well as the refining plant Schwarze Pumpe.
- Beside the adequate supply of lignite Lausitz Energie Bergbau AG's goal is at the same time to reduce and limit as far as possible the impacts of mining on the environment and landscapes to the unavoidable. With timely recultivation straight after mining a safe diverse post-mining landscape is created with woodlands, fields and grasslands as well as areas for nature conservation. The opencast mine Cottbus-Nord closed as plan in 2015 is being transformed into a lake – the future Cottbuser Ostsee lake until the mid-2020s. It will be the biggest post-mining lake in Germany for now.

○ **Smelters**
▪ Nickelhütter Aue GmbH[35]: Co, Cu and Ni
- Offering clients a "recycling loop" for waste materials containing Ni, Co, Cu, Mo, V and W

[35] Nickelhütter Aue GmbH, http://www.nickelhuette.com/index.asp

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- Modern smelting works producing non-ferrous metal concentrates out of electroplating slurries and residues. By following metallurgical processes, these concentrates are refined into non-ferrous metals and Ni-, Cu-, Co-, V- chemicals. The cycle is closed by using these chemicals in the electroplating industry
- Recycling spent catalysts from petrochemical industries, chemical industries and from edible oil hydrogenation
- For further application in surface technology, copper sulphate is produced out of copper chloride solution generated by electronical industries
- The waste heat resulting from the pyrometallurgical processes is used to generate electricity and heat. We are able to satisfy our own energy needs and supply thermal energy to other companies situated in our hometown.

▪ Feinhütte Halsbrücke GmbH[36]: Sn and Pb
- Pyrometallurgical process

▪ Befesa Zinc Freiberg GmbH: Zn, one out of only four remaining tin -smelters in Europe:
- Pyrometallurgical process

▪ Muldenhütten: Pb
- Pyrometallurgical process
- The third largest lead smelter in Germany
- Employing 155 staff to process about 55,000 t of lead and lead alloys, including tin and antimony alloys
- Secondary lead smelter with integrated incinerator for hazardous wastes and polypropylene extrusion plant

○ **Exploration** permissions issued since 2011
▪ In total 21 permissions are issued
▪ The permissions are given to local companies such as Saxony Minerals & Exploration (SME) AG (Halsbrücke), Helmholtz-Zentrum Dresden-Rossendorf e.V. (Dresden), Tin International AG (Leipzig), Deutsche Lithium GmbH (Freiberg), Beak Consultants GmbH (Freiberg), Nickelhütte Aue GmbH (Aue), e.tc.
▪ Other international companies such as TGER PTY. Ltd. West Perth (Australia), GLOBEX Mining Enterprises Inc., Toronto (Canada) Teutonic Exploration Pty. Ltd., Perth (Australia) and Vital Metals Limited (VML) Perth (Australia)

[36] Feinhütte Halsbrücke GmbH, https://www.feinhuette.de

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Industry in Saxony[37]	Number of companies	Active workers
M&M industry	12	4,460
Lignite extractive companies	2	2,242
Aggregate extractive companies	5	ND
Smelters for pig iron, steel and ferroalloys	5	2,218
M&M related industry	296	39,575
Steel pipe manufacturers	3	1,026
Manufacturers producing other iron and steel products	3	ND
Manufacturers producing and first processing non-ferrous metals	9	1,121
Foundries	28	6,481
Manufacturers producing metal products	253	30,947
Agriculture and forestry (no fishery)	148	21,882
Tourism[38]*	ND	96,200
***Number from 2016 including restaurants, hotels and other related sectors**		

Table 5.4: Registered companies (more than 50 active workers) in M&M industry and other industries with active personnel counts, 2018.

Industry in Saxony[39]	Number of companies	Percentage (%)
Mining industry	94	100%
Enterprises with more than 50 active workers	7	7.4%
Enterprises with between 10 to 49 active workers	24	25.5%
Enterprises with less than 10 active workers	63	67.0%
Tourism[40]	9,705	100%
Enterprises with more than 50 active workers	111	1.2%

[37] Sachsen statistic: Industry (May, 2018)
[38] Sachsen statistics: Toursism https://www.statistik.sachsen.de/html/498.htm
[39] Saxony: statistic report 2017 https://www.statistik.sachsen.de/download/100_Berichte-D/D_II_1_j17_SN.pdf
[40] Sachsen statistics: Toursism https://www.statistik.sachsen.de/html/498.htm

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Enterprises with between 10 to 49 active workers	757	7.8%
Enterprises with less than 10 active workers	8,837	91.1%
***Number from 2016 including restaurants, hotels and other related sectors**		

Table 5.5: Registered companies in mining and tourist industry with SME percentage in 2017.

- Ranking of the natural, M&M industries based on the acceptance of the public
  - Ranking industries based on the acceptance of the public:
    - The information is based on the presentation of Dr. Goedecke from the Chamber of Commerce Chemnitz and reference to a study: Messung der Industrieakceptanz in Deutschland from the German Federal Ministry for Economic affairs and Energy.

Most popular industries	Least popular industries
1. Health service	1. Tobacco industry
2. IT- and telecommunication	2. Chemical industry
3. Energy supply	3. Petroleum industry
4. Waste management	4. Pharmaceutical industry
5. Food industry	**5. Mining industry**
6. Electrical industry	6. Automotive industry

Table 5.6: List with the most and least popular industries in a country-level.

In Saxony, municipalities are founded by means of **tax revenues** (income tax, sales tax, trade tax), **non-tax revenues** (earnings from investments, etc.), and **transfers** from the regional and national budget. In 2016, Saxon municipalities earn more money than they spent it (Balance 41 Mio. €).

Infrastructure

- **Transport and transport accessibility**: Access to capital cities, harbours or other important logistic points
  - **Transport accessibility**:
    - Saxony has 3 harbours (Alberthafen Dresden-Friedrichstadt, Hafen Riesa and Lindenauer Hafen (Leipzig) and 2 international airports (Dresden and Leipzig/Halle international airports). 2 of the major European routes – the E40 (France – Kazakhstan), and the E55 (Sweden – Greece) intersect near Dresden. At the Leipzig/Halle International Airport the logistics giant DHL runs its most modern European air cargo hub.
    - Dresden - Berlin: 193 km / Leipzig - Berlin: 190 km
  - **Road network:**

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- Total 13,595 km
- 2 of the major European routes – the E40 (France – Kazakhstan), and the E55 (Sweden – Greece) intersect near Dresden.

- **Railway system:**
  - Interchange or transfer station with connection to major cities, harbours or airports
  - Total 2,600 km
  - Main transfer stations in Saxony: Dresden main railway station and Leipzig main railway station which connect to Berlin, Frankfurt, Munich and other major cities. Dresden main railway station also has connection to Prague main railway station.
  - Connection to airports:
    - Dresden main railway system is connected to the Dresden International Airport via a S-Bahn. The duration of traveling is 21 mins.
    - Leipzig main railway station is connected to the Leipzig/Halle International Airport via a S-Bahn. The duration of traveling is 12 mins.
  - Connection to harbours:
    - Alberthafen Dresden-Friedrichstadt
    - Hafen Riesa
    - Lindenauer Hafen (Leipzig)

- **Public transport system:**
  - Public transport system comprises basically bus, train and subway (S-Bahn). The frequency is enough for the transport between the main cities in Saxony and other major German cities. For example, there are 26 daily travels by high-speed trains and 68 buses from Dresden to Berlin. The traveling time from Dresden main railway station to Berlin main railway station is about 2 to 3 hours, to Munich main railway station is about 5 hours, to Frankfurt main railway station is about 4.5 hours (hourly) and to Prague main railway station is about 2 hours. Internal communication between villages and cities is also acceptable, and there is available as well an on-demand service.
  - Figure 3.1 shows the main public transportation infrastructure in Saxony.
  - Figure 3.2 shows the long-distance traveling time by airplane, train and truck from Saxony.

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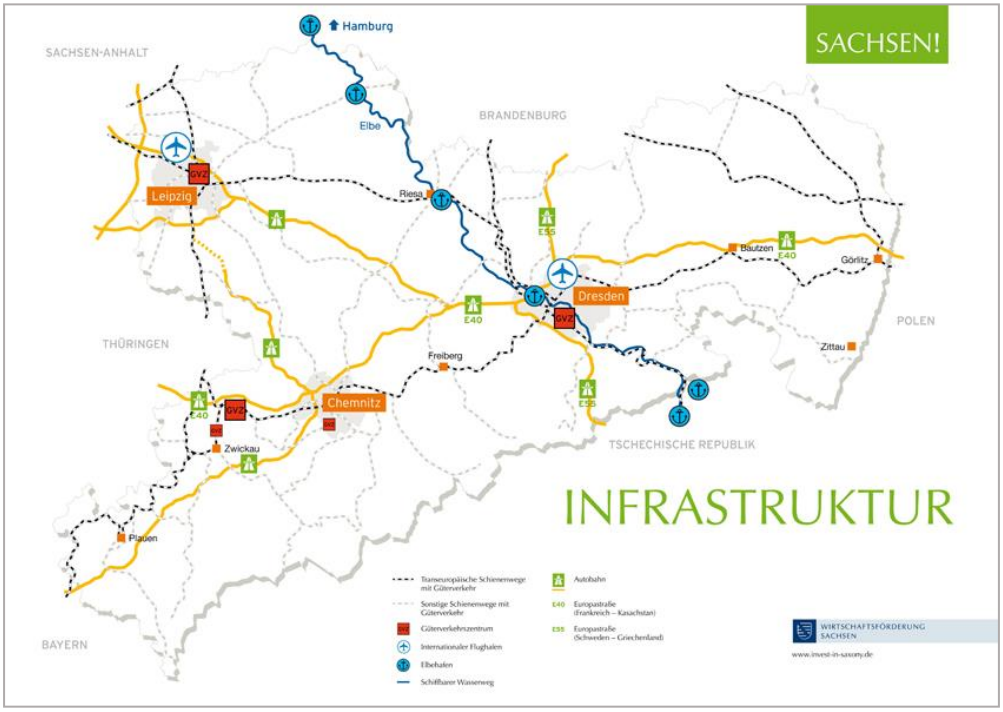

Figure 5.1: Main public transportation infrastructure in Saxony[41]

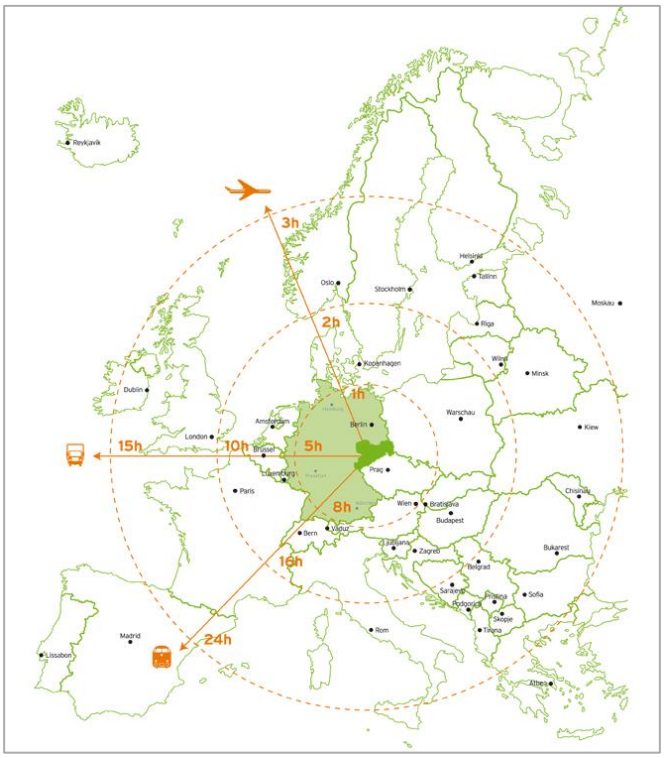

Figure 5.2: The long-distance traveling time by airplane, train and truck from Saxony[42]

-

[41] Wirtschaftsförderung Sachsen GmbH, https://standort-sachsen.de/de/investoren/standort-sachsen/lage-und-infrastruktur/verkehrsinfrastruktur

[42] Wirtschaftsförderung Sachsen GmbH, https://standort-sachsen.de/de/investoren/standort-sachsen/lage-und-infrastruktur/verkehrsinfrastruktur

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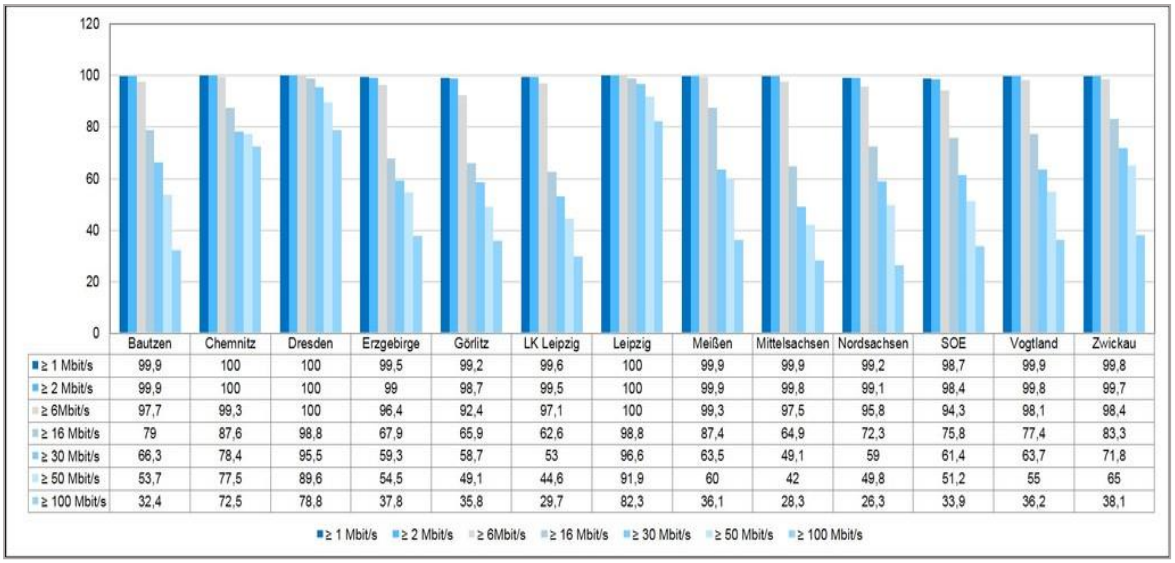
- **Telecommunication:**
  - Between 2010 and 2017 Saxon households with broadband services from 50 Mbit/s have increased from 18.6 to 65.7 percent. 95.6% of private households have an internet connection. 79.8 % of the Saxony households have a computer. In a German-wide survey, Saxony's digitalized economy reached 48 of 100 points. 18% of the economy has a high digitalization, 47% a medium and 35% a low one. SME has a low digitalization rate. (Reference: Statistisches Landesamt des Freistaates Sachsen)
  - **Figure** 3.3 shows the broadband internet access in Saxony. In general, the big cities, Chemnitz, Dresden and Leipzig have better **internet access**. In these cities, more than 70% of the broadband internet access reaches 100 Mbit/s.



	Bautzen	Chemnitz	Dresden	Erzgebirge	Görlitz	LK Leipzig	Leipzig	Meißen	Mittelsachsen	Nordsachsen	SOE	Vogtland	Zwickau
≥ 1 Mbit/s	99,9	100	100	99,5	99,2	99,6	100	99,9	99,9	99,2	98,7	99,9	99,8
≥ 2 Mbit/s	99,9	100	100	99	98,7	99,5	100	99,9	99,8	99,1	98,4	99,8	99,7
≥ 6Mbit/s	97,7	99,3	100	96,4	92,4	97,1	100	99,3	97,5	95,8	94,3	98,1	98,4
≥ 16 Mbit/s	79	87,6	98,8	67,9	65,9	62,6	98,8	87,4	64,9	72,3	75,8	77,4	83,3
≥ 30 Mbit/s	66,3	78,4	95,5	59,3	58,7	53	96,6	63,5	49,1	59	61,4	63,7	71,8
≥ 50 Mbit/s	53,7	77,5	89,6	54,5	49,1	44,6	91,9	60	42	49,8	51,2	55	65
≥ 100 Mbit/s	32,4	72,5	78,8	37,8	35,8	29,7	82,3	36,1	28,3	26,3	33,9	36,2	38,1

Figure 5.3: Broadband internet access in Saxony in 2017[43]

Energy Sources

- Pie chart with the **share of conventional energy** and the **share of renewable energy** (indirect indicator for perception of mining and regional development regarding green economy)

Saxony	2005	2010	2016
Energy sources - Consumption	2,384 TJ lignite 4,076 TJ Oil 38,506 TJ Gas 31,360 TJ Electricity 1,795 GWh Renewable energy production (brut)	3,690 TJ lignite 2,999 TJ Oil 39,348 TJ Gas 33,323 TJ electricity 3,232 GWh Renewable energy production (brut)	3,993 TJ lignite 1,845 TJ Oil 43,139 TJ Gas 40,342 TJ electricity 5,699 GWh Renewable energy production (brut)

Table 5.6: Energy sources of Saxony[44]

[43] Statistisches Landesamt des Freistaates Sachsen, https://www.digitale.offensive.sachsen.de/10657.html
[44] Statistisches Landesamt des Freistaates Sachsen

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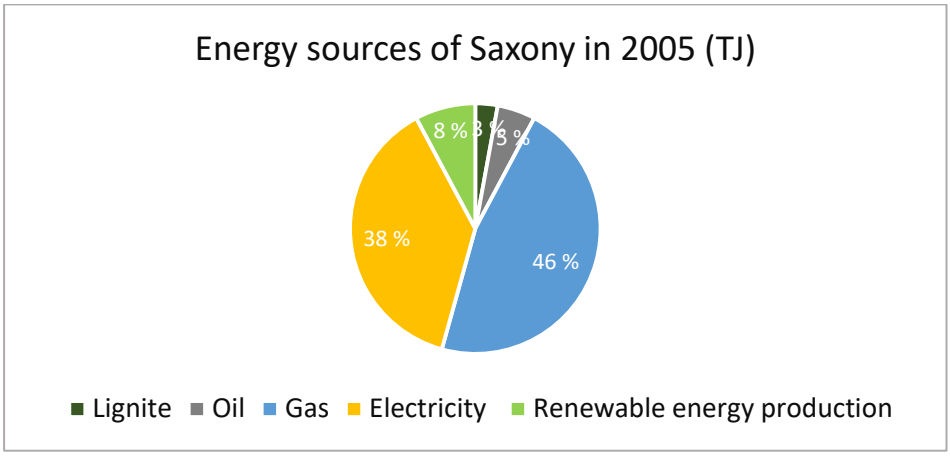

Figure 5.4: Energy sources of Saxony in 2005 (TJ)

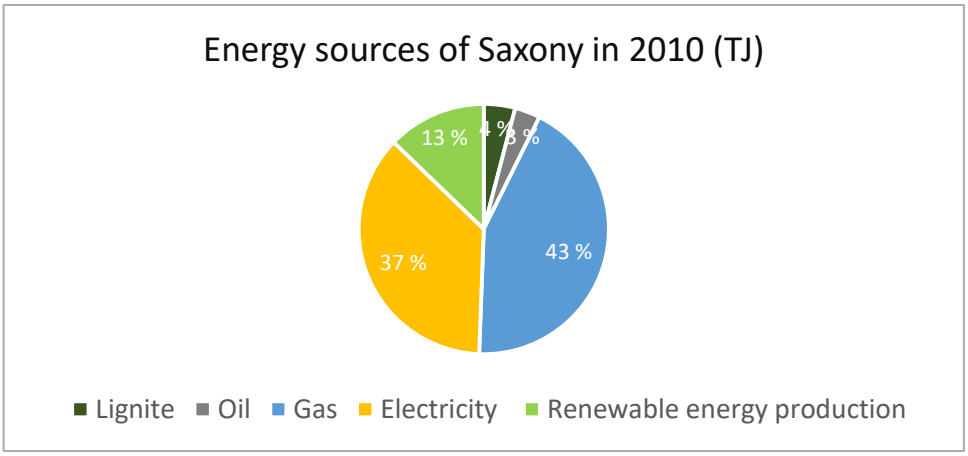

Figure 5.5: Energy sources of Saxony in 2010 (TJ)

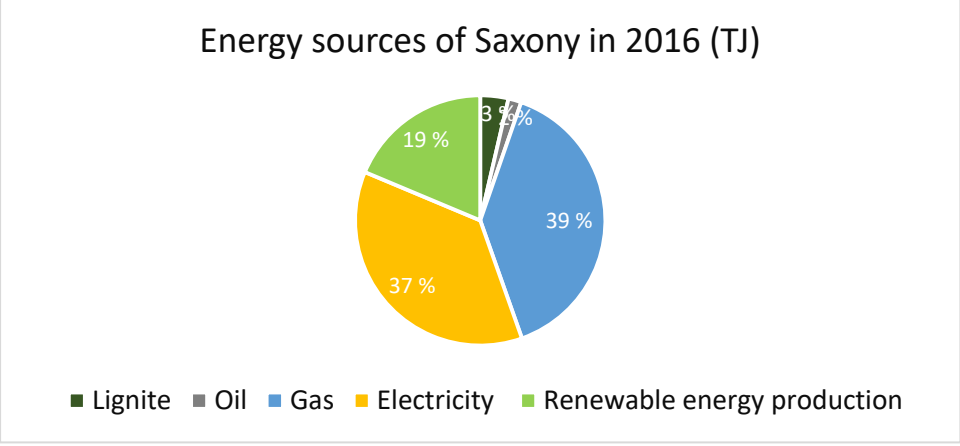

Figure 5.6: Energy sources of Saxony in 2016 (TJ)

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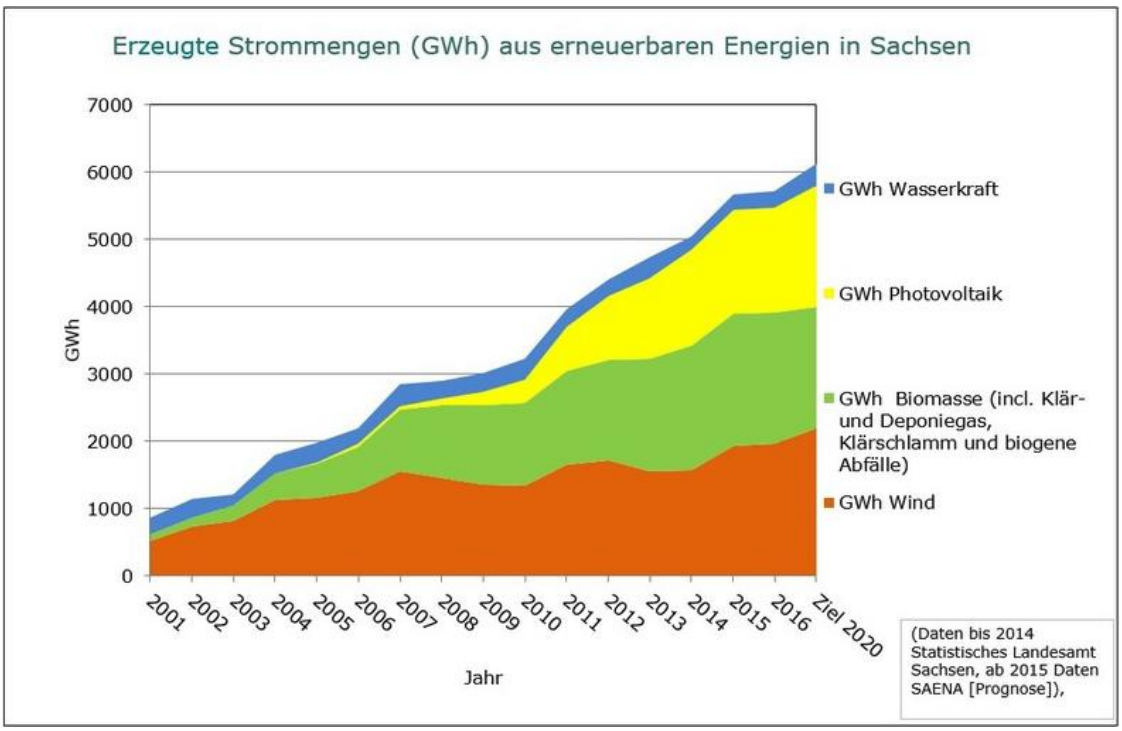

Figure 5.7: Electricity renewable energy sources in Saxony from 2001 to 2016, 2016 to 2020 is project number[45] (Blue: Hydropower; Yellow: Photovoltaic; Green: Biomass; Orange: Wind)

- **M&M related UNESCO World Heritage**[46]
  - One on the tentative list: **Mining Cultural Landscape Erzgebirge/Krušnohoří**:

    The Krušné hory Mountains region is heavily influenced by mining and ore processing in the past. More than 800 years of activities contribute to a unique landscape and customs on both sides of the border.
    The mining cultural landscape Montanregion Krušnohoří/Erzgebirge consists of six Czech cultural heritage places. These areas are the historical mining town of Krupka with its Starý Martin gallery, the Mědník hill in Měděnec, the historical mining town of Jáchymov, the town of Horní Blatná with the Blatenský moat, the mound at Boží Dar and the Mauritius mine in Hřebečná near Abertamy.
    Saxony has nominated 22 cultural heritage sites, including the historical mining towns of Freiberg, Annaberg-Buchholz, Marienberg and Schneeberg as well as other mountain landmarks including objects related to the connected industrial branches.

- **Other UNESCO World Heritage**[47]
  - **Muskau Park** (German: Muskauer Park, officially: Fürst-Pückler-Park Bad Muskau; Polish: Park Mużakowski) is a landscape park in the Upper Lusatia region of Germany and Poland.

[45] Saena, http://www.saena.de/themen/erneuerbare-energien-in-sachsen.html
[46] Krušné hory and Erzgebirge, http://www.krusnehory-erzgebirge.eu/en
[47] Wikipedia

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It is the largest and one of the most famous English gardens in Central Europe, stretching along both sides of the German–Polish border on the Lusatian Neisse. The park was laid out from 1815 onwards at the behest of Prince Hermann von Pückler-Muskau (1785–1871), centered on his Schloss Muskau residence. In July 2004, Muskau Park was added to the list of UNESCO World Heritage Sites.

- The **Dresden Elbe Valley** is a cultural landscape and former World Heritage Site stretching along the Elbe river in Dresden, the state capital of Saxony, Germany.
  The valley, extending for some 20 km and passing through the Dresden Basin, is one of two major cultural landscapes built up over the centuries along the Central European river Elbe, along with the Dessau-Wörlitz Garden Realm downstream. With respect to its scenic and architectural values, including the Dresden urban area as well as natural riverbanks and slopes, the Elbe Valley was entered on the World Heritage Site list of the UNESCO in 2004.
  However, in July 2006 it was designated a World Heritage in Danger and finally delisted in June 2009, in the course of the construction of the Waldschlösschen Bridge river crossing.

NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

National and Regional GDP

- National and regional GDP[48]
- GDP per capita

Saxony	2005	2010	2015	2016
GDP in M €	84,653	95,053	113,955	118,887
GDP per capita	20,000	23,300	28,000	29,200

Table 5.7: Saxony's GDP

Germany	2005	2010	2016	2017
GDP in M €	2,300,860	2,580,060	3,144,050	3,263,350
GDP per capita	27,888.93	31,540.21	38,260.10	39,545.38

Table 5.8: Germany's GDP

[48] Eurostat

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National and Regional Employment Level

- Employment rate
- Unemployment rate
- Youth unemployment rate

Saxony	2005	2010	2016	2017
Employment Number	1,912,500	1,975,300	2,035,200	2,054,200
Unemployment Rate	20%	11.80%	7.5%	6.7%
Youth Unemployment Rate[49]	ND	16.1%	ND	7.1%

Table 5.9: Employment level of Saxony[50]

Germany	2005	2010	2016	2017
Employment Rate	69.4%	75%	78.6%	79.2%
Unemployment Rate	8.16%	5.24%	3.29%	3.00%
Youth Unemployment Rate (15-24y)	1.31%	0.81%	0.55%	0.53%
Employment rate: % of labour force **Unemployment rate: % of labour force** **Youth unemployment rate: % of labour force**				

Table 5.10: Employment level of Germany[51]

[49] 15-24y
[50] Statistisches Landesamt des Freistaates Sachsen
[51] Eurostat

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National and Regional Economic Structure/Employment by Sector

- For instance, agriculture, industry, construction and service sectors

	Saxony	Germany
2005	Agriculture, forestry & fishing 1%, industry 23.1%, construction 5.9%, services 16.2 %, Financial and insurance activities 27.1 %, public and private services 26.6%	**2016** Industry 25.6%; Agriculture, forestry & fishing 0.6%; Construction 4.8%; Distributive trades, transport, accommodation & food services 15.7%; Information & communication 4.9%; Financial and insurance activities 3.9%; Real estate activities 10.9%; Professional, scientific, technical, administrative and support services 11.2%; Public admin., defence, education, human health and social work activities 18.4%; Arts, entertainment and recreation/other services 4%
2010	Agriculture, forestry & fishing 1%, industry 22.2 %, construction 6.4%, services 15.1%, Financial and insurance activities27.8%, public and private services 27.5%	
2016	Agriculture, forestry & fishing 0,6%, industry 24.7%, construction 7.5%, services 18.9%, Financial and insurance activities 21.5%, public and private services 26.8%	

Table 5.11: Economy structure of Saxony and Germany[52]

- Main industries based on the share of Saxony's **industrial turnover** in 2017 (67.4 Bil. €)[53]:
  - Automobile industry – 27%
  - Machine construction – 13%
  - Food industry – 9%
  - **Metal production – 13%**
  - Electrical engineering/microelectronics – 12%
  - Chemical products – 4%
  - Further sectors – 23%

[52] Saxony: Statistisches Landesamt des Freistaates Sachsen
Germany: Table 3: Gross value added at basic prices, 2006 and 2016 (% share of total gross value added), Source: Eurostat, http://ec.europa.eu/eurostat/statistics-explained/images/0/01/Gross_value_added_at_basic_prices%2C_2006_and_2016_%28%25_share_of_total_gross_value_added%29_YB17.png

[53] A Service of the Saxony Economic Development Corporation (WFS) https://business-saxony.com/en/industry-sectors

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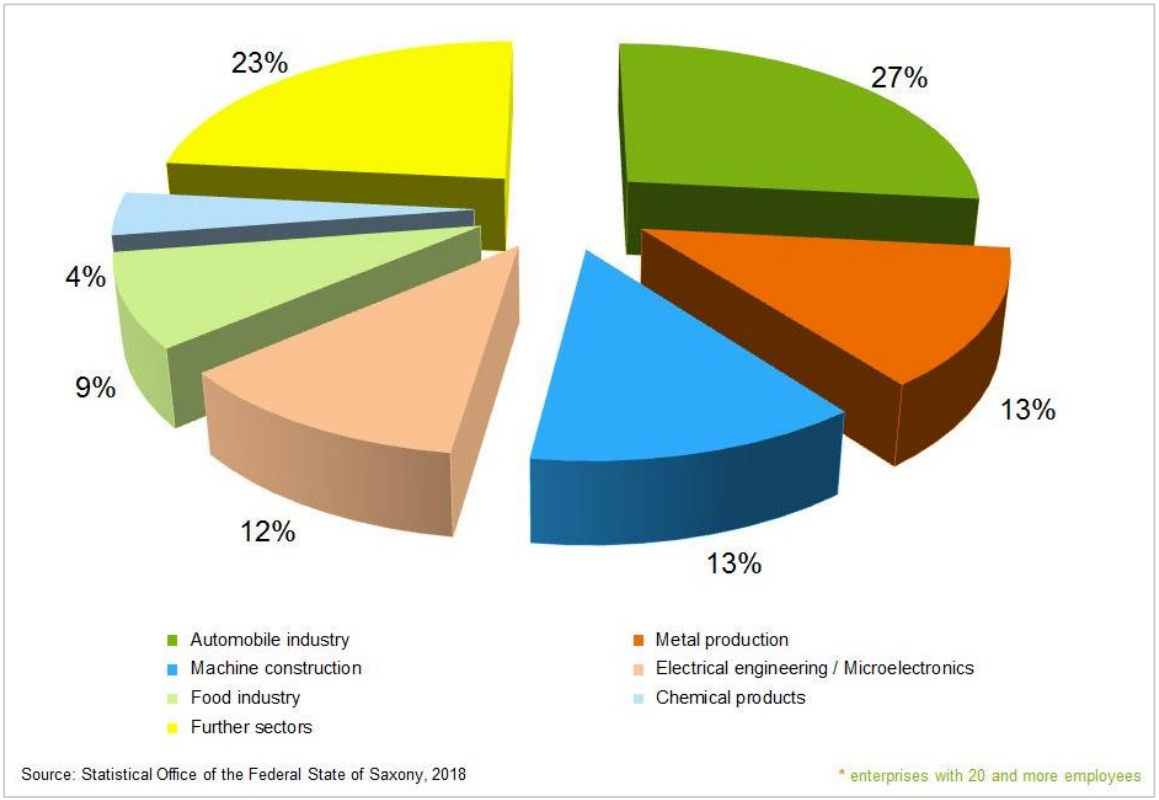

Figure 5.8: Main important branches - industries based on the share of Saxony's industrial turnover for the year of 2017 (67.4 Bil. €). Source: Statistical Office of the Federal State of Saxony, 2018.

National and Regional GERD (Investment in Research and Development)

A part of this indicator is moved to T2.3 survey as T2.3 focus on research capacity of a region. The focus of this indicator shifts to the regional participation in FP7 and H2020 (research and development projects).

Saxony	2005	2010	2016	2017
GERD	ND	2.74%	2.71%	2.73%
Private GERD	ND	1.11%	0.78%	ND

Table 5.12: GERD of Saxony[54], GERD and private GERD: % of GDP

Germany	2005	2010	2015	2016
GERD	ND	2.71%	2.92%	2.94%
Private GERD	ND	1.82%	2.00%	2.00%

Table 5.13: GERD of Germany[55], GERD and private GERD: % of GDP

[54] Aufwendungen der Sächsischen Wirtschaft für Forschung und Entwicklung (FuE), https://kleineanfragen.de/sachsen/6/12527-aufwendungen-der-saechsischen-wirtschaft-fuer-forschung-und-entwicklung-fue ; Forschung in Sachsen auf Spitzenniveau, https://standort-sachsen.de/de/standort/innovationskraft/ueberblick-forschung-in-sachsen

[55] Eurostat

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National and Regional Export Rate and Trading Partners

- National and Regional export rate
- Short description regarding export and import situation of regional M&M industry

Saxony	2005	2010	2016	2017
Export Goods in M €	17.5	24.9	36.8	41.4
Export Industrial Goods in M €*	16.26	23.2	34.8	ND
Main Export Trading Partners	Intra-EU: Italy, France, GB, Spain, Czech Republic Extra-EU: USA, Malaysia, VR China	Intra-EU: France, Italy, Poland, Czech Republic Extra-EU: China, USA, Russia	Intra-EU: GB, France, Poland, Czech Republic, Italy, Switzerland, Belgium Extra-EU: China, USA, Taiwan	ND
***Industrial goods; Due to the lack of M&M export data**				

Table 5.14: Export rates and export trading partners of Saxony[56]

Additional Information for Saxony[57]

- **Direct** and **indirect** RM imports:
  - 2005: Amount of RM 797 M €
  - 2010: Amount of RM 1,102 M €

- **Foreign trade**[58] - **Export** (Figure 4.2):
  - Export in total 41,400 M €
  - Export partners: two largest individual export partners are China and USA; European continent has a share of 58%

- **Foreign trade**[59] - **Import** (Figure 4.3):
  - Import in total 24,250 M €
  - Import partners: more than ¾ is from European countries with ¼ from neighbouring countries

- Share of Saxony's export turnover[60] (Figure 4.4)
  - **Automotive industry**: most important export goods (9.2 Bil. €, 2017); the sales to foreign countries have more than doubled over the past ten years; main customers: USA and China

[56] Statistisches Landesamt des Freistaates Sachsen
[57] Statistisches Landesamt des Freistaates Sachsen
[58] A Service of the Saxony Economic Development Corporation (WFS) https://business-saxony.com/en/industry-sectors
[59] A Service of the Saxony Economic Development Corporation (WFS) https://business-saxony.com/en/industry-sectors
[60] A Service of the Saxony Economic Development Corporation (WFS) https://business-saxony.com/en/industry-sectors

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- **Machine construction**: 4.3 Bil. € (7.8% higher than 2016)
- **Electrical engineering/microelectronics**: 3.1b euro
- **Metal production**: 2.1 Bil. € (10.5% higher than 2016)

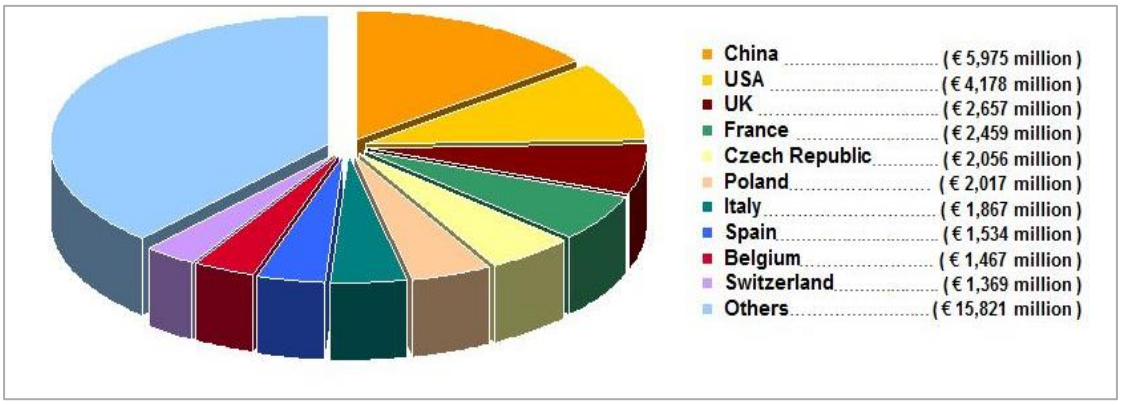

Figure 5.9: Saxony's export partners for the year of 2017 – export in total 41,400 M €. Source: Statistical Office of the Federal State of Saxony, 2018.

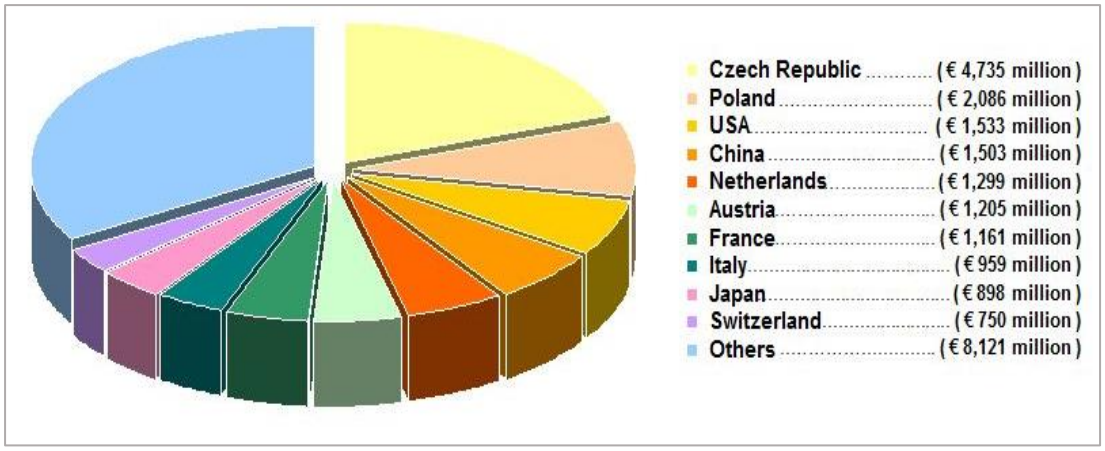

Figure 5.10: Saxony's import partners for the year of 2017 – import in total 24,250 M €. Source: Statistical Office of the Federal State of Saxony, 2018.

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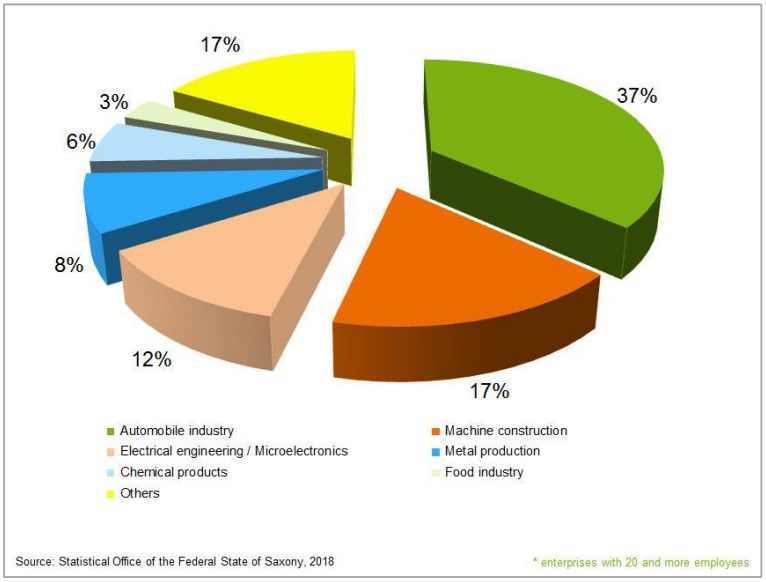

Figure 5.11: Saxony's most important branches based on the share of Saxony's export turnover for the year of 2017. Source: Statistical Office of the Federal State of Saxony, 2018.

Germany		**2005**	**2010**	**2016**	**2017**
Intra-EU and Extra-EU	Export Goods Rate	33.92%	36.81%	38.34%	39.28%
	Export Goods Rate of M&M Industry*	ND	ND	ND	ND
	Export Goods Rate of RM**	3.31%	4.16%	3.32%	3.55%
	Export Goods Rate of Mineral fuels, lubricants and related materials**	4.08%	3.96%	3.63%	3.91%
Intra-EU	Export Goods Rate	21.90%	22.21%	22.45%	22.98%
	Export Goods Rate of RM**	2.09%	2.69%	2.27%	2.36%
	Export Goods Rate of Mineral fuels, lubricants and related materials**	2.66%	2.78%	2.41%	2.61%
Extra-EU	Export Goods Rate	12.02%	14.60%	15.89%	16.31%
	Main Export Trading Partners	ND	ND	ND	Intra-EU: France, Netherlands, UK Extra-EU: USA, China, Russia

***Lacking metallurgy data; Replaced by raw materials and Mineral fuels, lubricants and related materials**
Export Goods Rates: % of GDP, Original data in Million Euro
****Other Rates: % of respective Export Goods Rates**
Export trading partner: Destatis

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Table 5.15: Export rates and trading partners of Germany[61]

Additional Information for Germany[62]

- Origins of direct and indirect RM imports in 2011:
  - **Metal ores**: China, Latin America, Brazil
  - **Minerals**: China, Asia, Europe, Middle and near East
- Import dependency of RM consumption (RMC) in 2010: Ca. 70% Foreign share of RMC

  - **Metal ores** (Iron ores, mangan ores and non-iron ores): Foreign share accounts for close to 100% of the German demand
  - **Industrial minerals** (Fertilizer minerals, Natriumchlorid, Chemical minerals and quartz sand): Foreign share accounts for around 60% of the German demand

National and Regional Number of Registered Company

- National and regional number of registered companies
- SME percentage

Saxony		**2005**	**2010**	**2016**	**2017**
Number of Registered Company	Total	164,064	174,539	166,387	164,511
	M&Q Industry*	134	105	99	94
SME Percentage (50-250 staffs)	Total	ND	6.7%	7.4%	7.4%
	M&Q Industry*	ND	29.6 %	36.40%	32.90%
Micro Percentage (<50 staffs)	Total	91%	90.70%	89.70%	89.60%
	M&Q Industry*	ND	70.50%	63.60%	67%
Multinational Companies**	M&Q Industry*	ND	ND	ND	ND
***Lacking the information in metallurgy ****No information**					

[61] Eurostat; Destatis, https://www.destatis.de/EN/FactsFigures/NationalEconomyEnvironment/ForeignTrade/Tables/OrderRankGermanyTradingPartners.pdf?__blob=publicationFile

[62] The use of natural resources, report for Germany 2016 https://www.umweltbundesamt.de/sites/default/files/medien/377/publikationen/161025_ressourcenbericht_en.pdf

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Table 5.16: Registered companies in Saxony[63]

Germany		2010	2015
Number of Registered Company	Total	2,073,925	2,408,352
	M&Q Industry*	1,836	1,813
SME Percentage (50-250 staffs)	Total	ND	2.40%
	M&Q Industry*	6.21%	6.73%
Micro Percentage (<50 staffs)	Total	ND	97.12%
	M&Q Industry*	92.43%	92.06%
Big Companies Percentage	M&Q Industry*	1.36%	1.21%
***Lacking the information in metallurgy**			

Table 5.17: Registered companies in Germany[64]

REGIONAL INFORMATION IN M&M INDUSTRY

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

Short Description of Regional M&M Sector

Saxony is a **mining state**. Lignite is extracted in three open-cast mines, and nearly 300 small and medium enterprises produce aggregates, industrial minerals and hard rock. Mining enjoys a solid **public reputation** thanks to its centuries-old history, and as a result to the ever-growing wealth brought to Saxony.

Saxony is a land rich in RM but at comparably rather **small-scale deposits/occurrences** except for a number of tin and lithium deposits which are actually under investigation. Most income is generated by aggregate mining: Solid rock, sand, gravel. Traditionally, the mining of the underground and kaoline, supply an innovative technical ceramics and china industry. The first European china has been invented in 1710 in Saxony. Regarding ore and spar mineralizations, most of the **shallow deposits** have been

[63] Statistisches Landesamt des Freistaates Sachsen
[64] Eurostat

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mined over a long mining period stretching from the medieval times to 1990. Most of these deposits are now **depleted** or mining **economically not viable.**

Investigations to valorise the substantial occurrences of close to **surface low-grade** ore and **deep-seated** potentially **high-grade** ore are now **subject to R&D** and extensive data exploration. Actually, the investigations are focussing commodities indium, tungsten, tin, fluorite, lithium, gallium, molybdenum, copper, and silver. **Figure** 5.2 indicates the location of the Saxon RM deposits on the map and **Figure** 5.3 shows the different mining companies governed by the Saxon mining authority.

Most of these ore and spar deposits in Saxony are located in the Ore Mountains, Vogtland or distinct distribution areas. The rest of the deposits can be found near Schleife and Weisswasser in Lusatia (North Sudeten Basin), north Leipzig (Delitzsch Granodiorite Massif) and the central Saxon Hills (Granulite Mountains). Due to the **increase** in global market prices, the exploration of ore and spar, particularly tin, tungsten, zinc, lithium, fluorite and barite, including substantial CRM byproducts restarted in 2005 and led to the reopening of a fluorspar mine in 2015. Another mining project – in the cross border region to the Czech Republic - focusing on lithium is already in the phase of feasibility and the permitting procedures have also started at the end of 2017 while **further projects** are planned.

Saxony is still one of the true **metallurgy regions** in the EU. **Pyro-** and **hydrometallurgical** works are closely associated with metal mining by history up to present times. Today the smelters are entirely operated with scrap, though backward integration is a raising subject to concerns in scrap supply. The main works are Nickelhütte Aue GmbH (Co, Cu, Ni), Befesa (Zn), Muldenhütten (Pb) and Feinhütte Halsbrücke GmbH (Sn); the latter one out of only four remaining tin-smelters in Europe.

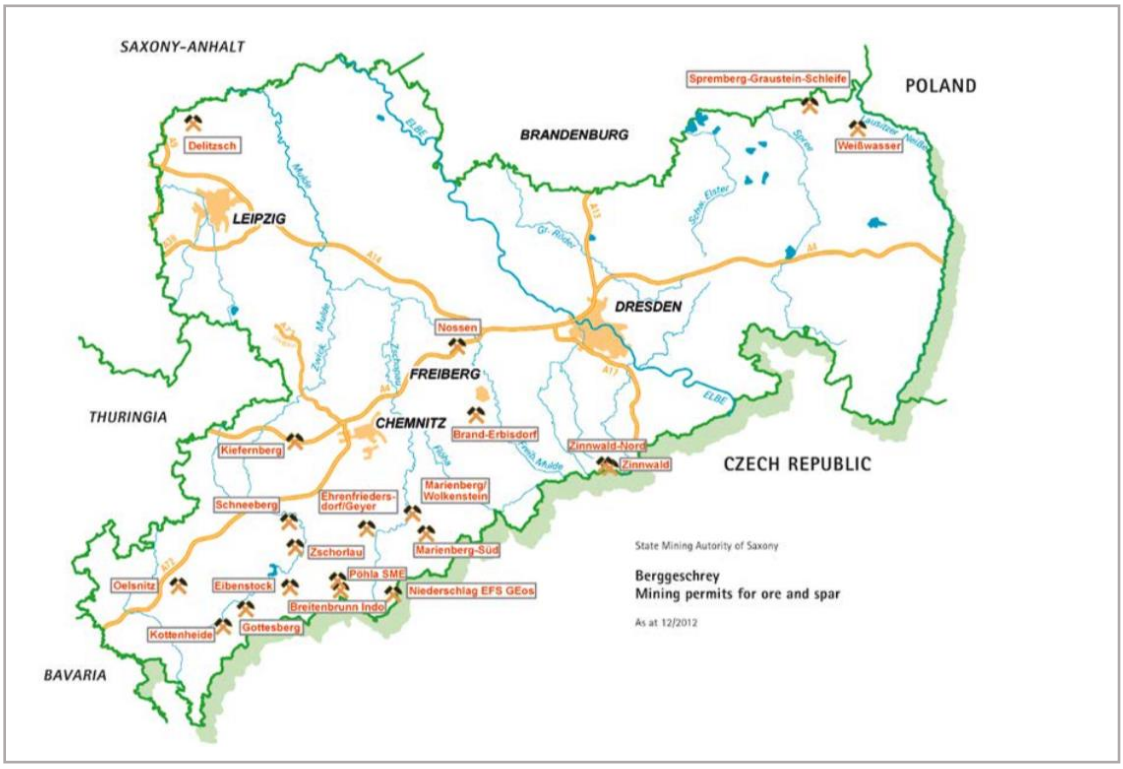

Figure 5.12: Mining permits for ore and spar in 2012[65]

[65] Saxon Raw Material Strategy, https://publikationen.sachsen.de/bdb/artikel/29796

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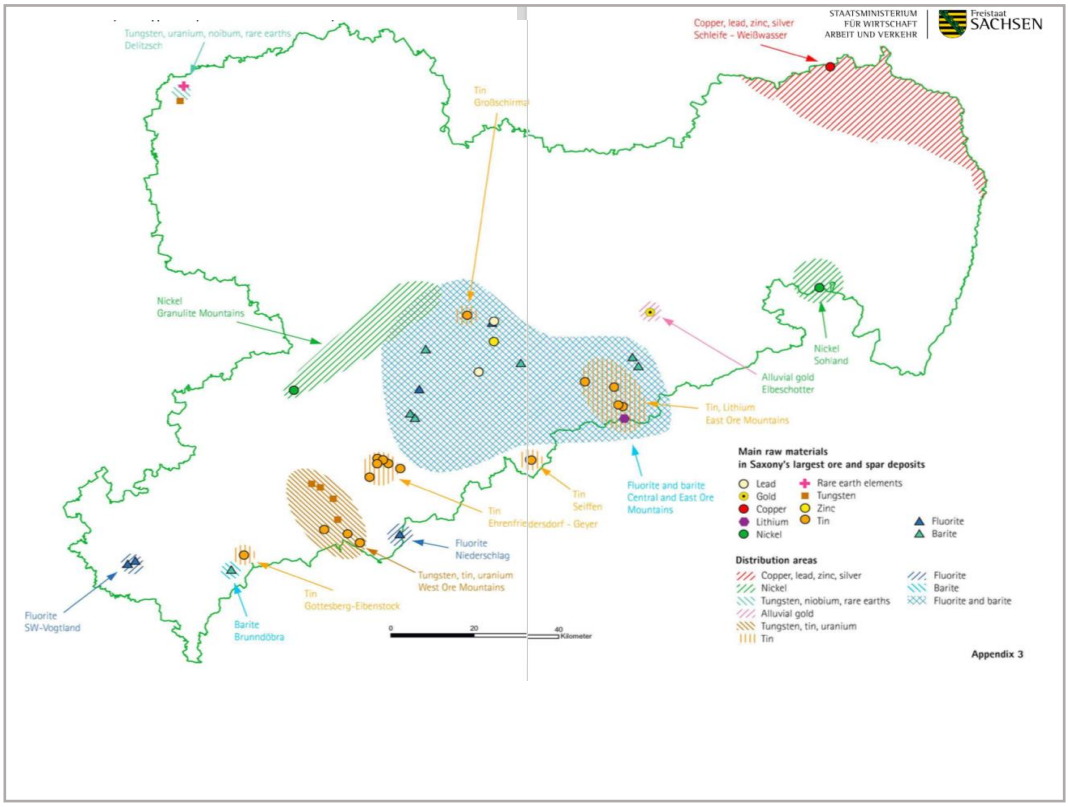

Figure 5.13: Main raw materials in Saxon's largest ore and spar deposits[66]

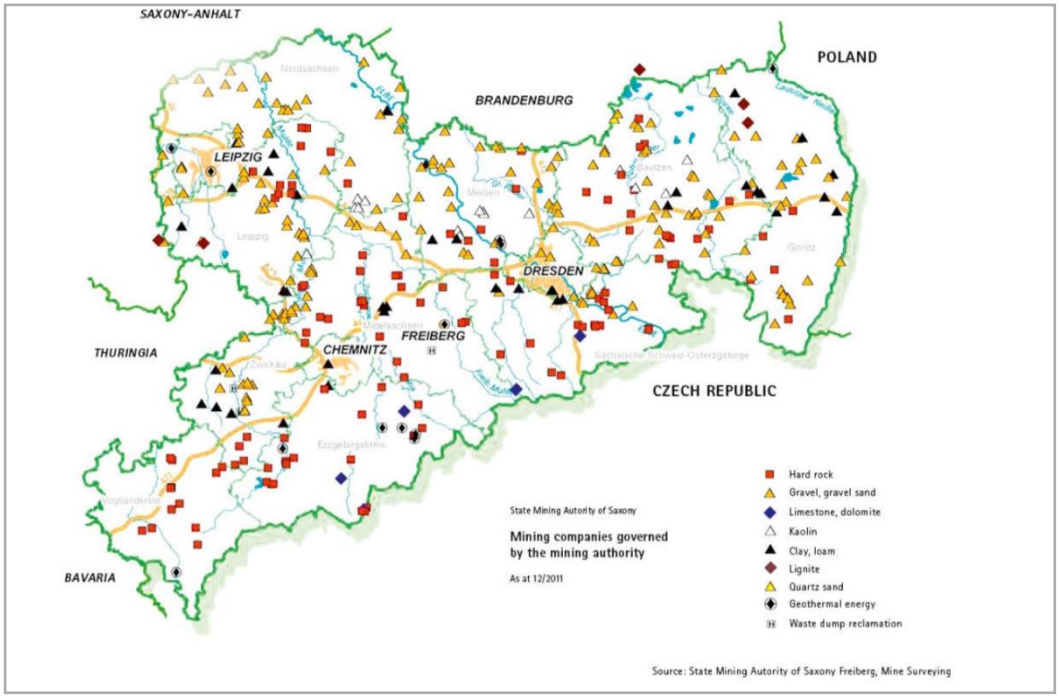

Figure 5.14: Mining companies governed by the Saxon mining authority[67]

[66] Saxon Raw Material Strategy, https://publikationen.sachsen.de/bdb/artikel/29796
[67] Saxon Raw Material Strategy, https://publikationen.sachsen.de/bdb/artikel/29796

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Figure 5.15 that follows, shows the total turnover of mining, extraction of rocks and earth from processing companies (20 staffs or more) in colour grey (Bergbau, Gewinnung von Stein und Erden) in 2015.

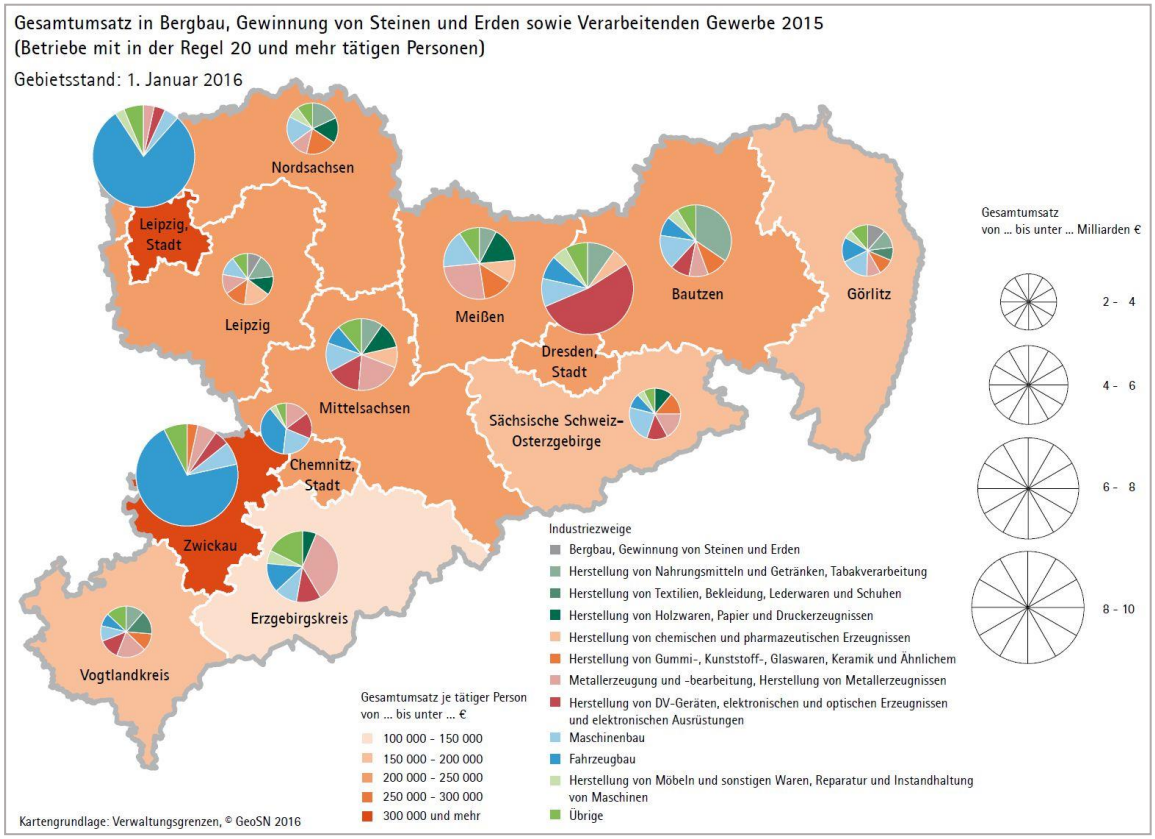

Figure 5.15: Total turnover of mining, extraction of rocks and earth from processing companies (20 staffs or more) in colour grey in 2015[68]

Saxony is one of the **main lignite mining states** in Germany. Lignite is being mined at a global scale. The approx. 30 M t of lignite mined here every year makes up around 18% of the German total volume mined and it represents about 3.5% of the lignite produced worldwide.

Lignite exists in comparatively large quantities and it is substantially contributing to the power generation. However, is lignite mining now subjected to a politically driven closure in terms of the implementation of the “energiewende”?

[68] Reference: Verwaltungsgrenzen GeoSN, 2016

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Short Description of Mining Policy

- National/Federal level:
    - Specialist law: **Federal Mining Act** (BBergG)[69]
        - The Federal Mining Act covers provisions related to mining activities: Mining authorization, Exploration, extraction and treatment, Authority to issue Mining Ordinance, Mining supervision, Mining authorization book and mining authorization map, Mining and land ownership and public transportation facilities, Other activities and facilities, Special provisions for the continental shelf, execution, Resource to the courts and administrative fines and criminal law provisions.
        - One-stop shop system (which usually excludes aggregates): The mining authority is responsible for the whole licensing and permitting procedure as well as for inspections and supervision competences. Therefore, it is the only contact for the applicant.
    - Specialist law: **Mineral Deposits Act**
    - **Other laws** covering the German spatial planning system
        - Federal Building Code
        - Federal Regional Planning Act
        - The regional planning laws of the Länder (States)

- Regional level:
    - **Saxon Mining Office**
        - One-stop shop administration structure
        - All the mining exploration and extraction permits are issued through the Saxon Mining Office
    - Average **duration** of the permitting process
        - On average, it takes about five months to grant licences (exploration licences (Erlaubnis)) as well as extracting licences (Bewilligung). Permitting procedure for mining operations (operational plans) including participation of appropriate authorities (but without EIA) requires three months to twelve months, sometimes longer.
    - **EIA** and **other requirements** for mineral developers
        - The Saxon Mining Office provides directives concerning operational plans including EIA on its website ("Betriebsplanrichtlinie")

- Additional proactive policy from the **German Federal Government**: The German Government's RM strategy, Safeguarding and sustainable supply of non-energy mineral resources for Germany (2010).
    - The general framework support (for the private sector) focuses on raw materials policy, support for research and a joined-up international raw materials policy. In addition, German Government is raising awareness amongst the German regional governments that the interests of raw materials sector should be taken into accounts in terms of spatial planning, regional planning and authorisation procedure when exploiting (exploration and extraction) domestic raw materials.
    - The raw materials strategy addresses following topics

[69] Bundesministerium der Justiz und für Verbraucherschutz, https://www.gesetze-im-internet.de/englisch_bbergg/index.html ; Improving Framework Conditions for Extracting Minerals for the EU, 2010 EC & Planning Policies and Permitting Procedures to Ensure the Sustainable Supply of Aggregates in Europe, 2010 MUL

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- Reducing trade barriers and distortions of competition
- Measures to diversify supply sources of raw materials
- Domestic extraction of raw materials: The Länder (States) should take the need to secure raw materials supplies (and in the interests of output and jobs) into consideration in their spatial planning. All the stakeholders should be involved in the land use planning process to find a way to exploit the major known deposits while respecting other land uses.
- Raw materials efficiency: Cutting-edge findings from mineral deposits research, modern mining extraction technologies and further development of ore recovery and processing technologies
- Recycling
- Raw materials in the value chain: Improving raw materials processing capacity in Germany
- Materials efficiency: resource-efficiency technologies (ex. lightweight construction) and materials for substitution and recycling
- Promotion of vocational training for foreign skilled workers and managers in the raw materials sector
- Significance of derivatives and financial issues in trade in raw materials
- Structural measures: Establishing the German Mineral Resources Agency and resource technology institute in the east of Germany (Establishing New Research Institute for Resource Technology as part of the Helmholtz Association)
- Political backing
- Development co-operation (with countries having a wealth of raw materials)
- Bilateral raw materials partnerships
- European policy on raw materials
- Raw materials policy in the international context: German Government's support in enhancing the transparency of financial flows (Extractive Industries Transparency Initiative) and other issues

- Additional proactive policy from the **Saxon State government**: the Saxon RM Strategy (Press date 2012, amended version 2017)[70]
    - Objectives of Saxon RM policy: Framework conditions for mining local raw material: (1) Having land-use plans protecting regions has the potential of being used to mine mineral resources and lignite (2) Systematically updating the existing raw material database (3) Adapting the legal framework conditions to the needs of raw material economy
    - Other aspects: Secondary RM, Saxon internal networking of RM economy stakeholders, International co-operations, Research, Training of skilled specialists and Awareness of RM.

Short Description of Obstacles for Establishing Mining Industry

- National legal framework:
    - Federal laws in mining and environmental issues affect the regional performance
    - Latest example is the fracking debate which led to a restrictive regulation on the federal level

[70] Saxon raw meterial strategy

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- Lack of skilled labour force for mine operation
- Dense population
- Conflicting land-uses
- High production cost
- High energy cost
- Perception of general public
    - The current perception of mining in Germany is part of a **complex interaction** of governmental policies and lobbyism of national and international environmentalists, where assigning mining as a "no go" is only a mosaic stone of a general approach to a transformation of society at all. It is a logical consequence of the immediate ban of nuclear power of the central government (Atomausstieg) after Fukushima and continues in fighting lignite mining after the EU forced closure of hard coal mining in Europe. That elevated protagonists. Actually, Germany with a share of 32% of production in EU faces an **increasing bad - image campaign** against industry. Specific focal industries being recognized as "bad" are pharmacy, automotive (Diesel), tobacco, chemical industry. Mining ranges No. 5! Interestingly these branches are the backbone of Germany industry and consequently of its prosperity.
    - **Media** also affects the perception of general public on M&M sector. Whether it is in politics or the media, the subject of mining is mostly criticized and is based less on facts and more on ideologies and emotions. Media coverage emphasizes the lack of transparency and communication from exploration, mining and recycling companies as well as accidents and accidents within companies. This is becoming an increasing problem since most of the media consumption is from internet, an information source especially fed and addressed to the young generation and without a clear background in terms of reliability.
- The trend of **deindustrialisation**
    - Though not that much progressed as in other EU member states Germany suffers a decline of industry as part of the overall deindustrialisation of EU28. Mining is not the main contributor to job creation in Germany, however since the country almost entirely depends on RM supply from outside mining must be regarded as "key enabler" to maintain production and to secure a very thorough value chain. As there are fewer and fewer jobs in mining, knowledge about the industry is dwindling. For mining companies the loss of industrial acceptance is of major concern as it results in longer, more complex planning and approval procedures, loss of industry and company image and reputation, higher costs for companies, loss of domestic and foreign investors as there are more company closures and relocations abroad, problems in obtaining and retaining professionals due to the lack of opportunities, and the reduction and possible cancellation of state support measures.
- Strict EU **environmental** and **waste regulations**
    - The EU environmental regulations must be seen as a tremendous burden which actually must be seen as more serious than lack of skilled labour force or knowledge. A major challenge to many mine developers is seen in the fulfilment of at the European Waste Directive. The obligation of reviewing and reporting to the authorities has been too personal intensive. In particular, the smelters, most of them family owned and thus of SME type character reach its limit.
- **Bureaucracy**
    - Another impact that hinders entrepreneurship is the raising regional, national and EU bureaucracy. The latter is being regarded as a major challenge and subject to the present loss of acceptance of EU policies and "Europe" at all.
- **Education**: Awareness of RM

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- A review of the School masterplans by GKZ projects resulted in “chocking news” about how the entire learning has been transformed from conveying facts to conveying opinions. Interestingly, this a phenomenon not limited to Saxony, although education is subject to the state governments. Reference was made to NRW where – with regard to the lignite mining – business organisations of lignite industry are not allowed by law to disseminate and present information material at schools. Only environmentalists, such as Greenpeace or the German counterpart BUND were allowed so. As a result, students are beginning to leave the general education schools with a rudimentary knowledge of the importance of RM for industry and daily life, as well as the basic structure of the mining and extractive industries.
- The mining industry itself strongly recommends heightening the awareness of RM and there are a number of activities that have already been undertaken to build awareness. For example, there is an entire program dedicated to the improvement of RM awareness in Saxon schools as a measure resulting from the above-mentioned analysis.

Short Description of Chances for Establishing Mining Industry

- **Potential resources**
- **Policy stability**, guarantee of **private property**, and the **nature of free-market** provide reliable productions and prices to companies. More than this the consumer markets lay close by.
- **Community acceptance** due to the centuries long **mining history**
- Excellent **research infrastructure**
- **Saxon RM Strategy**
  - Indicating the supportive stance of the regional authority
  - Ensuring the framework conditions allowing current and future exploitations of raw material resources
  - Ensuring the framework conditions supporting the development of reclamation industry/secondary raw material industry
  - Raw material networks which reach out to individual stakeholders (GKZ)
  - Further developing international co-operations to market the expertise of Saxony in raw material sector
  - Strengthening existing raw material R&I structure and develop Freiberg into a mining hub
  - Continuing training of skilled specialist in Saxony
  - Maintaining independent and efficient Saxon mining administration
  - Maintaining an ideology-free, knowledge-based community awareness of raw materials, including teaching solid, basic science and facts at all levels of education and managing rehabilitation post-mining landscapes in Saxony.

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Regional GDP of M&M Industry

- Regional GDP of M&M industry
- Regional GDP of M&M industry per capita

Saxony	2005	2010	2016
GDP of Production Industry without Construction *	44,630,333	54,423,198	63,793,123
GDP of Production Industry without Construction per Capita*	10.44	13.12	15.63
***Lacking information in M&M industry**			

Table 5.18: GDP of M&M industry in Saxony[71]

Number of Registered M&M Company

- Number of registered M&M company
- SME percentage in the registered M&M company
- Giant M&M company in region
- Categorising the companies by types, for instance, production service (consulting)

Please find the data for the registered companies in M&M industry and the size of the companies, at the mentioned information, at the previous tables. Although there is no statistic from regional authority regarding categorising the companies by types, GKZ provides an overview of its member structure in M&M sector.

Support from Regional and/or National Government

The relevant administrative, private companies and research institutes (excluding cluster organisations and associations.

Institutional scheme: Geo-hub: Administrative, business and science institutes that form the mining network in Freiberg

- Saxon State Ministry of Economic Affairs, Labour and Transport
- State Mining Authority of Saxony (Saxon Mining Office)
- Geological Survey
- Geokompetenzzentrum Freiberg e.V.
- Freiberg University of Mining and Technology
- Helmholz Institute Freiberg for Resource Technology

Short Description Regarding Research and Innovation Activities in M&M Industry

The cluster Freiberg is the RM research hub in the Federal Republic and hosts the Helmholtz Centre Freiberg for Resource Technology, the Technical University Bergakademie Freiberg, Fraunhofer

[71] Statistisches Landesamt des Freistaates Sachsen

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Institute, and a substantial number of research-intensive industries to developing innovative technologies designed to provide the economy with mineral (especially metallic) resources, and recycling these in an environmentally friendly manner. GKZ, aiming at generating synergies from the multitude of players is the principle cluster management, triple helix network composed of industry, research, and administration operating globally.

Although there is no quantitative data available in Saxony, there are many examples of research and innovation in the Saxon mining and processing sector, three of which are presented here.

- Autonomous robots in underground mining[72]
    - Advantage: Extereme environment operation (heat and humidity), reduction of mining cost (not need for air conditioning) and lower safety risk (application of rescue robot and autonomous mine operation robot)
    - Mining-RoX project from the TU Freiberg
        - Mobile robot technology for assisting autonomous exploration of underground mines. The functions include detailed 3D scans and monitoring environmental conditions of the mine (air and water quality).
        - Research and teaching mine of the TU Freiberg provides a unique testing location for this pioneer technology.

- Biominig: Metal extraction with bacteria[73]
    - Application: Extraction of low concentrated metals in ores
        - Metals extraction from dumps of abandoned mines
        - Recycling metals from electronic scraps
    - Helmholtz research institute in Freiberg:
        - Bioleaching: Copper within the ore is often bonded with sulphur (metal sulphides) which is insoluble under normal conditions. It requires complicated chemical process. However, the bacteria can extract the copper by metabolism, called bioleaching. It is especially efficient when extracting small amounts of copper. In addition, it is more environmental friendly than traditional methods. Researchers are also looking into the potential of using bioleaching in extracting rare earth metals.
        - Biosorption: Biosorption means the researchers employ the special surface of the bacteria to create filter materials. The surface of the bacteria consists of envelope proteins which can efficiently bond with metal ions. Currently, this principle has been applied to extract arsenic and uranium from waste water by the researchers.

- Advanced processing: new processing technologies to valorise domestic greisen, pegmatite and skarn ore
    - Index reference: FAME – Flexible And Mobile Economic processing technologies – EU HORIZON grant number 641650.

[72] TU Freiberg Infomatik department, https://tu-freiberg.de/fakult1/inf/professuren/virtuelle-realitaet-und-multimedia/forschung/projekte/mining-rox
[73] Helmholtz, https://www.helmholtz.de/en/energy/biomining-metal-extraction-with-bacteria/

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EU Funding

- European Regional Development Funds (ERDF) Operational Programme 2014-2020: Sachsen 2,089M€[74]
  - Priorities: Research and development, SME competitiveness, Low-carbon economy, Climate change and risk prevention, Environment and resource efficiency and Social inclusion
- European Social Funds (ESF) Operational Programme 2014-2020: Saxony 828 M€ including national funding (Total EU contribution: 663M€)[75]
  - Priorities: Education and training, Employment and labour market and Social inclusion
- Other funding schemes[76]: Federal Germany ESF, Interreg V-A (Germany/Saxony –Czech Republic and Poland –Germany/Saxony), Central Europe, Interreg Europe, URBACT (European Territorial Cooperation Programme) and ESPON

- Projects related to M&M funded by Interreg are shown in **Table 5.19.**

Saxony	Project name	Description	Funding
Saxony-Czech Republic 2007-2013	ArchaeoMontan	Research on medieval mining with cross boarder knowledge transfer and cooperation between German and Czech researchers	3 M
	VODAMIN	Research on water quantity and quality and mutual processes between pit water, ground water and surface water in the region Zinnwald/Cínovec	3 M
	Cross-border raw material cadastre Saxony-Czech Republic as a contribution for European raw material supply (ROSAB)	Saxon and Czech experts from private enterprises and geological surveys perform a unique and innovative cross-border raw material cadastre along the Saxon-Bohemian Erzgebirge. The cadastre comprises the re-evaluation of eight raw material occurrences of Li, Sn, Fl, Ba, Zn, Pb, Co, W, U, and REE on the basis of an Internet-based data catalogue and joint hard copy expertizes	0.2 M
Saxony-Czech Republic 2014-2020	ArchaeoMontan 2018	Research on mining in Middle Age as commun and cross borders cultural heritage in the Erz Mountains, Creation of a cross boarder centre for medieval mining	4.6 M
	VODAMIN II	Research on measures on protection of water of harmful substances from mining and possibilities for geothermic use of pit water	2.8 M
	Experience of nature and culture heritage incl.	Improvement and extension of touristic infrastructure which leads to mining monuments	2.5 M

[74] EC OP Sachsen ERDF 2014-2020, http://ec.europa.eu/regional_policy/en/atlas/programmes/2014-2020/united-kingdom/2014de16rfop012

[75] ESIF-viewer, visualising planned investments using European Structural and Investment Funds http://ec.europa.eu/regional_policy/opempl/detail.cfm?cci=2014DE05SFOP012&lan=en

[76] ESIF-viewer, visualising planned investments using European Structural and Investment Funds http://s3platform.jrc.ec.europa.eu/esif-viewer

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	Infrastructure in the region central Erz Mountains		
	Vita-Min	Improvement of water in after-mining areas and research on resource conservation of mining and after-mining management	3 M
Saxony-Poland 2014-2020	MineLife (Living with mining)	Intensification of the institutional cooperation between citizens and institutions in the mining area (April 2017 – March 2020)	0.6 M

Table 5.19: Saxon projects related to M&M funded by Interreg

Short Description of M&M Cluster and Association

There are **three** important **regional networks** in RM sector mentioned by the Saxon RM strategy.

- **Geokompetenzzentrum Freiberg e.V.**
  - Administrative, industry and academic combined non-profit network organisation for M&M (minerals/raw materials)
  - Business Fields along the Entire Value Chain of Raw Materials
  - Member structure 165 members (2015)

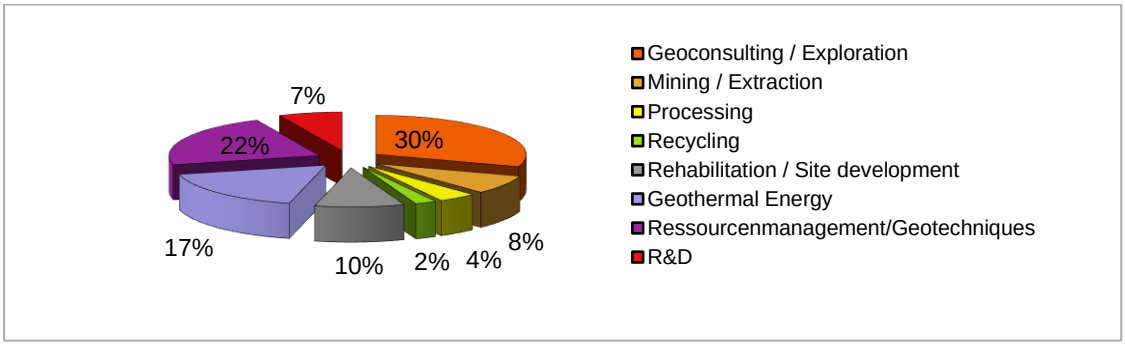

Figure 5.16: Member structure of GKZ in 2015

  - High accumulation of mining related business (of mainly SME type), e.g. Mining, Processing, Smelting, Recycling, Manufacturing and Consulting
    - SMEs in Lignite Mining (LMBV) and Uranium Production and Revitalisation (WISMUT)
    - Smelter (Sn, Zn, Ni, Co, Cu, scrap)
  - Universities and Research Institutes
    - TU Bergakademie Freiberg, Business Schools, Vocational Training and Helmholtz Institute Freiberg
    - Geological Survey, Supreme Mining Authority and Mining Archive
- **Freiberger Interessengemeinschaft der Recycling- und Entsorgungsunternehmen e.V. (FIRE e.V.)**: Network of recycling and disposal companies
- **LIBESA**: Saxon battery network with producers and the raw material suppliers

• Industries Closely Related to M&M from potentially domestic resources

- Industry closely related to lignite mining in Saxony: Energy industry

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- Industry closely related to scrap feed (including primary materials): Refining and Recycling industry
- Industry closely related to fluorspar: fluoric acid production
- Industry closely related to other industrial minerals (marble, kaoline): construction chemistry, porcellane
- Industry closely related to other CRM (Gallium, Indium, etc.): Compound materials and IC industry

Industries Conflicting to M&M

- Mining company vs. Visitor mine
  - An example from SAXORE junior mining company: A local community is worried that the new mining project will hamper their heritage which is currently on the tentative list of UNESCO World Heritage.

- Automotive industry vs. Mining company
  - Automotive industry is prominent in Saxony and creates large number of jobs comparing to mining industry. This influence the political decision when two industries have conflicts.
  - Jobs and values created at the downstream industry of mining is often overlooked as the connection between the two industries has somewhat lost in the society.

• Short Description of Promotion of M&M Industry[77]

The Free State of Saxony supports the current return to ore and spar mining. Exploring deposit sites anywhere always involves **financial expense** and **risk** without guarantee of success. The decision to carry out such a project must only ever be made in an **entrepreneurial spirit**, in keeping with the **global market conditions**. Although European regulations do not allow aid programmes aimed at funding the establishment of operational facilities, the Free State of Saxony is one of the world's best explored regions from a **geological** and **geophysical perspective**. Another player promoting the M&M industry is the **Saxon State Ministry for Economic Affairs, Labour and Transport** is the state's supreme mining authority. It is responsible for the strategic focus of Saxon RM policy.

In addition to the **Federal Mining Act**, at the regional level there is the Saxon RM Strategy[78]. The Strategy provides framework conditions for mining local RM and has the following primary guidelines and objectives:

- Local primary RM: To establish the framework conditions for extracting raw materials in such a way so as to enable profitable mining over the long term
- Secondary RM: To establish Saxony as a hub for the reclamation industry in Germany and Europe
- Hub of the RM: To promote networking between stakeholders in the raw material economy
- International co-operations: Building contacts to market know-how in raw materials
- Saxon RM research: To strengthen, expand and enable closer networking of existing structures in university /non-university fields

[77] Saxon Raw Material Strategy
[78] Saxon raw meterial strategy

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- Experts for the RM economy: To boost the training of local and foreign specialists and managers
- Saxon administration: To maintain and adapt existing administrative structures in accordance with the requirements of the raw material economy
- Awareness of RM: To work towards a knowledge-based, ideology-free awareness of raw materials in the community, including teaching solid, basic science and facts at all levels of education

The following list of management, business and science contacts forming a close network at the geo-hub of Freiberg in particular, and who can offer their skills and experience to help promoting the M&M industry:

- Ore and spar mining in the Free State of Saxony is governed by the Germany-wide Federal Mining Act (BBergG). Based in Freiberg, the State Mining Authority of Saxony is the official, executive authority for this act. It grants mining permits for mineral resources to be explored and mined and it supervises active and rehabilitative mining.
- In Saxony, the tasks of the State Geological Survey are performed by the Geology department at the Saxon State Office for Environment, Agriculture and Geology. Mining-related focal areas include geological surveying, securing, assessing and providing geological data and information, and advising companies on geological and raw material issues.
- The Geokompetenzzentrum is one of Germany's largest interdisciplinary networks, and pools business, scientific and management skills. It supports the valorisation of domestic resources by projects and intense panel work at Brussels.
- As part of the Dresden-Rossendorf Helmholtz Centre, the research institute develops innovative technologies designed to provide the economy with mineral (especially metallic) resources, and recycle these in an environmentally friendly manner. It co-operates closely with the Freiberg University of Mining and Technology. The world's oldest mining university stands for experience and skills in all areas of raw material research, from deposit formation, to searches and exploration, to the mining and treatment of RM.

The Freiberg office of culture-city-marketing (Amt für Kultur-Stadt-Marketing) promotes series of cultural events and festivals throughout the years based on the regional history of silver mining.[79]

The Role Metallurgy Plays in the Regional Circular Economy

- **Nickelhütter Aue GmbH**[80]: Co, Cu and Ni
  - Offering a "recycling loop" for waste materials containing Ni, Co, Cu, Mo, V and W
  - Modern smelting works producing non-ferrous metal concentrates out of electroplating slurries and residues. By following metallurgical processes, these concentrates are refined into non-ferrous metals and Ni-, Cu-, Co-, V- chemicals. The cycle is closed by using these chemicals in the electroplating industry
  - Recycling spent catalysts from petrochemical industries, chemical industries and from edible oil hydrogenation

[79] Silberstadt 2018 http://www.silberrausch-freiberg.de
[80] Nickelhütter Aue GmbH, http://www.nickelhuette.com/index.asp

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- For further application in surface technology, copper sulphate is produced out of copper chloride solution generated by electronical industries
- In 2002, Nickelhütte Aue GmbH expanded its processing spectrum to extend the production by vanadium compounds from NiV-containing filter dusts and - catalysts.
- Synergy effects are used by the recycling of transformers. Transformer oil is used to substitute fuel oil in the smelting department. Non-ferrous metals are further processed in other facilities of the plant.
- The waste heat resulting from the pyrometallurgical processes is used to generate electricity and heat. We are able to satisfy our own energy needs and supply thermal energy to other companies situated in our hometown.

- **Feinhütte Halsbrücke GmbH**[81]: Sn and Pb
  - Pyrometallurgical process
  - Recycling stannous materials, such as pewter tableware, residue from solder bath systems, used anodes, skimmings, ash, dust, slag and sludge
  - Recycling materials containing lead, such as Soft lead, cable lead, antimonial lead, balancing lead, battery lead, type metal, used anodes and babbit metal

- **Befesa Zinc Freiberg GmbH**: Zn, one out of only four remaining tin - smelters in Europe!
  - The technological leadership of Befesa Steel Dust Services regarding the pyrometallurgical treatment of electric arc furnace (EAF) Dust is expressed by the proprietary development of the SDHL technology. This technique marks a decisive step of optimizing the conventional Waelz process by increasing the recovery and reducing the utilization of non-renewable resources.
  - It carries out the treatment and recycling services of carbon steel and stainless-steel dusts as well as of galvanizing residues.
  - The dusts and scales generated in stainless steel mills as a by-product are processed in Befesa Steel Dust Recycling Services. The recycling facilities use the plasma-arc and submerged arc furnace technology. Through these processes metal alloys are recovered with a maximum of product quality and returned afterwards to the stainless-steel mills as a secondary raw material.

- **Muldenhütten**: Pb
  - Pyrometallurgical process
  - The third largest lead smelter in Germany
  - The smelter was renovated in 1993/94 to secondary lead smelter and since then continuously modernised. From this time on, accumulator scrap is fully recycled, processed and cast to lead. 80 employees, of which 4 are trainees, process lead acid accumulators, scrap lead, lead- containing residues and crude lead to lead, lead alloys, sodium sulphate, PP compounds with the trade name Seculene® PP as well as master alloys for antimony and tin.

• Short Description of How Future Regional Political Development Affects Regional M&M Industry

State policies and **regional development** are closely connected. Hence the support from the state policies affects the M&M industry tremendously. It influences especially in regard to how mining and industrial companies are welcome and supported in the general public. Regional politics usually **support**

[81] Feinhütte Halsbrücke GmbH, https://www.feinhuette.de

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mining and the economic activities following the mining value chain in the (former) mining regions where there are few alternatives for regional development. If the politicians are not convinced by the contribution of these industries to regional development it is likely that they will support the **other industries**, for instance, tourism or public service, instead.

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6. REGIONAL GENERAL BACKGROUND INFORMATION (KOŠICE, SLOVAKIA)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

- ## Capital
  - Košice Region

- ## Area (km^2)
  - 6,753 km^2

- ## Population
  - Number of inhabitants:
    771,947 (31.12.2005); 790,837 (31.12.2010); 798,103 (31.12.2016); 799,217 (31.12.2017)
  - Age Structure:
    The average age of the population: 41,90 (2005); 41,33 (2010); 44,75 (2016); 45,99 (2017)
  - Net Migration Rate
    Migration balance (per person) in the region: - 269 (2005); - 473 (2010); - 264 (2016); - 370 (2017)

- ## Optional: Urbanisation Rate

In 2009, as a result of the **migration movement**, the population of the Košice Region decreased by 158 persons, most in the Košice III district (-343 persons, ie 11.43 ‰) and Spišská Nová Ves (- 206). There is a process of **suburbanization**[82] between the city and the countryside. In the city of Košice there is a decrease in the number of inhabitants and in the district Košice-okolie, there is the registration of increments. In 2009, in Košice-okolie district 524 people migrated and 533 people decreased in Kosice. At the end of 2014, the 17 cities of the Košice Region registered the total number of 439,761 inhabitants, with the degree of **urbanization** reaching 55.3%. Compared to 2008, the number of inhabitants in towns increased by 1.8% (almost 7.7 th inhabitants).

The status of the **permanently living population** in the city of Košice is: 234,871 (2005); 233,886 (2010); 239,141 (2016); 239,095 (2017)

The status of the **permanently living population** in the Košice region is the following: 771,947 (2005); 780,000 (2010); 798,103 (2016); 799,217 (2017)

- ## Short Description of Indigenous Group

The **Indigenous Group** is a real threat to the MM industries. This factor can affect the triggering of the investment to such an extent that it may result in the termination of the investment. There are several

[82] A population shift from central urban areas into suburbs, resulting in the formation of (sub)urban sprawl (en.wikipedia.org)

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cases in **Slovakia** but also in the **Region of Košice** - case of uranium mining in Jahodná or case of Alpine Oil and Gas company- which invested over 20 M € in surroundings of Svidnik and due to the persistent resistance of the population and state authorities, they lost interest in investing in the specific site. Groups typically use tools such as petitioning, demonstrating, or medialization of the case in a bad light.

• Industries based on Natural Resources, M&M

- In the self-governing Region of Košice, there were several important mining companies, that have been closed since 90's. Nowadays, in the region the main companies existing in mining industry are: **Nafta, a.s**., exploiting several **natural gas** deposits (Senné, Trebišov, Stretava, Trhovište-Pozdišovce); **Eurotalc, s.r.o**., the new company mining **talc** deposit in Gemerská Poloma; **Carmeuse Slovakia s.r.o.**, exploiting several **limestone** and **dolomite** open pit mines.
- In the region as well as all over Slovakia, the mining is perceived as a **negative activity**. The most accepted way of mining is probably the **surface mining of building materials** (quarries, gravels), which are highly represented in the country and the population is **accustomed** to them. Despite the negative impact on the environment, **metallurgy** (U. S. Steel Košice) in the wider society is better accepted, as this effect is balanced by the **job creation**.
- The main job creator in the Region is **U. S. Steel Košice** with almost 12,000 employees, thus metallurgy industry.

• Infrastructure

The territory of the Region of Košice is characterized by significant **regional**, **rail** and **energy** trans-regional **transport flows** in the E-W and N-S directions.
In detail, in the field of **road transport**, there are the European routes E50 (Žilina - Prešov - Košice - Michalovce state border with Ukraine) E71 Košice - the national border with Hungary - Miskolc) and E58 (Zvolen - Rožňava – Košice). The D1 motorway is currently being implemented in the Košice - Prešov section, including the highway to Košíce, and the expressway R4 along the border with Hungary.
The density of the **road network** reaches roughly the same values in the Region of Košice as well as in the entire territory of the Slovak Republic. On the territory of the Košice Autonomous Region, on January 1, 2014, 2,382,464 km of roads were built and operated, and KSK ranked second in the Slovak Republic in terms of journey length. Of the total 2,382,464 km of roads, roughly 218 km of roads in the KSK are part of the international "E" trains and another nearly 126 km of roads are part of the "TEM" routes.
The Regional City of Košice is the second largest railway node in the Slovak Republic. The Košice Region has a dense network of **railway lines** linking it to the surrounding EU countries. It is connected to Ukraine and Russia through the East Slovakian translation system and the wide-gauge railway. Rail transport serves 83 out of 440 municipalities in the Košice Region. The main route is the Spišská Nová Ves - Margecany - Košice - Trebišov - Michalovce / Čierna nad Tisou route. The technical problems of the lines are their low transport speed, the relatively obsolete fleet and the inadequate level of railway stations in some towns and municipalities.
Public passenger transport - long-term in regional public passenger transport, **bus services** dominate the range of services. By means of contractual relations with self-governing regions, the bus carriers (Eurobus, a.s. and ARRIVA Michalovce, a.s.) have been providing suburban bus services since 2003.
The suburban transport is secured to all towns and villages of the Region of Košice. Traffic offer and analysis of its assessment are based on the KSK Traffic Service Plan processed from the Ministry level in 2007. From the assumption of competencies, the suburban transport fleet in the Košice Region gradually modernized and in 2014 it consisted of 457 buses, the average age being 5.86 years. The number of low-floor buses in suburban transport is 14. The structure of the fleet is continuously adapted to changes in traffic demand, in particular by an increasing share of low and medium capacity buses.

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The transport potential of the region is increased by Airport Košice - Airport Košice a.s., which belongs to the first category as a public airport of international importance. In the territory of the Košice Region, there is also the **public national airport** Spišská Nová Ves, two heliports for air rescue service and 16 airports for aviation work in agriculture. Finally, a **waterway** on the Bodrog river from Ladmovce to Hungary has also being activated.

• Energy Sources

From the comparison of Košice with other localities in Slovakia, significant reserves of **natural gas** are located in the districts of Michalovce, Sobrance and Trebišov (mining areas Bánovce nad Ondavou, Kapušianske Kľačany, Pavlovce nad Uhom, Pozdišovce and Trebišov, protected deposit area Rakovec nad Ondavou, Bačkov). The **lignite** deposit is located at the protected deposit area (CHLÚ) Fertile and anthracite in CHLÚ Veľká Tŕňa.

NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• National and Regional GDP

- **National GDP**:
  2005 – 50,415,092 € / index for the same period mr.r. 109,357
  2010 – 67,577,288 € / index for the same period mr.r. 105,551
  2016 – 81,153,966 € / index for the same period mr.r. 102,861

- **Regional GDP**:
  2005 – 6,106,093 € / index for the same period mr.r. 105,003
  2010 – 7,692,313 € / index for the same period mr.r. 107,002
  2016 – 9,372,425 € / index for the same period mr.r. 100,651

- **GDP per capita**:
  2005 – 9,358,486 € / index for the same period mr.r. 109,261
  2010 – 12,445,235 € / index for the same period mr.r. 105,314
  2016 – 14,943,269 € / index for the same period mr.r. 102,701

The most important sectors in terms of **GDP** creation in the Košice region, **GVA** and **job** creation, are the **metallurgical** and **metal-working** industries, the **engineering**, the **electrical** and **electronics** industries, as well as the **transport** and **storage**. Last but not least, there is also the sector of **IT services**.

• National and Regional Employment Level

- Development of the number of **economically active population** in the SR:
  2005 – 2,216,200
  2010 – 2,317,500
  2016 – 2,492,100
  2017 – 2,530,700

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- Development of the number of **economically active population** in the Region of Košice:
  2005 – 266,100
  2010 – 293,800
  2016 – 327,600
  2017 – 332,200

From the spatial point of view, for the most **economically active inhabitants** of the **city of Kosice**, their share corresponds to about the one third of the total number of economically active inhabitants of the region (**30.5%**). As for the other districts, the most economically active inhabitants are Košice - okolie (**15.3%**), Michalovce (**13.7%**) and Trebišov (**13.6%**).
In 2017, the **unemployment in Slovakia** was about **5.94%**, while for other years, the unemployment level in the Slovak Republic was recorded at **11.36%**, **12.46%**, and **8.76%**, for 2005, 2010 and 2016 respectively.
Regarding the **Region of Košice**, the unemployment was **9.94%** in 2017, while unemployment for 2005, 2010 and 2016 was **17.5%**, **16.78%**, and **12.76%**, respectively.
Unemployment in the **districts of Košice** region in 2017 recorded as follows:
Gelnica - 12,69%, Košice I - 5,39%, Košice II - 5,53%, Košice III - 3,87%, Košice IV - 4,51%, Košice-okolie - 12,12%, Michalovce - 11,29%, Rožňava - 16,23%, Sobrance - 12,93%, Spišská Nová Ves - 8,34%, Trebišov - 13,63%.

• National and Regional Economic Structure/Employment by Sector

In the territory of Košice, several sectors are decisive in which the region's potential from the point of view of **human resources** and the **material-raw material base** (wood, minerals, building materials, traditional production) are appreciated. These are primarily the industries - **engineering, woodworking, metallurgy** and **electrotechnics**, **geology** and **mining**, **construction**, **agriculture**, **tourism** and **services**. From the point of view of the industrial structure, the most important sectors in the region are **metallurgical**, **mechanical**, **chemical** and **ICT** and the **electrical industry**. Undoubtedly, **metallurgy**, which accounts for **60%** of the region's industrial output and **50%** of its exports, is dominant. There is also the largest company in the **U.S. Steel Košice**. An increasingly important economic and employment importance is gained by the **information** and **communication technology industry**.

Metallurgy: the automotive, mechanical engineering and construction industries provide the main space for the use of metallurgical products. It is represented, by the renowned steel producer **U.S Steel Košice, s.r.o.**, which produces flat rolled steel products (for the automotive and construction industry and packaging), steel pipes and radiators.

Engineering: Another renowned sector in the region is engineering, which is concentrated in almost every district of the region. The key companies in the field include **GETRAG FORD Transmissions Slovakia, s.r.o.** (gearboxes) or **Embraco Slovakia s.r.o.** (compressors for refrigerators) with a **Competence Center. Sitem Slovakia, s.r.o.**, metalworking; **Ves**; **Oerlikon Balzers** with a **Competence Center** (surface finishing for automotive components).

Electrical engineering: a sector represented by the manufacture of electrical apparatus and equipment, connecting materials and cabling. The major companies are: **IEE Sensing Slovakia s.r.o.**, **Molex Slovakia, a.s.**, **BSH Drives and Pumps s.r.o.**, **SEZ Krompachy a.s.**, **Yazaki Wiring Technologies Slovakia, s.r.o.**, **Elektroconnect, s.r.o.**, production of cable harnesses for world brand automobiles.

ICT and KIBS industry and services (knowledge intensive business services): a sector that has seen a rapid increase in recent years, particularly in terms of employment. The largest employers include **T-Systems Slovakia s.r.o.**, **IBM Slovensko, spol. with r.o.**, **Global Logic Slovakia s.r.o.**, **ATT s.r.o.**, **Siemens**

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s.r.o., **NESS KDC, s.r.o. Holcim**, **Embraco** and **other companies**. Under favorable circumstances, there is a growth potential of around 7,000. to 10,000 full-time jobs. Knowledge intensive services include primarily engineering testing, financial and consulting services. These are services to knowledge-oriented 24 competencies that are crucial to the development of innovation, technology transfer, consulting, marketing and export. Major development-engineering companies include **CEIT Biomedical Engineering, s.r.o**. **Antik Košice, Strojkov Engineering s.r.o. Gelnica**, **Hutný projekt Košice, Kopa Košice**, as well as **Air Berlin design center**.

Plastic processing: due to the strong position of the automotive industry in the Slovak Republic, this branch has also been extended to the Košice region. Representatives of this sector are **EHLEBRACHT Slowakei s.r.o.**, **Michalovce; Plastik s.r.o.**, **CRW Slovakia, s.r.o.**, **Triplus SK, s.r.o.**, **PASS-SK, s.r.o. Ves.**

Chemical Industry: The most famous company in Eastern Slovakia is **Chemko a.s. Slovakia** with its production of organic and inorganic chemicals, adhesives; **Diakol Strazske, s.r.o.**, production of formalin, production of formalin chemistry products; **Cenon, s.r.o.**, production of cyclohexanone; **TP2 heating plant, s.r.o.**, production and distribution of steam; **Chemtrans, s.r.o.**, transport and forwarding services; **Fiberstruct s.r.o.**, production of glass fiber reinforced plastic floor grids; **Simop SK, s.r.o.,** production of sewage treatment plants, oil product separators, greases, water shafts; **EBSTER SK s.r.o.**, sterilization of medical devices.

Building and construction industry: there are large multinational engineering companies **IS Košice a.s**, **Eurovia CS, a.s.**, **Building Michalovce s.r.o.**, **Chemkostav a.s.**, **UranPress, spol. with r.o**., **Spišská Nová Ves**; **Dúha, a.s.**, **Prešov**; as well as the manufacturer of plastic windows **Noves, s.r.o.** in Spišská **Nová Ves, Railway constructions, a.s. Košice**, as well as processors of construction materials **Holcim a.s.**, **Východoslovenské Stavebné hmoty a.s.**

Food industry: This sector is most concentrated in Košice, Michalovce and Spišská Nová Ves. The biggest producer among these producers is **Frucona Košice, a.s.**, **RYBA Košice spol. Ltd.** and producer of dairy products **Syraren Bel Slovakia a.s**., **MPC Cessi, a.s.**, **Spišská Nová Ves**, pasta production; **ChocoSuc Partner, s.r.o.**, Trebišov, production of chocolate and non-chocolate confectionery brands Deva.

Logistics: Košice have a unique opportunity to become a major tri-modal corridor (railways - a classical and wide - gauge gauge, highway, airport) after completion of the D1 and R4 motorway system and upgrading the railway infrastructure by 2020, where near the 25 Kosice international airport in Bočiar for strategical investors, there is a defined area for Global Logistics Industrial Park (GLIP), the Entry Point (logistics and light manufacturing) and a new industrial logistics park at Bidovce.

Creative economy: In conjunction with Košice - the European Capital of Culture, it is possible to count in the next few years several hundred new jobs linked to tourism, culture and a variety of services in the creative economy. Includes small medium-sized businesses and free trades, working in the fields of culture, design, multimedia, architecture, and crafts.

Electricity: **Slovenské elektrárne, a.** as a dominant producer of electricity in Slovakia, currently operates in the territory of the Košice Region the following **power generation plants**: 26 - **Vojany thermal power plant** - installed capacity 1320 MW - **Dobšiná hydroelectric power plant** - 26 MW installed capacity - **Ružín Hydro Power Plant** - installed power 61, 8 MW Significant sources of electricity include the Košice Heat Plant, and. s., which carries out combined heat and power generation, with an installed electrical capacity of 121 MW. Another source of electricity is the heating plant of **US Steel, s.r.o.** Košice, which was conceived as an industrial heating plant. For the production of electric energy, the condensing and backpressure turbine is installed in the heating plant. Their total installed capacity is 188 MW. Most of the electricity produced is consumed in the area of the metallurgical plant. Another bigger source of

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electricity in the region is the heating plant in **Chemko Strážske** industrial area, which is currently decommissioned. The owner of the heating plant is **Energetika s.r.o. Bratislava**.

For the Slovak Republik are represented the **employment indices**, by industry:

- **Industry total**: 102.7 (2010), 103.1 (2016), 104 (2017)
- **Construction total**: 98.1 (2010), 99.6 (2016), 103.6 (2017)
- **Transport and storage total**: 100.7 (2010), 102.6 (2016), 104.4 (2017)
- **Information and Communication total**: 90.4 (2010), 105.1 (2016), 102.6 (2017)

• National and Regional Export Rate and Trading Partners

→Import and export rates with main producing companies for **Energy RM**:

- National import, export and demand rate of **Crude oil** (**Table 6.1**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	5 788	5 556	5 988	5 345	5 822
Vývoz / Export [kt]	15	13	15	12	10
Dopyt / Demand [kt][1]	5 792	5 559	5 991	5 347	5 825

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.1: National import, export and demand rate of **Crude oil**

Crude oil is produced in Slovakia by the following company:

- NAFTA, a. s., Bratislava.

- National import, export and demand rate of **Hard coal** (**Table 6.2**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	4 035	3 328	3 835	3 886	3 599
Vývoz / Export [kt]	30	6	7	14	24
Dopyt / Demand [kt][1]	4 005	3 322	3 828	3 872	3 575

Table 6.2: National import, export and demand rate of **Hard coal**

- National import, export and demand rate of **Brown coal** (**Table 6.3**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	695	567	537	630	453
Vývoz / Export [kt]	7	0	1	0	20
Dopyt / Demand [kt][1]	3 064	2 769	2 649	2 730	2 621

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.3: National import, export and demand rate of **Brown coal**

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Coal is mined in Slovakia by the following companies:

- BAŇA ČÁRY, a. s., Čáry
- BAŇA DOLINA, a. s., Veľký Krtíš
- HORNONITRIANSKE BANE, a. s., Prievidza

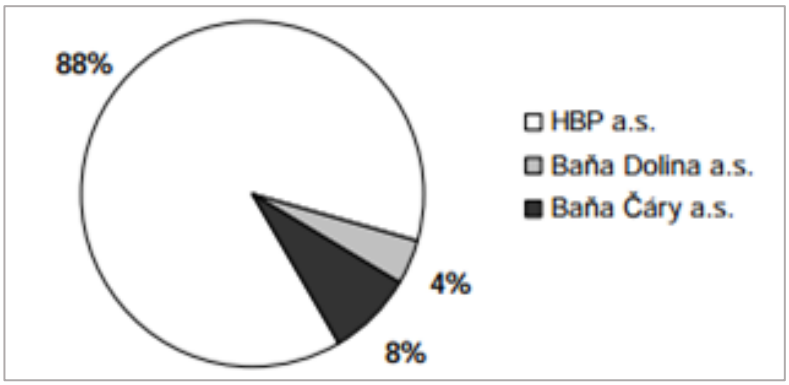

Figure: Coal mine production share, for the year 2013

- National import, export and demand rate of **Natural gas** (**Table 6.4**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	4 898	5 837	5 814	5 641	5 458
Vývoz / Export [kt]	422	1 201	1 531	1 435	1 120
Dopyt / Demand [kt][1]	4 590	4 742	4 389	4 312	4 453

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.4: National import, export and demand rate of **Natural gas**

Natural gas is produced in Slovakia by the following company:

- NAFTA, a. s., Bratislava

→Import-export rates with main producing companies for **Metallic ores**:

- National import, export and demand rate of **Copper** (**Table 6.5**)

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HS 2603 Medené rudy a koncentráty / *Copper ores and concentrates*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [t]	2 113	0	1	0	–
Vývoz / Export [t]	–		–	–	–

HS 7402 Nerafinovaná meď / *Unrefined copper*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [t]	0	20	3	208	771
Vývoz / Export [t]	26 251	31 685	38 507	40 404	19 941

HS 7403 Rafinovaná meď a zliatiny / *Refined copper and alloys*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [t]	4 706	6 140	7 543	8 451	9 714
Vývoz / Export [t]	3 721	3 943	5 090	3 368	10 027

HS 7404 Medený odpad a šrot / *Copper waste and scrap*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [t]	29 141	40 046	30 687	37 623	28 454
Vývoz / Export [t]	15 113	14 914	19 606	23 262	25 452

Table 6.5: National import, export and demand rate of **Copper** (Ores and concentrates, unrefined, refined, alloys, waste and scrap)

Copper is not mined in Slovakia.

- National import, export and demand rate of **Lead** (**Table 6.6**)

HS 7801 Olovo surové / *Unwrought lead*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [t]	481	136	291	711	325
Vývoz / Export [t]	247	250	539	386	1 626

HS 7802 Olovený odpad a šrot / *Lead waste and scrap*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [t]	N	74	67	307	329
Vývoz / Export [t]	288	663	737	759	1 258

Table 6.6: National import, export and demand rate of **Lead** (Unwrought, waste and scrap)

Lead is not mined in Slovakia.

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- National import, export and demand rate of **Mercury** (**Table 6.7**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kg]	4 534	4 704	27 835	10 075	3 131
Vývoz / Export [kg]	N	–	168	148	211

Table 6.7: National import, export and demand rate of **Mercury**

Mercury is not mined in Slovakia.

- National import, export and demand rate of **Silver** (**Table 6.8**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [t]	10	57	2 358	266	97
Vývoz / Export [t]	3	39	15	32	29

Table 6.8: National import, export and demand rate of **Silver**

Silver occurs in concentrate produced by gold ore processing on Banská Hodruša deposit and is mined by the following company:

- Slovenská banská, spol. s r. o., Hodruša-Hámre.

- National import, export and demand rate of **Tungsten** (**Table 6.9**)

HS 8101 Volfrám a predmety z neho, vrátane odpadu a šrotu / *Tungsten and articles thereof, including waste and scrap*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [t]	42	367	5 398	5 332	2 207
Vývoz / Export [t]	3	4	9	43	297

Table 6.9: National import, export and demand rate of **Tungsten**

Tungsten ores are not mined in Slovakia and domestic demand is covered by import.

- National import, export and demand rate of **Gold** (**Table 6.10**)

HS 7108 Zlato surové alebo vo forme polotovarov alebo prachu / *Gold unwrought or in semi-manufactured or powder form*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kg]	209	220	190	496	124
Vývoz / Export [kg]	1	3	20	2	268

Table 6.10: National import, export and demand rate of **Gold**

Gold is mined in Slovakia by the following company:

- SLOVENSKÁ BANSKÁ, spol. s r. o., Hodruša-Hámre

- National import, export and demand rate of **Iron** (**Table 6.11**)

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HS 2601 Železné rudy a koncentráty / *Iron ores and concentrates*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	4 498	5 797	5 103	5 403	5 647
Vývoz / Export [kt]	36	40	23	119	122
Dopyt / Demand [kt][1]	4 462	5 757	5 080	5 284	5 525

[1] dopyt (zdanlivá spotreba) = produkcia + import – export / demand (apparent consumption) = Production + Import – Export

HS 7201 Železo surové / *Pig iron*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	19	27	42	38	35
Vývoz / Export [kt]	30	64	25	29	42

HS 7204 Železný a oceľový odpad a šrot / *Ferrous waste and scrap*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	165	209	156	343	383
Vývoz / Export [kt]	320	503	656	431	366

Table 6.11: National import, export and demand rate of **Iron** (Ores and concentrates, pig iron, ferrous waste and scrap)

Iron ore is no longer mined in Slovakia since 2009.

→Import-export rates with main producing companies for industrial **Non-metallic ores**:

- National import, export and demand rate of **Barite** (**Table 6.12)**

HS 2511 Prírodný síran bárnatý (ťaživec), witherit / *Natural barium sulphate (barite), natural barium carbonate (witherite)*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	0,1	0,1	0,1	0,2	0,1
Vývoz / Export [kt]	6,3	0,6	0,2	0,2	10,8

Table 6.12: National import, export and demand rate of **Barite**

Barite is mined in Slovakia (Košice self-governing region) by the following company:

- Rudohorská investičná spoločnosť, a. s., Spišská Nová Ves

- National import, export and demand rate of **Bentonite** (**Table 6.13**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	6	6	27	26	7
Vývoz / Export [kt]	65	33	86	98	144
Dopyt / Demand [kt][1]	50	126	154	105	47

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.13: National import, export and demand rate of **Bentonite**

Bentonite is mined in Slovakia by the following companies:

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- BENTOKOP, spol. s r. o., Kopernica
- BENOX, spol. s r. o., Banská Bystrica
- ENERGOGAZ, a. s., Košice
- GE.NE.S, a. s., Hnúšťa
- HEADS Slovakia, spol. s r. o., Košice
- KOPEREKOMIN, spol. s r. o., Kremnica
- Kremnická banská spoločnosť, spol. s r. o., Kremnica
- LB Minerals, a. s., Košice
- REGOS, spol. s r. o., Bratislava

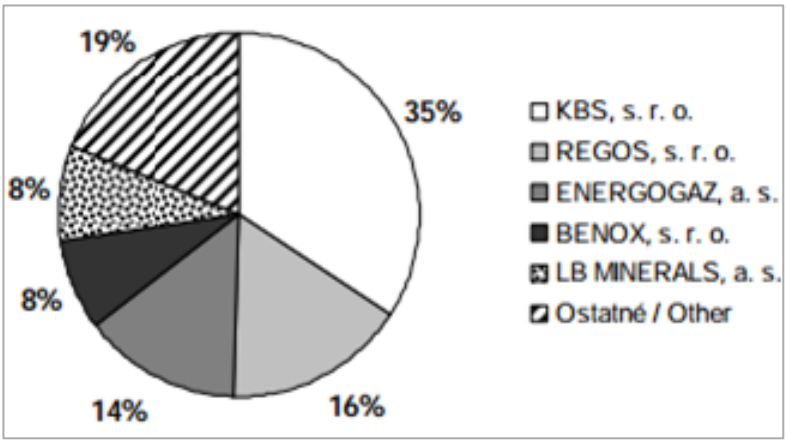

Figure: Bentonite mine production share, for the year 2013

- National import, export and demand rate of **Dolomite** (**Table 6.14**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	1	0	0	0	1
Vývoz / Export [kt]	313	424	399	429	566
Dopyt / Demand [kt][1]	927	880	950	1 038	650

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.14: National import, export and demand rate of **Dolomite**

Dolomite is mined in Slovakia by the following companies:

- Carmeuse Slovakia, spol. s r. o., Slavec
- DOBÝVANIE, spol. s r. o., Stráňavy
- DOLKAM Šuja, a. s., Rajec
- KAMEŇOLOMY, spol. s r. o., Nové Mesto nad Váhom
- LUVEMA, spol. s r. o., Nová Baňa
- Sopúch Vladimír C a V, Oravská Poruba
- V.D.S., a. s., Bratislava

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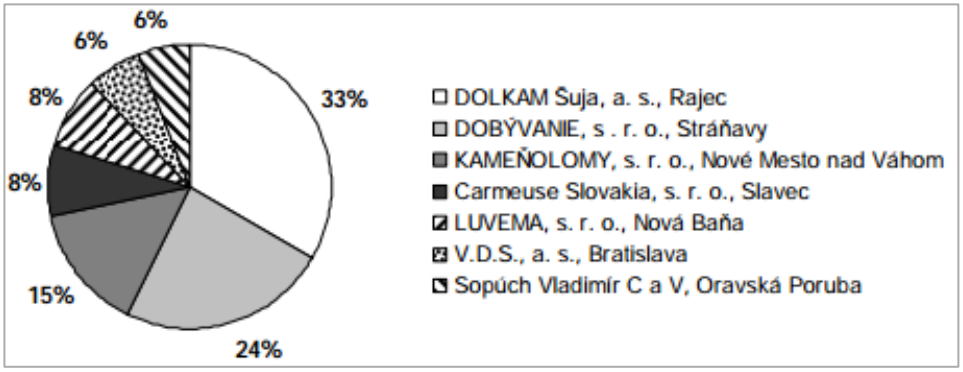

Figure: Dolomite mine production share, for the year 2013

- National import, export and demand rate of **Rock salt** (**Table 6.15**)

HS 2501 - Soľ a čistý NaCl, vo vodnom roztoku, morská voda / *Salt and pure NaCl, in water solution, sea water*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	167	245	239	226	408
Vývoz / Export [kt]	N	23	22	20	20

Table 6.15: National import, export and demand rate of **Rock salt**

- National import, export and demand rate of **Kaolin** (**Table 6.16**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	59	63	71	64	73
Vývoz / Export [kt]	1	4	1	0	14
Dopyt / Demand [kt][1]	68	59	74	67	65

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.16: National import, export and demand rate of **Kaolin**

Kaolin is mined in Košice self-governing region by the following company:

- LB MINERALS, a. s., Košice

- National import, export and demand rate of **Magnesite** (**Table 6.17**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	15	28	29	22	20
Vývoz / Export [kt]	261	333	338	270	269
Dopyt / Demand [kt][1]	232	345	443	370	335

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.17: National import, export and demand rate of **Magnesite**

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Magnesite is mined in Slovakia by the following companies:

- GE.NE.S, a. s., Hnúšťa
- SLOVMAG, a. s., Lubeník
- SMZ, a. s., Jelšava

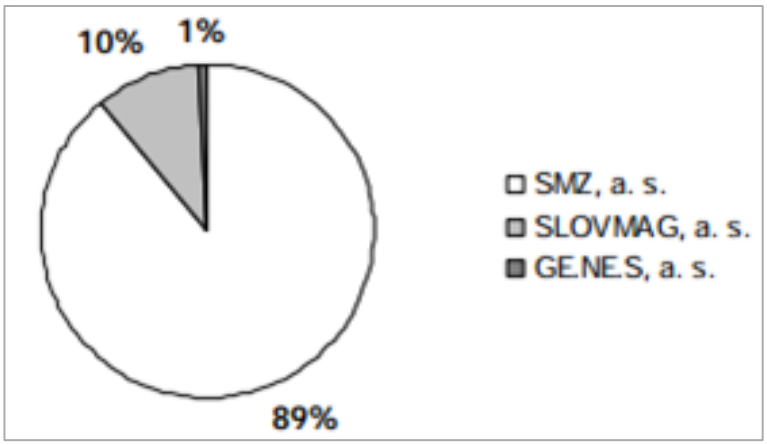

Figure: Magnesite mine production share, for the year 2013

- National import, export and demand rate of **Talc** (**Table 6.18**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	1,0	0,7	0,4	0,5	1,1
Vývoz / Export [kt]	0	0	0	0	0,9
Dopyt / Demand [kt][1]	1,0	7,7	7,4	2,5	10,2

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.18: National import, export and demand rate of **Talc**

Talc is mined in Slovakia by the following companies:

- EUROTALC, spol. s r. o., Gemerská Poloma
- GE.NE.S, a. s., Hnúšťa

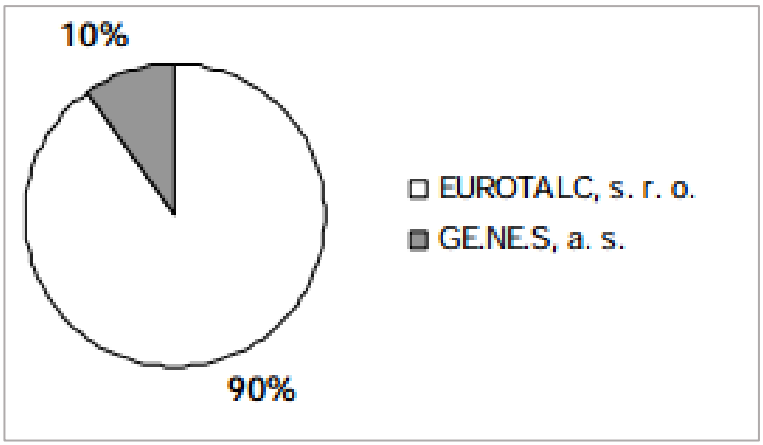

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Figure: Talc mine production share, for the year 2013

- National import, export and demand rate of **Gypsum & Anhydrite** (**Table 6.19**)

HS 2520 Sadrovec, anhydrit, sadra / *Gypsum, anhydrite, plaster*

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	99	91	111	91	115
Vývoz / Export [kt]	0	0	0	0	0
Dopyt / Demand [kt][1]	230	178	199	179	175

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.19: National import, export and demand rate of **Gypsum & Anhydrite**

Gypsum & Anhydrite is mined in Košice self-governing region by the following companies:

- Holcim (Slovensko), a. s., Rohožník
- VSK, a. s., Spišská Nová Ves - Novoveská Huta

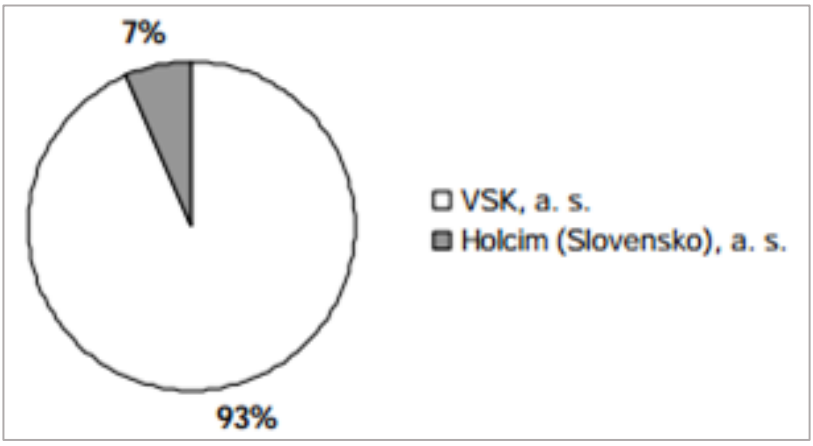

Figure: Gypsum & Anhydrite mine production share, for the year 2013

- National import, export and demand rate of **Limestone & Cement materials** (**Table 6.20**)

HS 2521 Vápenec (tavivo), vápenec a iné vápenaté kamene na výrobu vápna alebo cementu
Limestone (addition, flux), limestone and other calcareous stones for lime ore cement production

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	15	22	25	22	19
Vývoz / Export [kt]	442	518	430	428	522

HS 2522 Nehasené vápno, hasené vápno a hydraulické vápno okrem oxidu a hydroxidu vápenatého
Quick lime, slack lime and hydraulic lime, except calcium oxide and calcium hydroxide

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	48	69	70	81	91
Vývoz / Export [kt]	127	128	186	145	160

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HS 2523 Portlandský cement, hlinitanový cement, troskový cement, supersulfátový cement a podobné hydraulické cementy, tiež farbené a vo forme slinku / *Portland cement, secar cement, dross cement, super-salt cement and similar hydraulic cements, also coloured and in form of sinter*					
Rok / Year	**2009**	**2010**	**2011**	**2012**	**2013**
Dovoz / Import [kt]	370	296	394	433	390
Vývoz / Export [kt]	1 691	1 487	1 840	1 482	1 877

Table 6.20: National import, export and demand rate of **Limestone & Cement materials**

Limestone & Cement materials are mined in Slovakia by the following companies:

High purity Limestone:
- Calmit, spol. s r. o., závod Margecany
- Calmit, spol. s r. o., závod Tisovec
- Holcim (Slovensko), a. s., Rohožník

Other types of Limestone:
- Calmit, spol. s r. o., závod Žirany
- Carmeuse Slovakia, spol. s r. o., Slavec
- CEMMAC, a. s., Horné Srnie
- Cementáreň Lietavská Lúčka, a. s., Lietavská Lúčka
- DOBÝVANIE, spol. s r. o., Stráňavy
- Holcim (Slovensko), a. s., Rohožník
- KAMEŇOLOMY, spol. s r. o., Nové Mesto nad Váhom
- Považská cementáreň, a. s., Ladce
- TAJBA, a. s., Čaňa
- VAPEX, spol. s r. o., Ladmovce

Calcareous Marl:
- Holcim (Slovensko), a. s., Rohožník
- CEMMAC, a. s., Horné Srnie

Corrective Sialic Additives:
- Považská cementáreň, a. s., Ladce
- Holcim (Slovensko), a. s., Rohožník

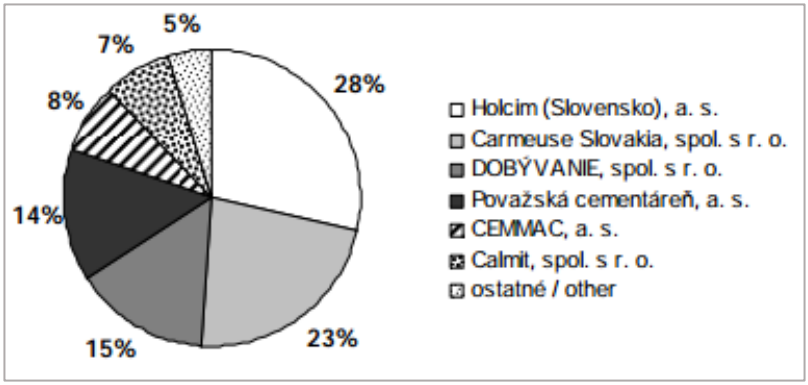

Figure: High purity limestone, limestone other and calcareous marl mine production share, for the year 2013

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- National import, export and demand rate of **Foundry & Glass sands** (**Table 6.21**)

Rok / Year	2009	2010	2011	2012	2013
Dovoz / Import [kt]	104	109	119	98	134
Vývoz / Export [kt]	144	86	68	123	179
Dopyt / Demand [kt][1]	462	536	527	454	431

[1] dopyt (zdanlivá spotreba) = produkcia + import – export
[1] *demand (apparent consumption) = Production + Import – Export*

Table 6.21: National import, export and demand rate of **Foundry & Glass sands**

Foundry & Glass sands are mined in Slovakia by following companies:

- KERKOSAND, spol. s r. o., Šajdíkove Humence
- LB MINERALS, a. s., Košice
- STUMBACH, spol. s r. o., Bratislava

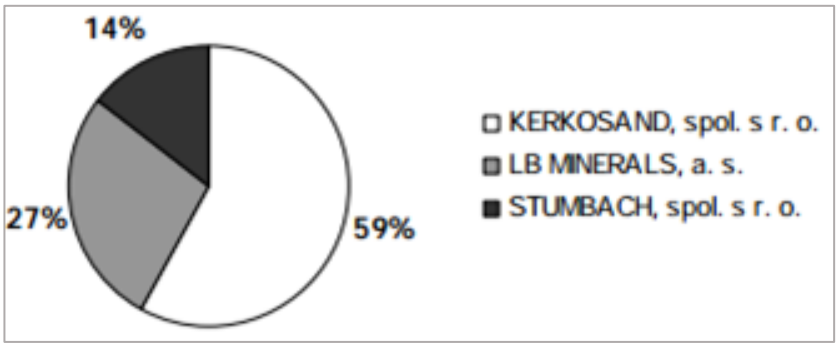

Figure: Foundry & Glass sands mine production share, for the year 2013

- Slovakia biggest problem in mining sector is in the mining activities of **metallic minerals**. For example, the non-existence of **Iron ore**'s mining sector, results that the whole metallurgy industry is dependent on the imports activity of Iron ore.
- The **energy sector** (**Crude oil** and **Natural gas**) is also highly dependent on the imports mostly from Russia. Because of non-existent **Hard coal** deposits - Hard coal is also solely imported.
- The **industrial non-metallic minerals** mining industry is in better conditions especially **Magnesite** mining, for which Slovakia is one of the top world producers. The mining of **limestone**, **cement materials** is sufficient for national consumption and even for exports to the neighbouring countries.

• National and Regional Number of Registered Company

- In Slovakia (data for the year of 2016), there are **696 registered companies** that are under the oversight of **Central mining bureau** (Hlavný banský úrad).
- **11,690 workers** are working in the mining sector (data for the year of 2016).
- Out of 696 registered companies, **only 3** (Hornonitrianske bane Prievidza, a.s.; NAFTA a.s., SMZ, a.s. Jelšava) have more than 249 employees (finstat.sk, for the year of 2017).
- Slovakian **SME percentage** in the mining industry is **99,57%.**

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REGIONAL INFORMATION IN M&M INDUSTRY

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• Short Description of Regional M&M Sector

An analysis of the socio-economic development for the Region of Košice accrues the following facts. The assessment of the **financial situation** of selected key decision-makers broken down by sectoral classification of economic activities (specified for the mining industry):

Focusing on the mining sector of **Energy RM** - oil and natural gas extraction - includes **Nafta Východ a.s., Michalovce Excavation Plant**, providing gas extraction annually in the amount of 200 M m^3. It performs mining activities - opening, preparation and extraction of exclusive deposits of flammable natural gases, salts, geothermal wells, provision and disposal of mining works and others. The plant has primary insolvency due to **credit crunch and institutional weaknesses** and looks for **new markets** for **mining and a strategic investor** for further development.

As for the mining sector of **Non-energy RM** - extraction and processing of iron and non-ferrous ores: **Želba, a.s. Spišská Nová Ves** with a focus on mining and other spare parts, especially engineering programs, managed a **huge loss**. The production capacities were used up to 70%, the sales were partially secured, the company suffered from secondary insolvency, and the number of employees decreased. Currently, the company has terminated mining operations. Želba a.s. OZ Siderit Nižná Slaná was focused on the extraction of iron ore - the siderite in the deep way and the thermal way it was processed into Fe concentrates and blast pellets and was the **monopoly producer** of this production in the SR, the main customer was **U. S. Steel Kosice** and **Komag, a.s**.

Regarding the mineral of Magnesite, constituting an **Industrial, non- metallic** mineral, with a focus on the mining activities, the reserved magnesite deposits occur on deepness on the Bankov locality, while the processing and refining of magnesite, the production of concentrates, magnesite clinkers, spinels and calcines, refractories also ceased its activity. **Strengths** of a.s. was the unique technology of producing clinker-based clinker concentrates, rewarding the domestic RM base. **Problems** persisted due to a lack of funding to ensure the movement of rock mining in Mine Bankov and the upgrading of production in the projected capacity. The company had a good position on foreign markets, out of a production of 16,471 t, 74% went to export (France, Germany, Hungary, Poland, Ukraine), while nowadays, Bankov consists a closed mine.

Emphasizing on the mining of **Non-energy RM** - mining and processing of other minerals (mining and processing of limestone and gypsum): Vápenka a.s. Margecany consists a large-scale deposit of limestone, cut, packed, ground limestone, gravel, produces a non-explosive mixture of Cevamit and has a long-term loss. With 107 workers, for revitalization, it needs a strategic partner or new markets for production sales. This includes other quarries in Košice - surroundings districts (Lom Malá Vieska, Lom Včeláre), whose economic results are part of the USSKE, Kalcit Gombasek and other smaller entities.

Finally, for the main activated, metallurgical companies, **U. S. Steel** is the largest integrated steel producer in Central Europe. USSK is situated on the outskirts of Košice and is the **second biggest employer** in Slovakia, the biggest in the region of Košice, and Eastern Slovakia. For input RM, U.S. Steel uses coal and their outputs are suitable for applications in the automotive, packaging, electrotechnical, consumer goods and building industries.

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• Short Description of Obstacles for Establishing Mining Industry

- Insufficient **economic**, **environmenta**l, and **social data** on **mineral deposits**, that can lead a potential investor to start a business.
- **Administrative barriers**, **bureaucracy**, **long-lasting and complicated processes** related to the settlement of property rights, adherence to stringent environmental requirements and laws, environmental impact assessment process, professional authorizations - a time-consuming process for obtaining this type of authorization.
- One of the most serious factors is public opinion and its influence. In most locations, mining is perceived as a **negative activity**. For this reason, it is necessary to endeavor to introduce a **social license** and to raise the importance of mining and to explain its particular aspects.

• Short Description of Chances for Establishing Mining Industry

- The **development of RM policy** into specific regional and local conditions for decision-making in the territory.
- The **update** of the information system to make it realistic to inform about the suitability and life of inventories of individual dedicated bearings – the introduction of **statistical monitoring** for secondary RM and the **classification** of mineral resources and resources according to UN methodology.
- The exploitation of the **potential of geothermal energy** in Eastern Slovakia with the financial support of EU grant schemes. The sources of geothermal energy in the KK territory are in the Košice Basin area, namely Beša - Čičarovce.
  In Košice Basin are also geothermal waters, which are bound to limestones and dolomites. The most important supplies of groundwater in the KK are: Bodrog and Hornád, Laborec, Latorica and Ondava in the sands and streams. The smallest reserves of groundwater are in the rocks of Volovské vrchy.
- The concentration on the **RM's self-sufficiency**.

• Regional GDP of M&M Industry

- Regional GDP data are not available for of M&M industry
- Regional GDP data are not available for of M&M industry per capita

• Support from Regional and/or National Government

- The relevant administrative, private companies and research institutes (excluding cluster organisations and associations.

Kosice Self-Governing Region - The Office of the Košice - Self-Governing Region (hereinafter KSK) provides professional, administrative and organizational work with tasks of self-government of higher territorial units under Act no. 302/2001 about **Self-Governing Regions**. KSK provides and coordinates the development and implementation of the program of **economic** and **social development** of the self-governing region. It cooperates with ministries and other government bodies within the preparation of the **National strategy** of regional development, update of the **Conception of Slovakia's territorial development** and **framework programming documents** for the disbursement of EU funds. It establishes the **Regional Innovation Strategy** and designs **Regional Innovation Policies**. It also creates the conditions for establishment and development of **territorial cooperation** and **partnerships**, **improvement** of the business environment, **cooperation** with other regions and other regional governments, universities, association of towns and municipalities, micro-regions and municipalities and

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other entities. KSK's total stuff is above 250 with annual revenue of more than 150 M €. Since its establishment, KSK has coordinated and participated in **more than 50 EU funded projects**.

Ministry of Economy of Slovak Republic - contributes to the creation of the **unified state policy** of the Slovak Republic. To the extent of its responsibilities and competences, it exercises state administration and fulfils further tasks stipulated in laws and other generally binding legal regulations. To the extent of its defined responsibilities and competences, the Ministry is also liable for defence issues and formation of conditions favourable for implementation of requirements for ensuring the preparations for defence and security. To the extent of its defined competences, the Ministry is also responsible to covenant the international agreements and treaties, to develop bilateral contacts and relations between the countries and international co-operation inclusive the tasks resulting for the Slovak Republic from both the international treaties and conventions and its membership in the international organizations.

Moreover, the **Ministry of Economy of Slovak Republic** inspects the issues in the matters subjected to the extent of its competences, it analyses the achievements and results and takes the measures to solve the topical issues. It also processes the concepts aimed at development of tasks it is entrusted with and at solving the fundamental issues to be submitted to the Government of the Slovak Republic. Ministry has under its administration an **update** on the **state's RM policy**.

Ministry of Environment of Slovak Republic - The Ministry was re-established as of 2 November 2010 to function as the central state administrative authority and supreme inspection authority in environmental affairs. To guarantee and inspection activity of the Government of the Slovak Republic, the Ministry of the Environment coordinates the activities of all Ministries and other central state administrative authorities of the Slovak Republic in environmental matters. The most relevant competencies of the Ministry are **waste management**, **environmental impact assessment** of activities and their consequences, **geological works** or **protection of water resources** and the **quality** of **groundwater and surface water**.

The main **Mining Office** is a budgetary organization, incorporated into the structure of the Ministry of Economy of the Slovak Republic. District Mining Offices carry out the tasks of the main supervision of state mining authorities. The tasks of the State Mining Administration in the Main Supervision Section are performed by the **Mining Authority** by the **Central Mine Inspectors** and by the **District Mines Offices** by the **District Miners Inspectors**.

• Number of Registered M&M Company

- Number of registered mining companies: In Slovakia (data for the year of 2016), there are **696 registered companies** that are under the oversight of Central mining bureau (Hlavný banský úrad). Out of 696 registered companies **only 3** (Hornonitrianske bane Prievidza, a.s.; NAFTA a.s., SMZ, a.s. Jelšava) have more than **249 employees** (finstat.sk, year 2017). Slovakian **SME percentage** in mining industry is **99,57%.**
- Number of registered metallurgy and metalworking companies: In Slovakia (data for the year of 2018, finstat.sk), there are **7,012 companies** that are conducting business in metallurgy and metalworking. Out of these 7,012 companies, **only 34** have more than **249 employees**. The **SME percentage** is **99,52%**.

Largest mining companies in Slovakia (according to profits, for the year of 2016):

- Nafta, a.s., Bratislava (extraction of oil and natural gas)
- Hornonitrianske bane, a.s., Prievidza (lignite coal mining)
- Alas Slovakia, s.r.o., Bratislava (open gravel pit mining)
- Pozagas, a.s., Malacky (subcontracting company for oil and gas extraction activities)
- Slovenská banská, s.r.o., Hodruša-Hámre (mining of gold)
- Eurovia – Kameňolomy, s.r.o., Košice (open pit mining of construction aggregate)

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- KSR – Kameňolomy SR, s.r.o., Zvolen (open pit mining of construction aggregate)
- T&B SK, s.r.o., Bojnice (Auxiliary activities in M&Q)
- Romin Slovakia, s.r.o., Kremnica (open gravel pit mining)
- KAS, a.s., Zlaté Moravce (open pit mining)

L**argest metallurgy and metal working companies** in Slovakia (according to profits, for the year of 2016):

- U.S. Steel Košice, s.r.o., Košice (production of steel)
- Slovalco, a.s., Žiar nad Hronom (production of aluminum)
- Bekaert Hlohovec, a.s., Hlohovec (cold wire drawing)
- ArcelorMittal Gonvarri SSC Slovakia, s.r.o., Senica (processing of flat steel)
- Železiarne Podbrezová, a.s., Podbrezová (production of steel)
- Nemak Slovakia, s.r.o., Žiar nad Hronom (production of aluminum)
- OFZ, a.s., Oravský Podzámok (production of iron and ferro-alloys)
- Hydro Extrusion Slovakia, a.s., Žiar nad Hronom (production of metal structures and alluminium)
- Cortizo Slovakia, a.s., Nová Baňa (production of aluminum)
- C.L.N. Slovakia, s.r.o., Košice (production of iron and ferro-alloys)

• Short Description of M&M Cluster and Association

- **EIT Raw Materials HUB Regional Center Kosice - HUB** was established in January 2018 by the European Institute of Innovation and Technology (EIT Raw Materials) in cooperation with the **Technical University of Kosice**. Activities of the HUB Center are implemented by the **Faculty of Mining, Ecology, Process Control and Geotechnology** (FBERG) and its objective is to mobilize all stakeholders falling to knowledge triangle and to support the local ecosystem in order to enhance the innovative potential of the region. All these actions, taking into account the lines of **European strategies**.
- Association of **Mining Guilds of Slovakia** - the association applies the **interests of organizations** in the field of **mining** and preserves tangible and intangible **cultural and industrial heritage**, especially **mining and metallurgical traditions and custo**ms as well as **mining-technical monuments** in Slovakia. It cooperates with state administration bodies, local authorities, educational and research institutions in Slovakia and abroad. The association expresses and recommends for the approval and implementation of projects proposed by individual members of the association.

• Industries Closely Related to M&M

- In the territory of the Region of Kosice, there are **processing and energy entities** whose **inputs** are closely related to **outputs** from MM production.

KOSIT a.s. owns 1 incinerator, 10 subsidiary companies, employs 545 workers and provides its services to 300,000 inhabitants and 500 entrepreneurs in Slovakia. At present, 24,290 containers, 190 cars in the fleet, 115,000 t of waste per year, 45,000 MWh of electricity, and 4,200 homes in the winter season. KOSIT company through its plants provides following services:

- **Service Division**: Waste removal, summer and winter maintenance

- **Waste Treatment Division**: annually processes 30,000 t of waste. Of this, 25,000 t are primarily intended for energy recovery. The residual waste in the form of secondary RM such as paper, plastic, glass and iron continue for further material appreciation.

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- **Production Division**: Municipal waste incinerator (annually energetically assess more than 100,000 t of waste. The "R1" status acquired in 2007 means that more than 65% of the energy produced is KOSIT a.s. commercially exploited by heat and power generation), Electricity generation (80,000 t of waste per year into 48,000 MWh), Heat delivery (volume of more than 36,000 MWh per year).

Heating plant Košice, a. s. is one of the largest producers and distributors of heat in the form of hot water and steam in the centralized heat supply system in Slovakia. Of the total annual heat consumption of 806,886 MWh in 2017, households make up 62% and other customers 38%. Heating plant also produces electricity and provides support services and control electricity for the needs of the Slovak electricity grid. The heat input of the heating plant is coal.

As there is a high potential for **geothermal energy** in the location, there are several entities that are trying to run geothermal parks to use energy to replace natural gas combustion, use heat as well as recreational purposes. At present, however, it is still not appropriate for banks or the state to support this activity, but it is important to note that this industry is on the rise.

Thermal power plant Vojany is situated in the Eastern Slovakia, district Michalovce. The installed generation capacity of currently operated units of the plant Vojany I (EVO I) is 2 x 110 MW. The advantageous location in the proximity of the Slovak-Ukrainian border, the utmost shortening of the semi-anthracite coal wide-gauge track from the Donbas-Kusbeck mining area and the possibility of cooling water off-take from the Laborec river were the most important considerations leading to the decision to build this thermal power plant.

In the region, projects focusing on **geotourism** have been implemented and are still being implemented, which has a direct positive impact on the **public awareness** of mining and indirectly enhances the mining industry.

• Short Description of Promotion of M&M Industry

- Promotion in terms of certain schemes, events and activities to raise awareness and relevant program.

Promotion of MM Industry in Slovakia is **partially** supported by **national media** (prime time news, national televisions, press and other) in a way of regular solving the **problems** related to mining companies, miners (employment), type of extracted RM (very current the issue of coal mines), energy self-sufficiency, new investments e.tc. The mentioned kind of maintaining **awareness** is possible to have the greatest impact in terms of affecting the broader population. There are also **associations** devoted to MM, being very active on the field of promotion through their own networks and channels to companies and policymakers.
Regarding the **promotion** among young people, professionals and companies, the **Faculty BERG** is very active not only within the Region but even within the whole country and the surrounded Europe, consisting the **unique institution** in the Slovakia. Through the **EIT Raw Materials membership** and the **established HUB Center**, Faculty BERG is dedicated to many **projects** and **activities** aimed at popularizing the sectors of MM, for example through **exhibitions**, **educational activities**, **world cafe sessions**, **networking events**, e.tc..

• The Role of Metallurgy Plays in the Regional Circular Economy

- Not able to provide required data of the metallurgy including the hydro- and pyro-metallurgy.

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• Short Description of Networking Potential

As Košice Region is a **small** region, **networking** of local stakeholders and **major players** is easier. There is a **good cooperation** between the Technical University of Kosice and the Košice Self-Governing Region in areas along the **entire value chain** of mineral resources. The two institutions have the most significant connection to the MM industries, i.e. the sum of important industrial companies, associations or government bodies and authorities.

EIT Raw Materials HUB Regional Center of Košice played a very important role in this area, which has allocated a special budget for the activity related to **networking** and **meetings**. The center in this area is very active and counts with a strategic impact.

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7. REGIONAL GENERAL BACKGROUND INFORMATION (ANDALUCIA, SPAIN)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

- **Capital**
  - Seville
- **Area (Km^2)**
  - 87.268
- **Population**
  - 8,371,270 (2011); 8,399,043 (2015); 8,409,738 (2018)
  - Age Structure

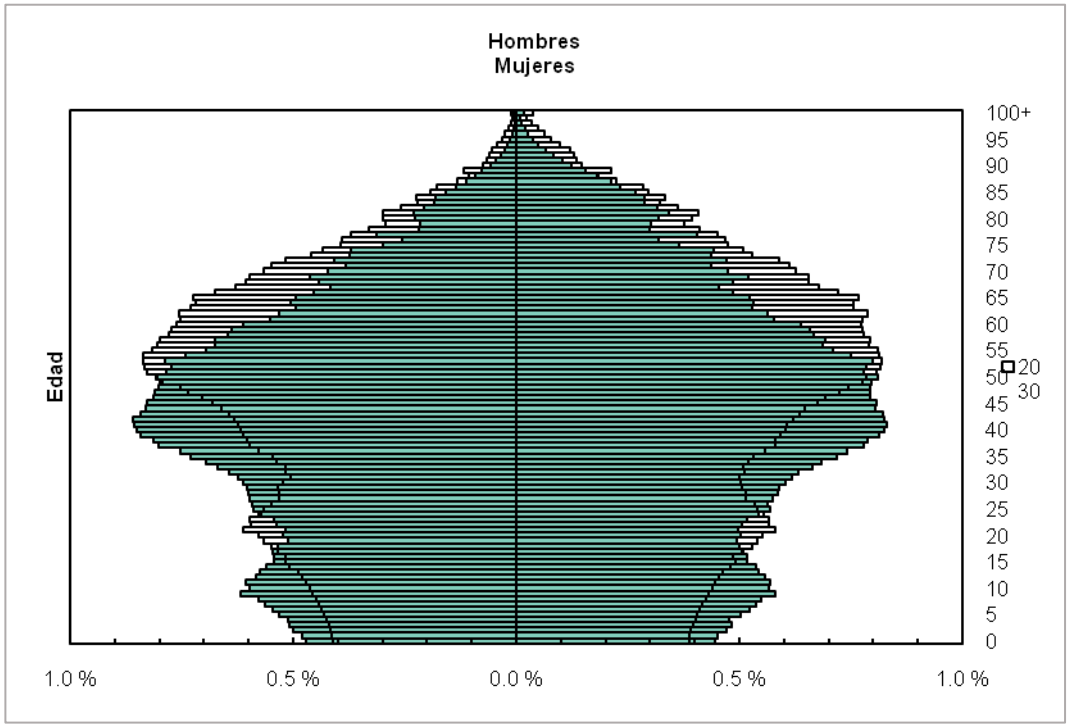

Figure 7.1: Data for the age structure of Andalucia

  - Number of registered foreigners: 618,791 (7,4% of the total population of Andalucia, 2018)
- **Short Description of Indigenous Group**
  - There are not indigenous groups in Andalucia, neither in Spain in general.

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• Industries based on Natural Resources, M&M

- Short description on regional M&M (pyro- and hydro- metallurgy) industries.
  - The **structure** of the mining sector in Andalucía is the following:
    - **Number of exploitations**: 480 and **Total Number of employees**: 6,473
    - **Aggregates**: 363 exploitations; 2,230 employees
    - **Natural stone**: 73 exploitations; 356 employees
    - **Industrial minerals**: 37 exploitations; 262 employees
    - **Metallic mining**: 5 exploitations; 3,596 employees
    - **Energy minerals**: 2 exploitations; 29 employees
    - **Hydrometallurgy industries**: Cobre las Cruces (CLC) manages a hydro-metallurgy process plant, which produces 72,000 t/yr cathodes Cu 99.999%. The employees are included in general data of the exploitation.
    - **Pyrometallurgy industries**: Atlantic Copper manage a pyro-metallurgy process plant in Huelva, which process concentrates from Grassberg (Indonesia) Freeport McMoran mine. It starts processing concentrates from Iberian Pyrite Belt mines (MATSA, Atalaya Minining), and it produces 300,000 t/yr Cu 99.99% in a smelting plant and a refinery plant; 1,150 employees.

- Ranking of the natural, MM industries based on the **acceptance** of the public.

There is no official statistical data. The mining activity is an ancient activity in the region and the acceptance of the public depending on two factors: the **age of the activity** and the **generation** of tangible positive effects in employment, and the economic development of the surrounding environment.
It is possible that the **aggregates mining** is the worst valued by the public, and **metallic mining** the greatest. In specific cases, a project could find ecologist groups opposition, depending from the place, the time context, and the presence of environmental protected species or habitat, and not from the type of mining activity.

- The main job creator is **metallic mining** in more than double the rest set.

• Infrastructure

- **Transport** and **Transport Accessibility**: there are connections for the main capitals, cities by highways, and the most important villages, by a wide network of main roads (90-100 km/h). This network connects the main mining areas with harbors, trains stations, and important logistic points.

The railway system is based on a high-speed line linking Seville, Málaga and Cordoba with Madrid-Barcelona-Europe, and a wide railway connecting the capitals. A new transversal line is under construction and it will connect Granada to Seville and it will constitute a Pan-European line, Mediterranean Corridor, from Algeciras harbor to Mediterranean cities (Murcia, Valencia, Barcelona, Europe). There are many interchange stations for connecting cities, harbors, airports, etc. Finally, regarding the wide transport network, the harbors and the airports, all of them belong to public sector.

- **Telecommunication**, mobile telephone and data transfer technologies (internet) covered more than 75% for the most advanced technologies and 95% for the usual technologies.

• Energy Sources

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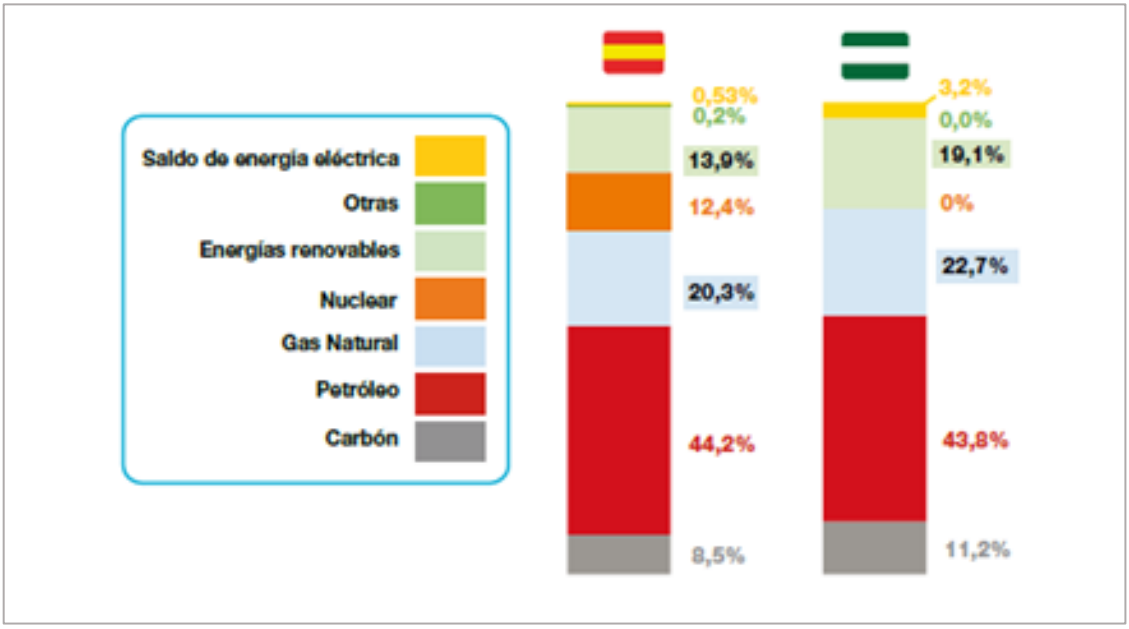

Figure 7.2: Share of consume for conventional energy in Andalucía and Spain (2016). Source: Datos energéticos de Andalucía (2016), Agencia Andaluza de la Energía, available at: www.agenciaandaluzadelaenergia.es

NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• National and Regional GDP

- National and regional GDP:
  Andalucia 155,213 M € (2017), Spain 1,166,319 M € (2017)
- GDP per capita:
  Andalucia 18,470 € (2017), Spain 25,100 € (2017)

• National and Regional Employment Level

- Employment rate (Activity rate): Spain 59%; Andalucia 57,5%.
- Unemployment rate: Spain 15,3%; Andalucia 23,1%
- Youth unemployment rate (< 25 years old): Spain 34,7%; Andalucia 47,3%

• National and Regional Economic Structure/Employment by Sector

- Spain (2016), agriculture: 4,46%, industry: 11,83%, construction: 5,51%, services: 67,04%, other: 11,17%
- Andalucia (2016), agriculture: 8,01%, industry: 9,22%, construction: 6,33%, services: 76,44%

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• National and Regional Export Rate and Trading Partners

- National and regional export rate and main trading partners

Spain (2016):
- Export: 22% GDP, import: 24% GDP, deficit: 25,000 M €
- Main partners export: Germany, France, Portugal, UK and Italy
- Main partners imports: Germany, France, China, Italy and USA

Andalucia (2017):
- Export: 21,1% GDP, import: 20% GDP, surplus: 1,700 M €.
- Main partners export: Europe 70%, Northern Africa 7,5%, Northern America 6%, Asia 11%, rest of the world 5,5%.
- Main partners imports: Europe 32%, Africa 28%, America 18%, Asia 21%, rest 1%.

- Short description regarding export and import situation of regional M&M industry

• National and Regional Number of Registered Company

- National (Spain 2016: 3,279,120 companies) and Regional (Andalucía 2016: 501,458 companies) number of registered companies
- SME percentage: Spain 99,87% SME, Andalucia 99,92%.

REGIONAL INFORMATION IN M&M INDUSTRY

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• Short Description of Regional M&M Sector

The regional mining sector is focused in four sub-sectors: **metallic mining**, **industrial minerals**, **natural stone** and **aggregates**.

Aggregates are distributed through the territory of the region and the production is depending on the building sector demand. After a strong period of decline (bursting of the housing bubble), it is now rising again at a moderate speed. 363 exploitation (75%) and 2,230 employees (34%). Production in Spain for 2018, was 152 Mt, and 703 M €. Andalucia's values correspond to 24% of the national sector.

Industrial Minerals in Andalucia are **silica sands**, **strontium**, **dolomite**, and the most important is the mineral of **gypsum** (first producer in Europe 7 Mt/yr).

Natural stone in Andalucia is focused on marble in Macael Area, Almería province, with production of 1 Mt/yr, that corresponds to 17 M €/yr. The expertise and advanced technologies -through new applications, new processes that are more efficient, and cheaper- have made international competitive companies of the region, such as Cosentino.

Metallic mining is an ancient activity in the region and periodically reborn strongly in one of the mining districts. At the end of the XIX century and beginning of XX c. mining activity rised from west to east from north to south of our region. **Copper** in Iberian Pyrite Belt (West), Córdoba (Central North) or Almería, **Iron** in Huelva, Málaga, Almería, Granada, Córdoba, Seville, **Lead** and **Zinc** in Huelva, Linares (Jaén, East), Córdoba (Central North) and Almería (East).

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In the middle of the XX c. remained the active metallic mines in IPB (iron pyrite, copper, gold), Peñarroya (Central north, Cordoba, copper and zinc), Linares (East, Jaen, lead) and Alquife (Central, Granada, iron). Today, after a convulse closing period at the end of XX c, there are many exploration-permits with more than 20 M €/yr estimated investment. Companies such as the First Quantum, Trafigura, Grupo Mexico, Glencore, Freeport-McMoran, etc, explore metallic minerals in Andalucia.
In specific, there are 5 actives metallic mines, producing copper cathodes, copper concentrates and conc-lead concentrates. Aguas Teñidas-Magdalena-Sotiel, exploited by MATSA, a Trafigura-Mubadala company, Riotinto, exploited by Atalaya Mining, a Trafigura-Yangu Yiangguan Copper-Liberty Metals-Orion Mines-others company and Cobre Las Cruces, a First Quantum Company. They produced 72,000 t/yr metal copper, and 700 kt/yr concentrates copper 78%, zinc 20% and lead 2%.
Aznalcollar mine, is a property of Grupo Mexico, and it is involved in the permitting process, expected to be completed by 2019.
Regarding metallurgy sector, there is a copper smelting and refinery in Huelva, Atlantic Copper, a Freeport McMoran company. It processes the concentrates from Grasberg mine, Indonesia and produces 300 kt/yr copper metal. Furthermore, there is another metallurgy plant in Los Barrios (Cádiz), ACERINOX, a stainless steel smelting and processing plant that produces 1 Mt/yr stainless steel from scrap iron.

• Short Description of Obstacles for Establishing Mining Industry

- Environmental protection, land use planning limitations and public acceptance.

More than 35% of regional surface is protected by an environmental figure (the highest part of the **Natura 2000** areas). The conditions at these areas, usually include mining prohibition, without any specification or justification, and that constitutes an obstacle for the establishment of mining industry.
Another weakness for the Region, is the creation of the **land use planning**, mainly because the creators planned the use of the whole territory, without any knowledge of the mineral potential, mineral demands and mineral scarcity. This resulted in not taking into account whether industry needs some specific minerals, in order to develop the economy and society aspect. As a result, it constitutes a weakness for the Region of Andalucia.
Furthermore, another obstacle for the Region of Andalucia is the fact that an important part of the regional territory, has **limitation** or **prohibition** of mining activities due to the landscape protection, the rural environment protection or agricultural protection.
Finally, another weakness is the **public acceptance**, that is against mining activities due to an educational shortage or deficit, a bad secular image, because of the ancient activities (abandoned mines and polluted areas), and recent examples of absence of environmental protection (Aznalcóllar).

• Short Description of Chances for Establishing Mining Industry

- The main chances for establishing Mining industry are the ones that follow: the high **mineral potential**, the good **spatial data infrastructures**, the **infrastructures** related to **transport** and **telecommunication**, the favorable **tax system**, the **legal security** for investments, the **modernization** of Andalucia's society, as well the **skilled workforce** e.tc.

• Regional GDP of M&M Industry

- Regional GDP of MM industry (1,800 M € 2017 estimated)
- Regional GDP of MM industry per capita (222€ 2014)

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• Support from Regional and/or National Government

- Regional mining Administration (DGIEM, and territorial departments), National Geological Survey (IGME), Regional Development Agency (IDEA), National Government Mining Department

• Number of Registered M&M Company

- Number of registered M&M company: 2,000 estimated
- SME percentage in the registered M&M company: 99,9%
- Giant M&M company in region:
  - ➔ Production: MATSA, COBRE LAS CRUCES, ATALAYA MINING, COSENTINO, ACERINOX, ATLANTIC COPPER, GRUPO MEXICO
  - ➔ Production services: SRK, GOLDER, TECNICAS REUNIDAS, AOMSA, FERPI, CAVOSA, etc.

• Short Description of M&M Cluster and Association

At national level, industrial minerals and aggregates companies are associated in **COMINROC** and at regional level there is the association of **ANEFA**. For metallic and some industrial minerals, at national level there is the association of **CONFEDEM**, while at regional level, the association of **AMINER** includes operation service and consulting companies.
At a local level, there is the association **Almerian Marble Companies** for natural stone, while at a national level, there is the association of **Federación de la Piedra** (FdP natural stone). Finally, there are many clusters with different degree of success, **Corporación Tecnológica de Andalucía**, **Centro Tecnológico de la Piedra** (natural stone), **Innovarcilla** (clay), and there are **others** in process to come true.

• Industries Closely Related to M&M

- Construction industry, metal industry (copper), secondary metallurgy (iron, aluminum, alloys), and chemical industry.

• Short Description of Promotion of M&M Industry

- Promotion in terms of certain **schemes**, **events** and **activities** to raise awareness and relevant program
- The promotion of mining is implemented in Andalucia by 3 actors: **Administration**, **Companies**, **Association/clusters**, and **joint actions**.

The **Mining Administration** promotes the activity by implementing the **Regional Mining Plan 2020** (Estrategia Minera de Andalucía 2020). It spreads information by a web portal, organize and support events with professionals groups or associations, local authorities, local public representatives, e.tc., it support new investments, innovation investments, internationalization activities, it takes part of international projects (H2020, RDEF, e.tc.) and initiatives of international organizations (f.i. OCDE).
Companies make **activities** with local stakeholders, organize local or regional awards, they do advertising campaigns to bring mining activity closer to the people. They also have a visit program, for schools and universities.
Associations/clusters organize great **events** and international **congress** to exchange experiences, to show business opportunities to attract partners and investors e.tc. For instance, Metallic Mining Hall, biannual congress held in Seville.
They also do information campaigns at school level and make information papers (small books) for dissemination, about mining activity and environment, mining activity and innovation, mining activity and regional development e.tc.

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The Role of Metallurgy Plays in the Regional Circular Economy

- The **metallurgy plants** linked to the circular economy are ACERINOX integrated plant with production 2.5 Mtn/yr stainless flat steel, SIDERURGICA SEVILLANA, 1 Mtn/yr building steel, and another small plants for iron and steel industry.
- Andalucia has a complete **recycling sector** from people customers to stainless steel industry. They recycle the iron scarp, producing and exporting to other regions and countries for steel and stainless production.

Short Description of Networking Potential

- The clustering of **production services companies** in metallic mining is one of the future developing areas. There is a need for a directory of companies in the mining sector that joint producers, auxiliary and services, consulting, e.tc., so as to offer services to investors of the mining sector.
- Need for linking the mining companies with the **innovation framework** (technological centers, universities, research and innovation companies, e.tc.).
- Necessity to professionalize the **clusters** and **associations** that are interested more for the private sector.

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8. REGIONAL GENERAL BACKGROUND INFORMATION (CASTILLA Y LEÓN, SPAIN)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

- **Capital**
  - Valladolid
- **Area (km^2)**
  - 94,226 km^2
- **Population**

Year		2005	2010	2016	2017
Number of Inhabitants		2,510,849	2,559,515	2,447,519	2,425,801
Population Density (people/km^2):		26.65	27.16	25.97	25.74
Age Structure (%):	**<15 years**	11.45	11.88	12.07	11.96
	15-64 years	65.99	65.53	63.49	62.97
	>65 years	22.56	22.59	24.44	25.07
Net Migration Rate (%):		ND	0.78	0.34	0.78

Table 8.1: Data for the Number of inhabitants, Population density, Age structure and Net Migration rate. Source: CESCYL, http://www.cescyl.es/es/publicaciones/informes-anuales; EUROSTAT, https://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tgs00099&language=en, INE, http://www.ine.es/jaxi/Tabla.htm?path=/t20/e245/p04/provi/l0/&file=0ccaa007.px&L=0

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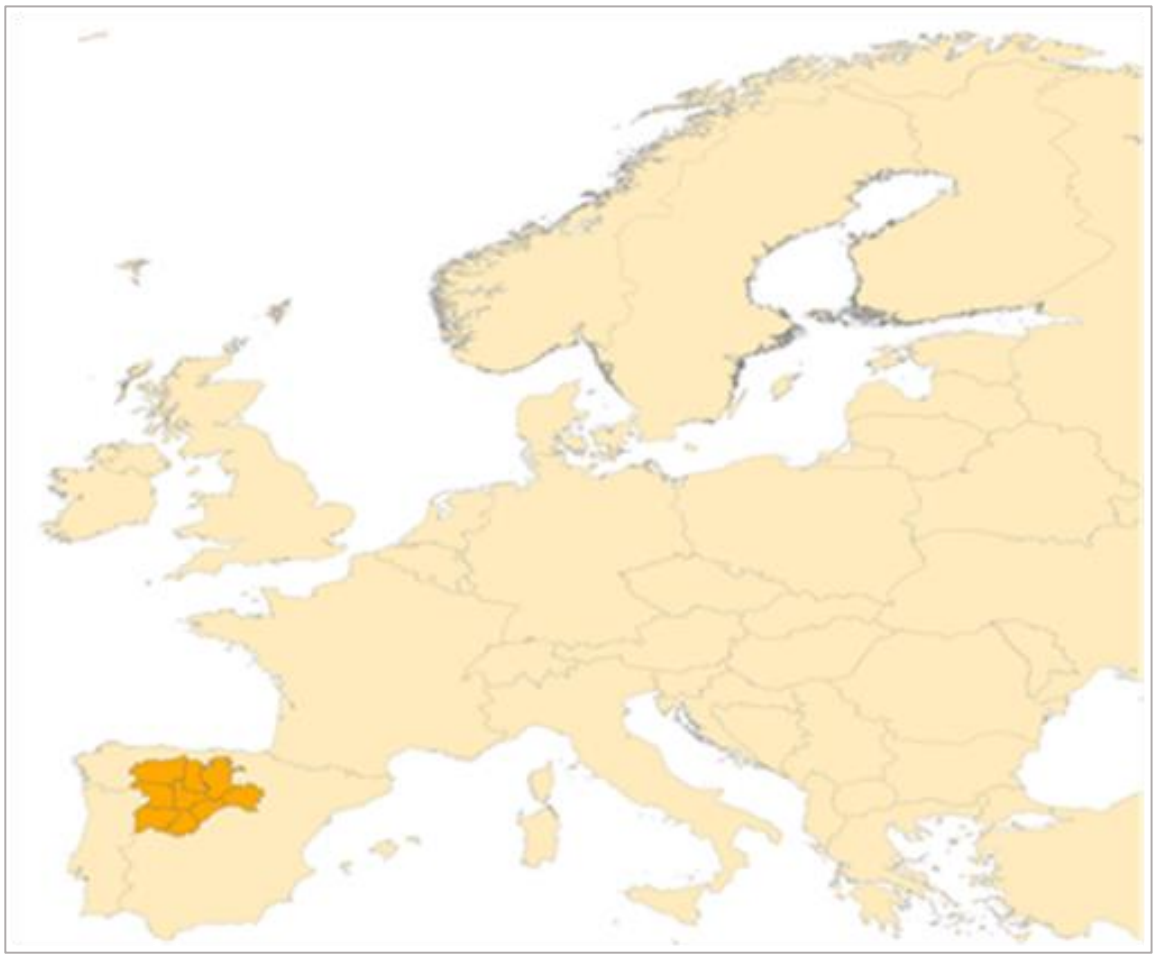

Figure 8.1: Castilla y León in Europe

- ## Optional: Urbanisation Rate

The following **Table 8.2** represents data for the mentioned provinces, regarding the population dimension, the surface of each province and the corresponding density.

Province	Population	Surface	Density
	Year (2017)	(km^2)	(Inh/ km^2)
Ávila	160,700	8,050	19.96
Burgos	358,171	14,292	25.06
León	468,316	15,581	30.06
Palencia	163,390	8,053	20.29
Salamanca	333,603	12,350	27.01
Segovia	154,184	6,923	22.27
Soria	88,903	10,306	8.63
Valladolid	521,130	8,110	64.26
Zamora	177,404	10,561	16.8
TOTAL	2,425,801	94,226	25.74

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Table 8.2: Data for the population, surface and density of the specific cities of Castilla y León.

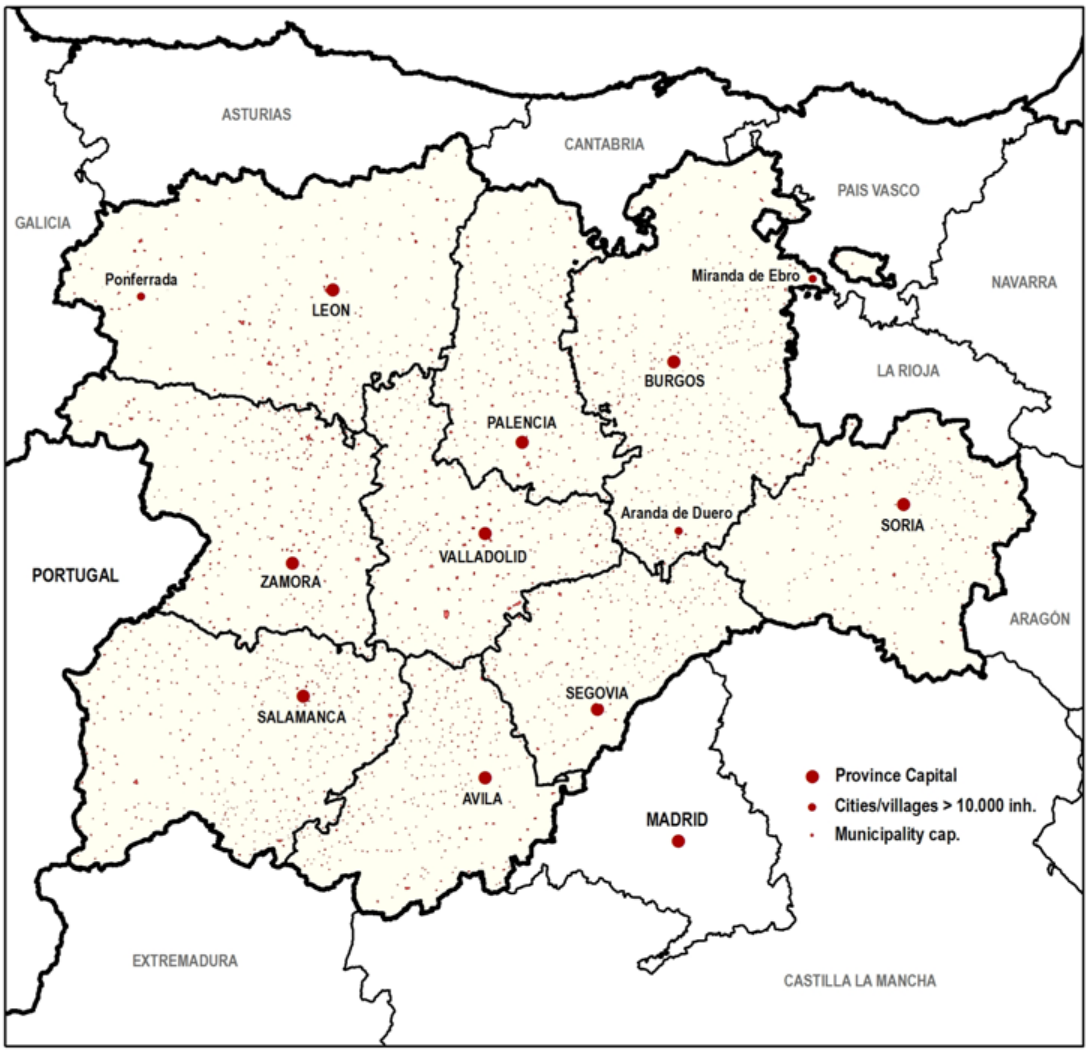

Figure 8.2: Map for the distribution of population for the Region of Castilla y León.

• Short Description of Indigenous Group

- In Castilla y León, 94.74% of the population is Spanish. There is no indigenous group that can affect the M&M industry.

• Industries based on Natural Resources, M&M

- Mining industries comprises in Castilla y León both **underground** and **open-pit** exploitations, with a clear predominance of the **last type**. **Treatment plants** depend on the mineral/rock, with **crushing**, **cleaning** and **sorting** being common techniques in **aggregate plants** and in most cases in **industrial minerals**. These techniques are used, as well as ore preparation, for the **final extraction process**, such as the case of the gravity separation of tungsten minerals and flotation of K-feldspar.
  There is no **metal extraction** in Castilla y León as final product of the mining industry, with the exception of the case of tungsten the final saleable product is a concentrate of scheelite (Los Santos W mine). In the magnesite mine of Borobia, saleable MgO is obtained by means of

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calcination of the magnesite. A special case is the glauberite exploitation, in which salts are extracted by dissolution in situ (directly in the deposit) and later Na-sulphate precipitation in the treatment plant.

Downstream industries related with the mining activity in Castilla y León are: four coal power plants, four cement plants, many concrete plants, one factory of absorbent products, several glass and ceramic factories and one silicon carbide plant. Many of them are attached (concrete plants) or very close (power plants, ceramic factories) to the mining exploitations. In the past there were steel and ferroalloys industries. There is also an **Al-recycling industry** in Valladolid. RM produced in Castilla y León feed **tiles industries** in the Spanish Mediterranean Coast, **fertilizer**s in several plants in Spain, **ferrosilicon industries** in Norway and **tungsten-related industries** in USA.

- Ranking of the natural, M&M industries, based on the acceptance of the public: there is any survey conducted in this sense. However, some industries such as **wood** or **food industries** are usually **well accepted.**
- **Main job creator**: there is no data or surveys conducted in this sense.

• Infrastructure

Transportation System

Castilla y León has good accessibility both by **road** (**highway**) and **railway**, both in the internal communications between the main cities and externally with the surrounding regions. Distances from the main cities on the region to the capital (Valladolid) are usually 1-1.5 h by car. The main routes from France to Madrid or Lisbon cross Castilla y León, connecting on the way up to 4 provincial capital cities (Burgos, Palencia, Valladolid and Salamanca). There are also 4 **airports** (Valladolid, León, Salamanca and Burgos) with a traffic 288,630 passengers (data for the year of 2016).

Taking as reference the Valladolid, because it is the capital and it is situated in the middle of the region, it communicates with **capital cities**, **harbors** and other important **logistic points** are as follow:

- **Valladolid-Madrid**: 1h by high-speed train and 2h by motorway.
- **Valladolid-Barajas airport** (Madrid): 1.5h by motorway; Barajas is the 6th airport with the highest traffic in the EU.
- **Valladolid-Bilbao/Santander/Gijón** (the main harbors in the Spanish Atlantic coast): 240-320 km, 2.5-3.5h by motorway, up to 3h by train

CyLoG is a strategy of the regional administration of logistic issues, and it involves the management and promotion of a net of 15 logistic enclaves located in the main cities and nodes of communication.

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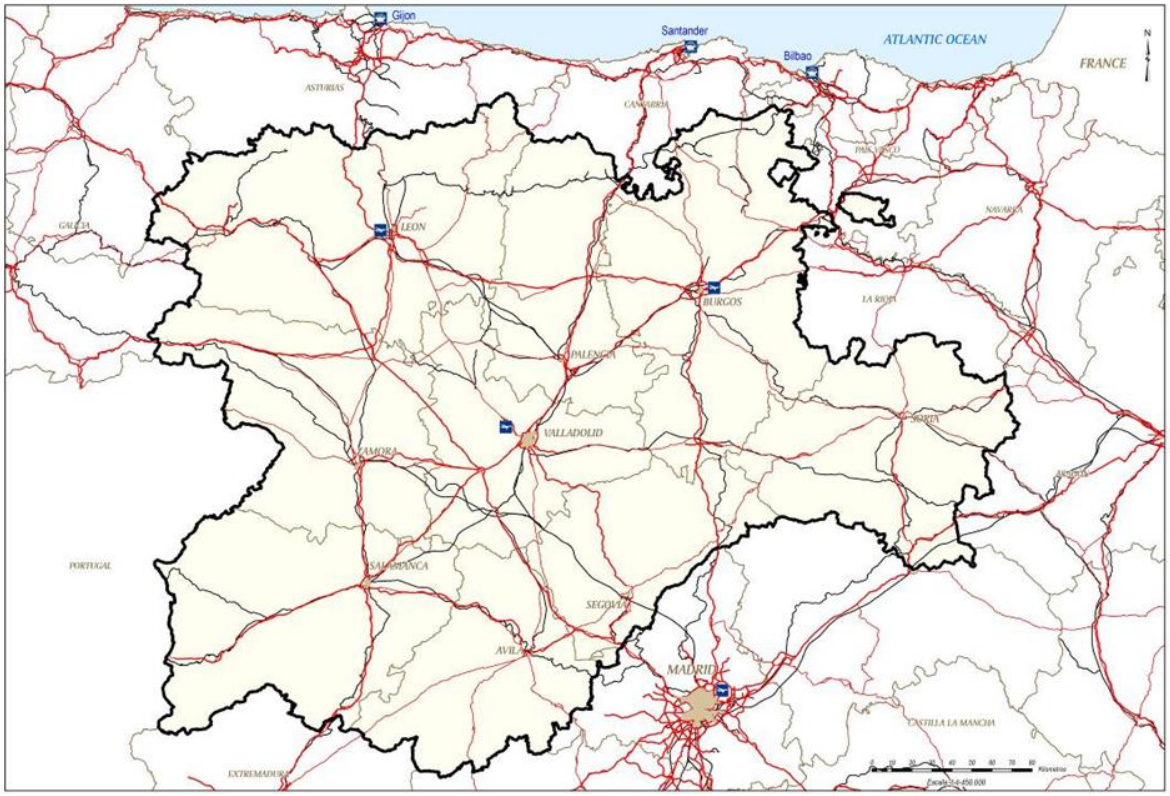

Figure 8.3: Map for the Infrastructure network for the Region of Castilla y León: motorways and national roads in red lines; railway system in black lines; airport and harbors in blue squares.

Road network

Castilla y León is crossed by the **road network** that communicates Madrid with France and harbors in the North coast. Total length is 32,449 km, of which 5,233 km depend on the State, 11,287 km on the region and 15,929 km on the provinces. Total length of high capacity (motorways, double way in general) is 1,910 km (Regional Ministry of Development).

Railway system

Castilla y León is crossed by the **railway network** that communicates Madrid with France and regions in the North coast. The railway net has more than 3,000 km (565 km for high-speed service) and 127 stations. All the province capital cities are connected by railway, and 5 of them (León, Palencia, Valladolid, Zamora and Segovia) have train station with high-speed service. In 2016, the main train stations in long distance travels (>300 km) were León (697,777 passengers), Valladolid (640,192 passengers) and Salamanca (325,812 passengers); in middle distances (60-300 km), the main stations were Valladolid (1,766,706 passengers), Segovia (863,529 passengers) and Ávila (590,191 passengers). There are 8 logistic facilities connected by railway. More than 3,200 t/day are moved through the regional net (Spanish Railway Foundation, Ministry of Development).

Public transport system

Public transport system comprises basically **bus** and **train**. The frequency is enough for the transport between the main cities in Castilla y León or these cities and Madrid. For example, there are 6 daily travels by high-speed trains and 8 by bus from Valladolid to Madrid. Internal communication between villages and cities is also acceptable, and there is available as well an on-demand service, co-founded by users and the provincial administration, to cover special cases of small villages not included in the regular routes of the public transport.

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Telecommunication

In 2016, broadband services >1 MG and >10 MG were available for the 97.3% and 85.1% of the Castilla y León population, respectively (Regional Ministry of Development and Environment).
In 2017, 77.1% of the Castilla y León homes had a type of computer, 78.2% had access to broadband connection, 80% landline phone and 97% mobile phone. The percentages of companies with internet connection were 66.8% (<10 employees) and 98.8% (10 and more employees) (Telefónica Foundation).

• Energy Sources

Energy sources comprises in Castilla y León:

- **Coal**: 4 coal - based power plants
- **Cogeneration**: 6 combined-cycle plants, 69 engines and steam/ gas turbines
- **Biomass/Biogas**
- **Hydraulic energy**
- **Wind energy**: 227 wind farms
- **Solar energy**

There was also a **nuclear plant** in operation from 1970 to 2012, nowadays in process of dismantling.
Breakdown by source of installed power/electricity produced in 2017 is:

Source	Power (MW)	Production (GWh)
Wind	5,591	11,132
Hydraulic	4,401	4,332
Coal	2,734	6,910
Solar	495	910
Cogeneration	494	2,362
Biomass/Biogas	47	276
TOTAL	13,762	32,424

Table 8.3: Data for the type of energy source, power (MW), and production (GWh), respectively.

Renewable energy sources (wind, hydraulic, solar energies and biomass/biogas) represented in 2017, with the 78% of the installed power (10,534 MW) and the 64% of the electricity generated (16,649 GWh) in Castilla y León. The region is **leader** in renewables energies in Spain, both in **installed power** (21.9%) and **production** (19.3%), especially in **wind energy** (24.2% of the national installed power and 22.9% of the national production) and **hydraulic energy** (25.8% of the national installed power and 22.5% of the national production) (http://energia.jcyl.es/web/jcyl/Energia/es/Plantilla66y33/1261039021854/_/_/_).

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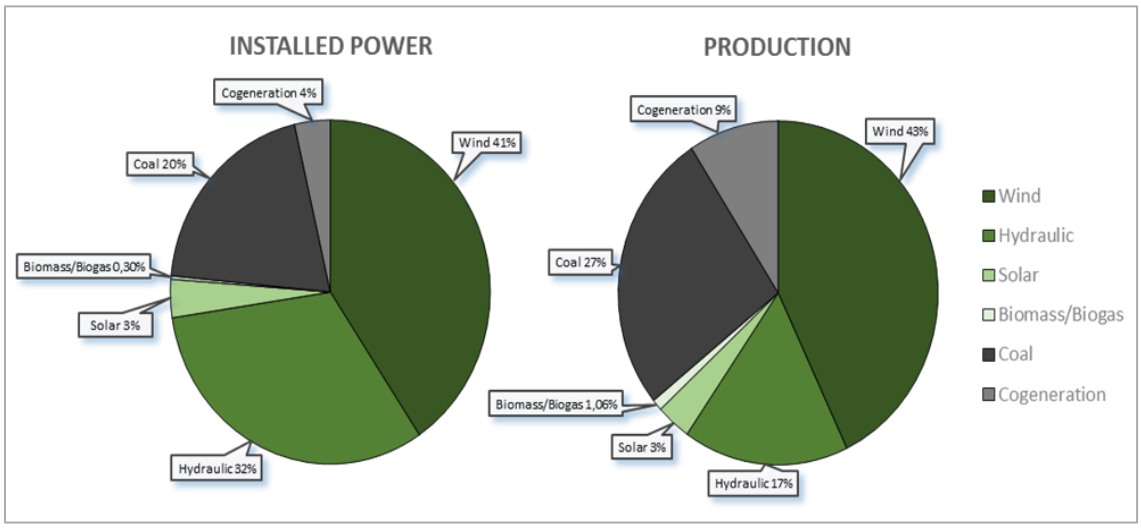

Figure 8.4: Pie charts with the share of conventional energy, and the share of renewable energy (indirect indicator for perception of mining and regional development regarding green economy) (http://www.ree.es/es/estadisticas-del-sistema-electrico-espanol/informe-de-energias-renovables/informe-2017)

NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• National and Regional GDP

- GDP per capita

The following **Table 8.4** represents data for the GDP per capita, and GDP per capita in in €/inh.

Spain	GDP (M €)	GDP €/inh.
2005	930,566	21,300
2010	1,080,935	23,200
2016	1,118,743	24,100
2017	1,166,319	25,100
CyL	**GDP (M €)**	**GDP €/inh.**
2005	48,866	19,645
2010	55,558	21,827
2016	55,533	22,722
2017	57,094	23,555

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Table 8.4: Data for the GDP per capita, and GDP per capita in €/inh., for the country of Spain and the Region of Castilla y León. Source: EUROSTAT, INE (National Statistics Institute of Spain) (https://datosmacro.expansion.com/pib/espana https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736167628&menu=resultados&idp=1254735576581)

• National and Regional Employment Level

The following **Table 8.5** represents data related to employment, unemployment, and youth unemployment, for the country of Spain, and the Region of Castilla y León.

Spain	Employ.	Unemp.	Youth Unemp.[83]
2005	57.8	9.15	18.57
2010	60.28	19.86	42.8
2016	59.23	19.64	42.92
2017	58.84	17.23	37.5
CyL	**Employ.**	**Unemp.**	**Youth Unemp.**
2005	52.9	8.53	19.5
2010	55.08	15.8	34.01
2016	46.38	15.82	39.04
2017	47.06	14.08	36.24

Table 8.5: Employment, Unemployment, and Youth Unemployment, % as annual average. Source: EPA (Working Population Survey, carried out by the INE).

• National and Regional Economic Structure/Employment by Sector

The following **Table 8.6** represents the GDP, and Employment factor by type of activity, for the country of Spain and the Region of Castilla y León.

GDP/Spain	Agriculture	Industry	Construction	Services
2005	3.2	18.16	11.53	67.11
2010	2.55	17.17	8.84	71.44
2016	2.77	17.86	5.62	73.76
2017	ND	ND	ND	ND
GDP/CyL	**Agriculture**	**Industry**	**Construction**	**Services**
2005	5.57	20.33	10.06	64.05
2010	4.12	20.45	10.03	65.4
2016	3.77	20.74	6.71	68.79
2017	ND	ND	ND	ND

[83] Youth in Spain referss to 16-25 years

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Employment/Spain	Agriculture	Industry	Construction	Services
2005	5.31	16.48	12.01	66.2
2010	4.29	12.48	9.22	74.01
2016	4.46	11.83	5.51	78.2
2017	4.55	12.39	5.62	77.44
Employment/CyL	**Agriculture**	**Industry**	**Construction**	**Services**
2005	9.26	16.23	12.93	61.57
2010	6.16	13.5	9.32	71.02
2016	ND	ND	ND	ND
2017	ND	ND	ND	ND

Table 8.6: Data for the GDP, and Employment, by type of activity. Source: http://www.ine.es/prodyser/pubweb/anuarios_mnu.htm, https://estadistica.jcyl.es/web/jcyl/Estadistica/es/Plantilla100/1284165715006/_/_/_

• National and Regional Export Rate and Trading Partners

Regarding the foreign trade in 2017, at the national and regional level, it corresponds to the following values:

	Exports (M €)	Imports (M €)	Trade Balance (M €)
Spain	277,125.70	301,870.10	-24,744.40
CyL	15,597.60	12,703.60	2,894.00

Table 8.7: Data for the imports, exports and trade balance, for the country of Spain and the Region of Castilla y León.

At the national level, the main trading partners were:

Country	Exports (M €)	Country	Imports (M €)
France	41,636.80	**Germany**	38,896.00
Germany	30,946.50	**France**	33,331.30
Italy	22,243.00	**China**	25,661.90
Portugal	19,843.90	**Italy**	20,183.70
UK	18,950.30	**USA**	13,823.60
USA	12,461.50	**Netherlands**	12,487.10
Netherlands	9,549.20	**UK**	11,443.90
Belgium	8,258.10	**Portugal**	11,001.20
Morocco	8,024.80	**Belgium**	7,807.90
China	6,257.60	**Morocco**	6,284.10

Table 8.8: Data for the trading partners, at a national level.

In Spain, the three main industries in exporting activities were **Automobiles**, **Chemical Products** and **Automotive Components**; Metallic and Non-Metallic Minerals ranked at 12th position. In imports, the

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three industries were **Chemical Products**, **Fuel** and **Lubricants** and **Automotive Components**; Metallic and Non-Metallic Minerals ranked at 10th position.
In Castilla y León, the main trading partner in 2017 was France, with 3,969.6 M € in exports and 4,012.5 M € in imports. Other important trade partners were Germany, Belgium, Italy, UK and Portugal, with 0.5-1.5 M € in exports or imports. The main trading industries at the regional level were **Automobiles** (there are 2 Renault factories in Castilla y León), **Semi-processed** and **Intermediate Products**, and **Capital Goods** (https://www.icex.es/icex/es/Navegacion-zona-contacto/revista-el-exportador/en-cifras/index.html, https://www.ecova.es/docs/ConclusionesComExCyl.pdf

- **Short description regarding export and import situation of regional M&M industry**

Regarding to **Metallic** and **Non-Metallic Minerals** position, the foreign trade in Spain was in 2017 as follows (https://www.ecova.es/docs/ConclusionesComExCyl.pdf):

- **Exports**: 4,502.9 M €
- **Imports**: 5,274.1 M €

In Castilla y León, **Ores** and **Minerals** were traded as follows (coal and other energetic minerals are not included) (https://www.ecova.es/docs/ConclusionesComExCyl.pdf):

- **Exports**: 29.36 M €, 87 companies
- **Imports**: 23.85 M €, 119 companies

- **National and Regional Number of Registered Company**

The following **Table 8.9** represents the national and regional number of Registered companies, as well the SME (range from 1 to 199 employees) percentage (http://estadistica.jcyl.es/web/jcyl/Estadistica/es/Plantilla100Detalle/1246989275272/2/1284627187207/Comunicacion)

Spain	Total	SME (%)
2005	3,064,129	99.82
2010	3,250,576	99.24
2016	3,282,346	99.77
2017	3,337,646	ND
CyL	**Total**	**SME (%)**
2005	163,856	99.9
2010	166,509	99.9
2016	161,619	99.9
2017	161,986	99.9

Table 8.9: Number of Registered companies and SME percentage, for the country of Spain and the Region of Castilla y León.

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REGIONAL INFORMATION IN M&M INDUSTRY

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• Short Description of Regional M&M Sector

According to Mining Statistics of Spain, the recent evolution of the sector, in terms of number of exploitations, employment and value of production is represented at the **Table 8.10**, that follows:

Spain	Nº exploitation	Employment	Value of production (€)
2005	4,227	45,292	3,984,819,949
2010	3,612	37,698	3,427,175,777
2016	2,807	29,520	2,890,403,155
CyL	**Nº exploitation**	**Employment**	**Value of production (€)**
2005	647	7,661	568,933,147
2010	580	6,390	404,776,824
2016	449	3,515	290,438,589

Table 8.10: Data for the number of exploitations, employment and value of production, for the country of Spain and the Region of Castilla y León. Source: https://www.mincotur.gob.es/energia/mineria/Estadistica/Paginas/Consulta.aspx

According to the last published data (Mining Statistics of Spain), in 2016 there were **449 active exploitations** with **3,515 employees** and a **total value of production of 290,438,589 €**, for the Region of Castilla y León. Compared with the national context, these numbers represent the **16.0%** (exploitations), **11.9%** (employment) and **10.1%** (production value), of the country's values.

The breakdown by sectors is as follows (data for the year of 2016):

Sector	Nº Exploitation	Employment	Value of Production (€)
Energetics	8	292	15,817,378
Metallic Minerals	1	137	ND
Industrial Minerals	19	505	129,170,256
Ornamental Minerals	94	1,169	70,073,756
Quarry Products	327	1,412	63,705,099
Total	449	3,515	290,438,589

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Table 8.11: Data for the year of 2016, for the number of exploitations, employment and value of production, for the Region of Castilla y León.

- **Energetics**. In 2016, there were still active 7 coal exploitations (mainly anthracite) and 1 of oil/gas. Coal mining has kept a strong activity in the northern provinces of León and Palencia since the last decades of the 19th century. Many villages in and around the coal basins have a **strong economic dependence** of this kind of mining. Nevertheless, the coal mining activity began to decline in the 90's; in addition, policies intended to reduce the emission of greenhouse gases have limited dramatically the production of coal (219,152 t in 2016). The **oil/gas exploitation**, in production since 1967, has today a limited production as well, even though it is an area with an **interesting potential** for non-conventional hydrocarbons. There is an **advanced project** of uranium in Salamanca province that could be in production in a short term (there was a U mine in operation in 1974-2000).

- **Metallic minerals**. Nowadays, there is **only one active exploitation** (Los Santos W mine) that represent around the 90% and 25% of the national and EU **tungsten production** respectively. A new tungsten mine (Barruecopardo W mine) is expected to start operations in 2019. Both exploitations represent, as well as other advanced projects, the resurgence of the W-Sn mining in western provinces (Salamanca and Zamora), very active along the 20th century. On the other hand, there are **advanced projects of iron, lead-zinc** and **tin-tungsten** that could be in production in a **medium term**. Furthermore, there is an interesting potential for **mining exploration** of **copper, cobalt, nickel, gold** and **some other metals** that were exploited in the past.

- **Industrial Minerals.** Industrial minerals represent in Castilla y León the **44.5%** of the value of production. The most outstanding activities in this field correspond to the exploitations of glauberite (Na-Ca sulphate) in Burgos and K-feldspar in Segovia; in both cases, Castilla y León is the **national leader** in production in Spain. It is also remarkable a magnesite exploitation in Soria province, started up in 2015, that represents the 25% of the national production. There is also an **interesting potential** for mining exploration of talc, graphite, lithium, e.tc.

- **Ornamental rocks.** The most remarkable is the roofing slate sector, in which Castilla y León represents **1/3** of the **national production**, and Spain is the **world's largest producer**. Roofing slate companies are mainly located in León province and their products are mostly sold (> 90%) on international markets. There are producers of some other kind of rocks, but the slate sector clearly stands out in terms of employment (75 %) and value of production.

- **Quarry Products.** This category groups the aggregates and some industrial minerals related with the construction sector (e.g. gypsum and clays for tiles). This kind of RM represents the 73% of regional exploitations and the 40% of jobs. It is the **most geographically widespread** as well. In the last years, a **strong crisis** has badly affected the construction sector and the production of related RM, mainly quarry products but also ornamental rocks (except for the roofing slate). This crisis led to the reduce of exploitations and jobs.

Additionally, there are mineral resources, such as **springs** and **thermal waters**, both ruled by the Spanish Mining Act. There are in Castilla y León 18 bottling plants and 12 thermal baths, with a total turnover of 100 M €/yr (bottling plants) and 20 M €/yr (thermal baths).

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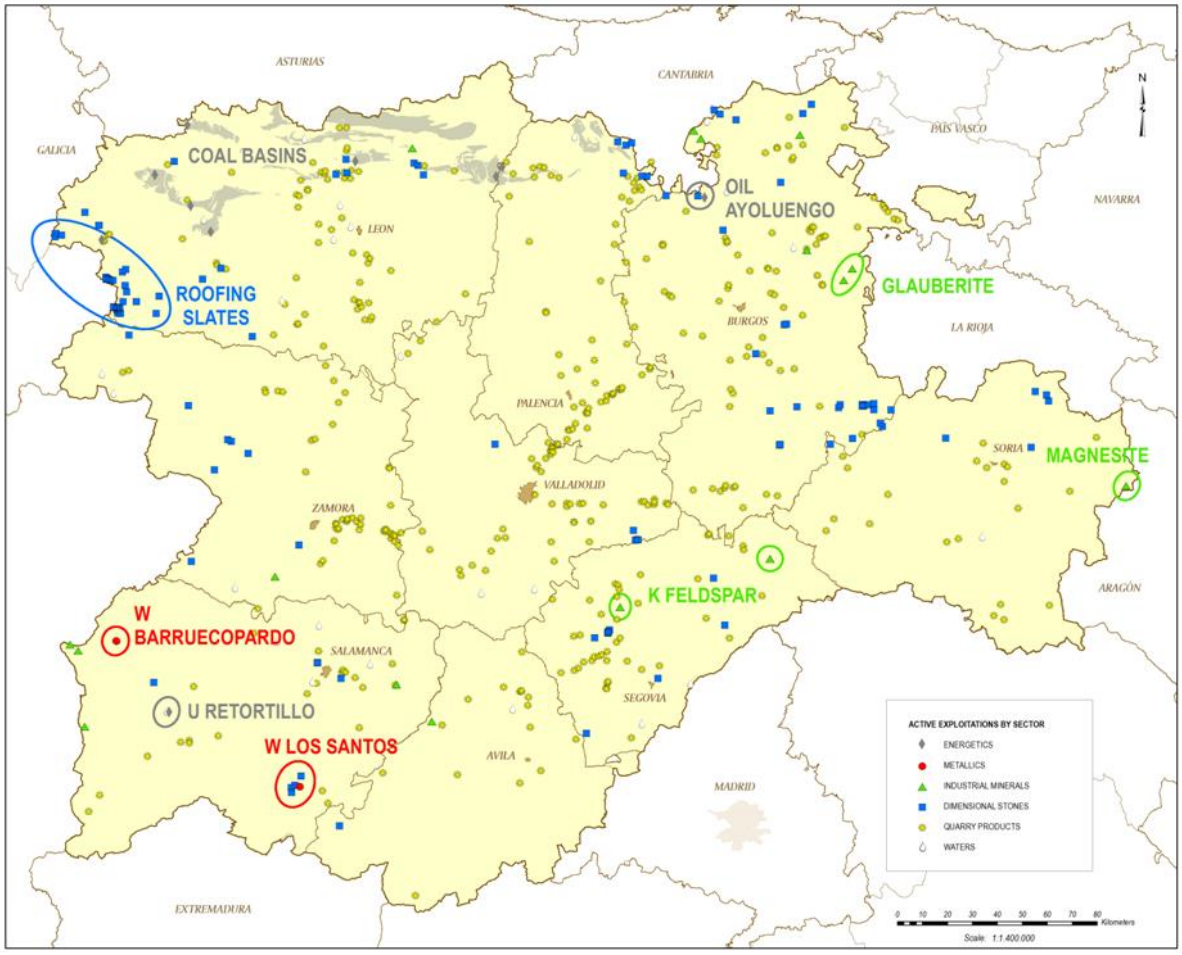

Figure 8.5: Geographic distribution of mining exploitations in the Region of Castilla y León

• Short Description of Obstacles for Establishing Mining Industry

Regarding the **time context** to obtain permits, it is characterized as excessive, because permitting processes require the participation of several parts of the administration (Mining, Environment, Waters, Heritage, Urbanism, etc.). In this sense, **regulatory aspects** are improvable, while an update of the **Mining Act** would be desirable to boost the mining industry.

Land use planning is sometimes an obstacle for access to mining resources. This planning that constitutes an obstacle, can be related to **environmentally protected areas** or with **urban development plans.**

In Spain there is a number of **protected spaces** with **different legal status** (Natural Park, National Park, Natural Reserve, Natural Monument), that constitute the Spanish Natural Spaces Net (REN). Areas in this net has a legal instrument (PORN) for zoning and classifying in different categories the whole protected surface and, depending on the category, mining activities can be admissible (usually with restrictions) or prohibited. The REN in Castilla y León represent a total protected surface of 7,983.42 km^2; in 3,910.78 km^2 of this surface (the 48.99%) mining activities are prohibited and in the remaining are allowed with more or less restrictions.

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Figure 8.6: REN (Natural Spaces Net) in Castilla y León

Obstacles can be harder in the case of **urban planning**. According to the Law of Urbanism, municipalities can classify rural lands of the whole municipal territory in **10 categories**. One of them is dedicated to Extractive use and it is implemented in specific cases of ongoing exploitations. There is another Common use category in which extractive activities are admissible. However, in the remaining 8 categories the mining activity is banned, even with a positive Environmental Impact Assessment; to set up exploitation in these kinds of land it is needed to apply for an urban rezoning to the Common or Extractive categories. The rezoning process can last 2 years or more, depending on the municipality, and not always it is achieved. That represents currently the main obstacle for the mining activity since this Law of Urbanism rules over the whole territory (even though not all the municipalities have developed their own municipal land use planning yet). The General Directorate of Energy and Mines has started conversations with the competent administration to correct this **negative effect** on the mining industry and it waits for a modification on the Law of Urbanism can be achieved.

Out of the **land use planning issues**, there are some cases in which mining and other industries are competing for the land use, although they are not common situations. For example, in Castilla y León there were some cases of coincidence of mining projects and wind farms. In other regions in Spain there were **conflicts** with mining and other land uses such as tourism, hunting, livestock, etc.

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Another important obstacle is the **social opposition**. Movements against the setting up of new exploitations have a great impact on the public opinion and the media, and sometimes they influence in the **policy - making**.

• Short Description of Chances for Establishing Mining Industry

Regardless of the RM market conditions, chances could be related to the **mineral potential**. Castilla y León is a **large region** (the 3rd largest region in the EU) with a **varied geology**, and a **wide, diverse mining potential**. Around 50 different metallic ores, industrial minerals and ornamental rocks have been or are being exploited, and there might be resources yet to be discovered.

The general characteristics of the **population** (skilled workforce, medium-low density of population), the **transportation system** (railway, roads, tracks, etc.), the **geological knowledge** (all the territory at 1:50,000, as well as specific studies, thesis, etc.), the **legal security** (including environmental aspects), the **companies of services** (drilling, geophysics, etc.), and the **facilities** in general (nets of electricity, water, gas, etc.) are very **attractive** for foreign and domestic mining companies.

On the other hand, there are chances related to the **regional policies**. In Castilla y León there is a **specific Plan** for the **Economic Development of Mining Municipalities**, which includes financial support for mining projects alternative to coal. The regional administration supports in general the implementation of **mining projects,** in order to create employment and wealth rural depopulated areas.

Another chance for mining companies, regarding the active exploitations, is the **Exhaustion Factor**, that constitutes a concept defined in the **Spanish Mining Act** (Ley 22/1973) and comprises **investments** on:

- Exploration of new mineral deposits
- Research to improve the recovery or the quality of the products
- Research to obtain a better knowledge of the deposit resources
- Acquisition of shares in mining exploration/research companies
- Laboratories or research equipment for mining activities

These **investments** reduce the taxable base of the corporate income tax (25% of the company profits), with a limit of the 30%. This represent an accounting gain for the company, and it is the reason for what mining companies account for these investments as Exhaustion Factor.

• Regional GDP of M&M Industry

- Regional GDP of M&M industry
- Regional GDP of M&M industry per capita

Spain	Mining GDP (€)	GDP per capita (€)
2005	3,984,819,949	90.54
2010	3,427,175,777	73.44
2016	2,890,403,155	62.12
CyL	**Mining GDP (€)**	**GDP per capita (€)**
2005	568,933,147	226.59
2010	404,776,824	158.15
2016	290,438,589	118.67

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Table 8.12: Data for the economic factors of Mining GDP, and GDP per capita, for the country of Spain, and the Region of Castilla y León.

• Support from Regional and/or National Government

The relevant administrative, private companies and research institutes (excluding cluster organizations and associations.

- Regional Directorate for Energy and Mines
- SIEMCALSA
- ICAMCYL
- Institute for Enterprise Competitiveness (ICE)
- Geological Survey of Spain (IGME)
- Fundación Sta. Bárbara
- Univ. León (School of Mines)
- Univ. Salamanca (Faculty of Geology)
- Univ. Burgos (ICCRAM)

In Spain, the State has the competences in basic legislation, and the regions (autonomous communities), are in charge of the general management and the detailed legislative developments. In Castilla y León, the administration in charge of mining issues is the Mining Service, which is a part of the General Directorate for Energy and Mines, which is, in turn, part of the Regional Ministry of Economy and Finance.
Castilla y León has 9 provinces, and each one has a delegation of the regional administration, including a provincial Section of Mines, in charge of the daily management of the mining procedures (really, there are 10 Sections because there is an area –El Bierzo- with a mining activity especially important that has its own Section).

• Number of Registered M&M Company

- Number of registered M&M company

There is not specific data for this kind of companies. According to the last published Mining Statistics (2016), there are in Spain 2,807 active exploitations and 449 in Castilla y León. These data can give an idea about the amount of companies working in the mining sector.

- SME percentage in the registered M&M company

Employment	Exploitations (Spain)	Exploitations (CyL)
01-09	2,211	378
10-19	381	37
20-49	154	22
50-99	36	7
100-499	18	5
500 and more	7	0
Total	2,807	449

Table 8.13: Data for the employment, and number of exploitations, for the country of Spain and the Region of Castilla y León.

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Attending to the EU employment criteria (1-9 micro-company and 10-49 small company), 78.77% of the national mining companies are **micro-companies** and 19.06% are **small companies**. **Only** the 2.17% are **medium-large companies**.
In Castilla y León the situation is **similar**: 84.19% **micro-companies**, 13.14% **small companies** and 2.67% **medium-large companies**. Micro-companies are the 92% in Quarry products, the most atomized sector.

- Giant M&M company in region

There are not companies that can be described as giant in Castilla y León. In terms of employment (data from 2016), the biggest companies are those that exploit **tungsten** (Daytal Resources Spain, S.L.), **coal** (S.A. Hullera Vasco-Leonesa), and **glauberite** (Minera Santa Marta, S.A. and CRIMIDESA), with roughly 100-140 employees each one.
Nevertheless, some of the companies operating in Castilla y León are owned by "Grupos" (trusts or holdings) with activity in other regions. There is also the case of SAMCA with exploitations in Castilla y León and Aragón (glauberite, china clay, special clays, ceramic clays, K-feldspar). That occurs mainly in industrial minerals. Other companies, such as Daytal exploit in other countries. Therefore, having into account this point, there are probably several giant mining companies at the national or international level that develop a part of their activity in Castilla y León.

- Categorizing the companies by types, for instance, production service (consulting)

Companies described above are operators in charge of mining exploitations. There is some **consulting** in Castilla y Léon but there is not much available information about numbers or categories.

• Short Description of M&M Cluster and Association

Roughly, there are twelve **associations** at the regional or national level. Usually, associations group companies working in a same sub-sector or in a specific product. The most outstanding in Castilla y León are:

- CARBUNIÓN: national federation of coal mining companies
- CONFEDEM: national confederation of M&M companies
- COMINROC: national confederation of extractive industries of ind. min.
- AINDEX: national association of industrial minerals producers
- PINACAL: regional association of ornamental rock producers
- APICAL and APROPICALE: regional assoc. of roofing slate producers
- ANEFA: nationalassociation of aggregate producers
- AFARCYL: regional association of aggregate producers
- ATEDY: national technical and business association of gypsum
- OFICEMEN: national association of cement producers
- HISPALYT: national association of tiles and bricks producers

There are as well professional associations of geologists and mining engineers.
Recently, a regional Mining Cluster is being constituted, conducted by ICAMCYL and with the support of the regional administration, grouping together almost 40 regional and national companies of the mining industry and related services. This cluster will act as a vehicle to improve business competitiveness, and contribute to innovation, shared knowledge and integration of technological solutions to boost a new sustainable mining activity.

• Industries Closely Related to M&M

Industries directly related with mineral RM are: four thermal power stations, four cement plants, many concrete plants, one silicon carbide plant, one factory of absorbent products and several glass and

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ceramic (common brick & tiles and refractory bricks) factories, apart from the specific industrial facilities attached to the exploitation centres. Historically, there were also steel, ferroalloys and talc industries, nowadays closed.

Related to the RM supply from Castilla y León, there are also industries of tiles in the Spanish Mediterranean Coast (using CyL K-feldspar), glass in several parts of Spain and Portugal (with CyL silica and wollastonite), detergents and fertilizers in Spain (with CyL Na.sulphate and MgO respectively), ferrosilicon in Norway (with CyL silica gravel) and tungsten products in the USA.

• Short Description of Promotion of M&M Industry

Nowadays, the Regional administration promotes M&M industry from **5 perspectives**:

- **Administrative**, through activities carried out by the Mining Service. The most outstanding initiative is the **Regional Strategy of Mineral Resources** in Castilla y León 2017-2020; this Strategy has **3 main objectives**: 1. Administration (reconfiguring the administrative model to contribute to achieve improvements in the mining sector); 2. Mining Sector (boosting the improvement of the mining activities competitiveness which will develop the mining potential in Castilla y León); and 3. Society (improving the integration of mining activities in the whole society and its sustainable integration in the territory). Related with the coal mining there are two plans with founding capability: Plan MINER (at the national level), and the Plan for the Economic Revitalization of the Mining Municipalities (at the regional level);both plans are focused on the same mining areas and include founding opportunities for companies and infrastructures.
- **Exploration and promotion** of mining potential, through the Mining Exploration and Exploitation Company of Castilla y León (SIEMCALSA). Among its activities, it is worth to remark the exploration and promotion of some **mineral deposits**, such as the active Los Santos W mine, and publications such as The Mining Book of Castilla y León. SIEMCALSA participates as well in UE mining projects related with the promotion of the mining industry.
- **R&D activities**, mainly through the recently created ICAMCYL. This Institute has recently organized a Mining Cluster and will act as a nexus between the UE calls, promotions, activities, etc. and the mining companies in the region.
- Financial, through the Institute for the Enterprise Competitiveness (ICE). As ICAMCYL, the ICE plays an important role in the engagement of the mining companies in R&D+I programs and projects, and it has financial capacity to support that kind of activities.
- Training, through the Santa Bárbara Foundation. This regional institution organizes training courses and some other activities related with the mining industry.

• The Role of Metallurgy Plays in the Regional Circular Economy

- Regardless the mining companies themselves, there are some companies focused on **recycling activities**. For instance, the case of the company **BEFESA**, engaged in the Al - recycling.

• Short Description of Networking Potential

- All the institutions above, they are already engaged in **collaborative projects** at the EU level (H2020, ERAMIN, Interreg, etc.), so there is an interesting potential for **expand networking** on this basis. Furthermore, the recently created **Cluster of Mining** will serve to strengthen the networking among mining companies, but also with Institutes and Administration.

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9.REGIONAL GENERAL BACKGROUND INFORMATION (ALENTEJO, PORTUGAL)

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• Capital

- The capital of Alentejo Region (NUT II) is Évora

• Area (km²)

- 31,604.90 km² (INE, 2017)

• Population

- Number of Inhabitants
- Age Structure
- Net Migration Rate

According to **Table 9.1** the number of inhabitants in Alentejo Region decreased from 2001 to 2017.

Year	2001	2006	2010	2016	2017
Alentejo Region	776,585	764,285	749,055	718,087	711,950

Table 9.1: Evolution of the number of inhabitants in Alentejo from 2001 to 2017 (INE, Anuário Estatístico da Região Alentejo 2001, 2006, 2010, 2016, 2017)

According to the collected data (**Table 9.2**), in 2017, persons with age between 15-64 years accounted for 52% of the Alentejo Region total population.

Years	0-14	15-24	25 - 64	≥ 65
Alentejo Region	13%	10%	52%	25%

Table 9.2: Age structure (INE, 2017)

Similar to other regions in Portugal, also Alentejo is experiencing growth in the number and proportion of older persons in its population (**Table 9.3**).

Year	2001	2006	2010	2016	2017
Alentejo	167,9	171,6	173,4	194,7	199,2

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Table 9.3: Aging index[84] (INE, Anuário Estatístico da Região Alentejo 2001, 2006, 2010, 2016, 2017)

• Optional: Urbanisation Rate

In Alentejo Region the urbanization rate, considering the places with a population of 2,000 or more inhabitants, reached 49,8% in 2001, which is relatively close to the national average (54,8%), in particular the Central Alentejo (56,1%) by influence of the city of Évora(MAOTDR, 2007).

• Short Description of Indigenous Group

- There are no indigenous groups in Alentejo Region.

• Industries based on Natural Resources, M&M

- Short description on regional M&M (pyro- and hydro- metallurgy) industries
- Ranking of the natural, M&M industries based on the acceptance of the public
- The main job creator

In Alentejo, there are considerable reserves of ornamental rocks (marble, granite and schist), aggregates, and metallic minerals (with emphasis on the resources of the pyrite range of Baixo Alentejo) (CCDR, 2014).
Table 9.4 presents the main occurrences/deposits each site in Alentejo region. Note that, it may occur more than one secondary substance in each site.

Substances and/or Metals	Nº occurrences
Asbestos	4
Arsenic (As)	1
Lead (Pb)	21
Coper (Cu)	85
Tin (Sn)	2
Feldspar	1
Iron (Fe)	63
Phosphorus (P)	10
Manganese (Mn)	102
Molybdenum (Mo)	1
Gold (Au)	35
Pyrite (FeS2)	6
Silicon dioxide (SiO2)	15
Tungsten (W)	3
Uranium (U)	39

[84] The ratio of the number of elderly persons of an age when they are generally economically inactive (aged 65 and over) to the number of young persons (from 0 to 14).

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Zinc (Zn)	9
Zirconium (Zr)	2

Table 9.4: Occurrences / Deposits of metallic and non-metallic substances, in the Alentejo region (SIORMINP database LNEG, 2019).

Regardless of it size there is a clear dominance of **copper, manganese** and **iron** number of occurrences/deposits. Yet, according to the same database, the biggest deposits in Alentejo Region are of **copper** and **zinc** and this are located in **Aljustrel** and **Castro Verde municipality**. **Figure 9.1** below presents the mineral occurrences in the Alentejo with information regarding the location of active mining[2].

Iberian Pyrite Belt
Active mining:
1. Neves Corvo (Somincor/Lundin Mining)
2. Aljustrel (Almina)

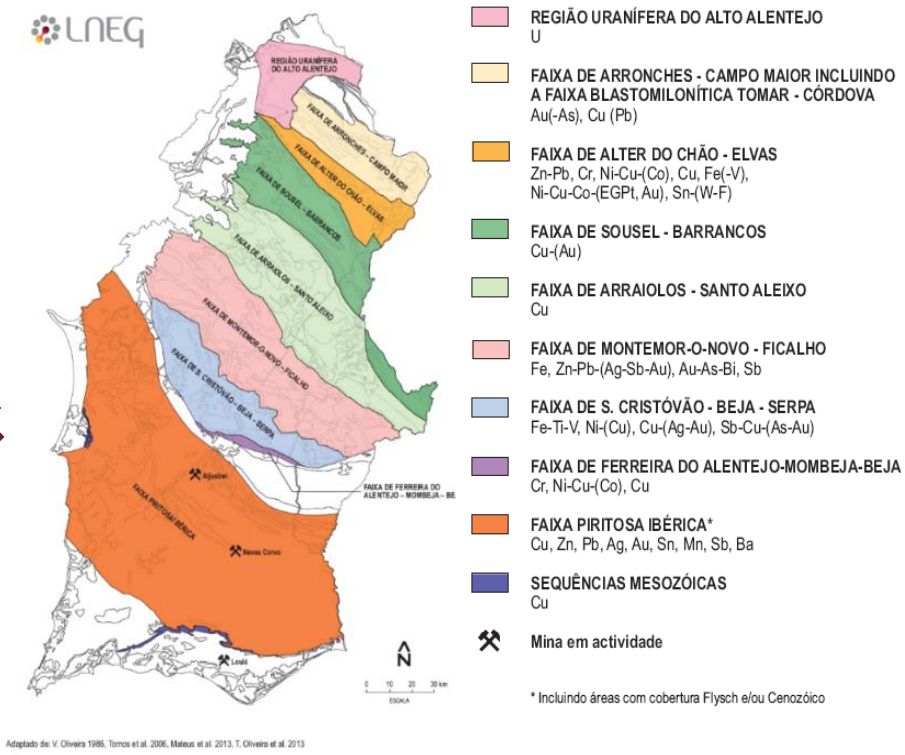

Figure 9.1: Regions with metalliferous potential in South of Portugal (LNEG, 2006)

According to INE (2017) in 2016 in Alentejo Region there were 3,199 th people working in M&Q. The main job creator in the mining sector in Alentejo is Somincor. In 2017, Somincor employed 1,700 th people (1000 employees and 700 contractors) (Lundin Mining, 2017).

[2] Alentejo and Algarve mineral occurrences map Atlanterra project, EU Interreg Atlantic Area, Matos and Filipe Eds, LNEG 2013 http://www.lneg.pt/download/7904 (Presentation from CCDRA, the 2nd MIREU SLO Workshop)

- ## Infrastructure

According to the study developed by Carvalho et al. (2009) the Alentejo Region has good road accessibility, with a reasonable set of motorways. In the Alentejo Region, important infrastructures such as IP8 (Sines / Beja / Spain) and IC33 (Sines / Évora / Spain) cross the main urban centers. The use of the

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car as a means of transport has been reinforced, to the detriment of buses. The car is the means of transport used by 63.5% of the population of the Alentejo Region in the trips from home to work or from home to the place of study. This means of transportation grew 16.3% between 2011 and 2012. The collective transport system, in 2011 the bus was used only by 7.2% of the population in the home / work or study place (Carvalho et al., 2009).

The current railway network links the major cities of Alentejo to Lisbon. The existing lines have been updated, electrified and improved in terms of safety. Major investments in the improvement of the cross-border section Évora-Elvas/Caia (Spanish border) as part of the rail freight axis between Sines-Elvas-Madrid-Paris is expected to be functioning by 2021. Design studies include works for the renewal of the stretch Évora-Évora Norte as well as the construction of the new railway line between Évora Norte and Elvas/Caia (border with Spain).This new interoperable line will allow the movement of 740m freight trains and will be designed for high-speed (over 250 km/h),
The line will be part of the Atlantic corridor which is part of a Global Project that aims to develop a high-capacity freight and passenger railway axis linking Portugal with Spain and the centre of Europe in order to support economic growth and the regional development of the concerned regions. It will also promote modal split, increase the competitiveness of the port of Sines and serve several logistic platforms, including Minas de Neves Corvo .
Port of Sines is a deep-water port with several types of terminals, fishing port and recreation considered the "Atlantic Port of Europe". The port and the industrial and logistic area have good access roads and railways, creating an infrastructure of international choice (Carvalho et al., 2009). In 2011, Beja Airport opened (Freitas, 2012). This infrastructure is an important reference for the region in terms of the aeronautical cluster[3].

[3] provided by CCDR-Alentejo 30 May 2019

• Energy Sources

Portugal is mostly dependent on **energy imports**. Most of the coal imported at Sines Port is used at the Sines Power Plant to produce most of the national electric energy. There is a **relevant shift** towards the decarbonisation of the Portuguese economy through the sustainable use of the endogenous resources: wind, sun and water. In Alentejo, by 2020 it is expected that around 15% of all energy in the region will be produced from renewable sources, and by 2050, with the change between coal to Natural Gas, the region will be able to maximize its natural renewable resources to produce energy (Guilherme and Fialho,2017).

		2009	2010	2011	2012	2013	2014	2015
Renewable	Tep	91.581	158.724	157.132	113.616	195.043	191.606	161.954
	%	10	22	18	11	19	19	14
Non-renewable	Tep	**871.221**	**553.052**	**731.862**	**893.249**	**839.558**	**834.303**	**967.126**
	%	**90**	**78**	**82**	**89**	**81**	**81**	**86**
Total	Tep	962.802	711.776	888.994	1.006.865	1.034.601	1.025.909	1.129.080

Table 9.5: Production of electricity through renewable and non-renewable sources in Alentejo Region (DGEG, 2009-2015)

In **Table 9.6** corresponding to the installed power by typology in Alentejo it is possible to confirm that with the implementation the planned projects, the installed capacity of renewable resources in the

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region will triple its value (from 162.14 MW to 680.98 MW) (Guilherme and Fialho, 2017). **Figure 9.2** presents the sources of Energy and power installed in Alentejo.

Source of energy production	Current Power	%	Current and Future Power	%
Biogás Total	3.64	0.35	3.64	0.23
Eólica Total	117.3	11.2	117.3	7.49
Photovoltaic Total	162.14	15.48	680.98	43.48
PCH Total	40.2	3.84	40.2	2.57
Grand Hydric Total	723.9	69.13	723.9	46.23
Total Geral	1 047.18		1 566.02	

Table 9.6: Evolution of installed power by type in Alentejo (MW)
(e2p, 2017 and CCDR-Alentejo, 2017 (AInca 23 a 26 e 28 a 32, 1ºS 2017)

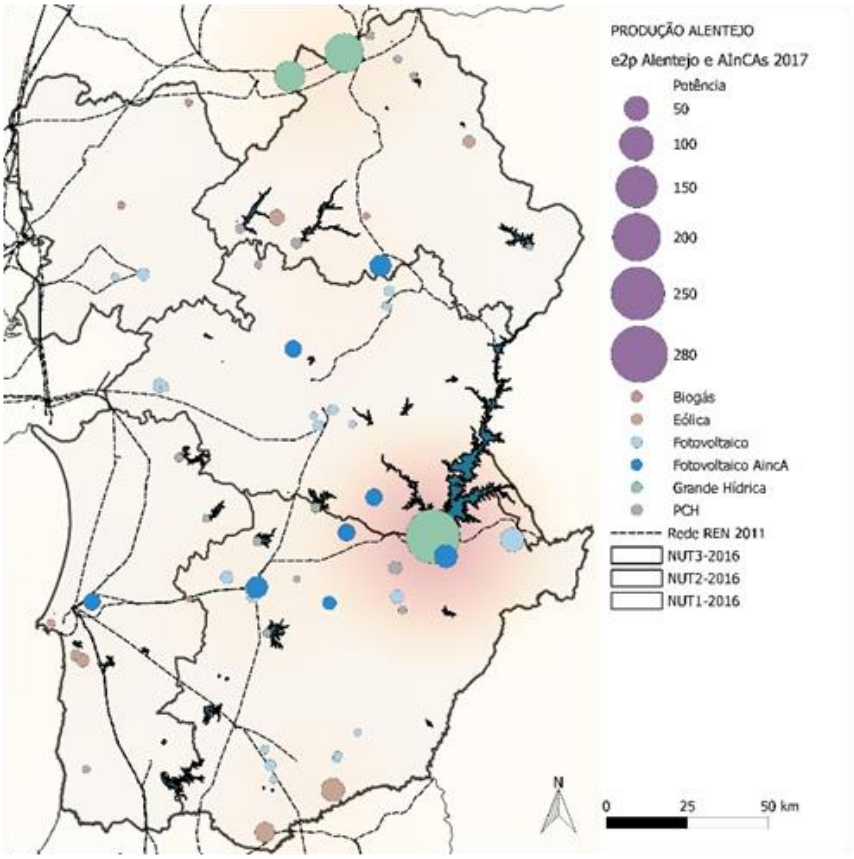

Figure 9.2: Sources of Energy and power installed in Alentejo (2017)

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NATIONAL AND REGIONAL ECONOMY INDICATORS

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• National and Regional GDP

The Portuguese GDP grew from 2001 to 2017. The same happened with the GDP in Alentejo Region although it grew in a slower pace (**Table 9.7**).

Year	2001	2004	2010	2016	2017
Portugal	122,801	144,128	172,859	186,480	194,613
Alentejo	5,043	9,722	11,252	12,120	12,736

Table 9.7: GDP in M € (INE, Anuário Estatístico da Região Alentejo 2001, 2004, 2010, 2016, 2017)

In 2017, the Portuguese GDP per capita was 18,9 th €, which reveals an improvement in comparison to 2001, when it stood at 13,1 th €. GDP per capita in Alentejo Region shows similarities with the Portuguese one in the same period of analysis, with the value of 2001 being substantially lower than in 2017 (**Table 9.8**).

Year	2001	2004	2010	2016	2017
Portugal	13,1	14,5	17,0	18,1	18,9
Alentejo	12,0	13,4	15,5	16,8	17,8

Table 9.8: GDP per-capita (103 €) (INE, Anuário Estatístico da Região Alentejo 2001, 2004, 2010, 2016, 2017)

• National and Regional Employment Level

According to **Table 9.9**, employment rate in Portugal, although slightly, decreased between 2006 and 2016, and from 2016 to 2017 it increased again. Comparing to the national values the Alentejo Region has a lower employment rate, yet the region shows less variations presenting more stable values in this indicator in the same period.

Year	2006	2009	2010	2016	2017
Portugal	57,7	56,0	55,2	52,0	53,7
Alentejo Region	52,2	50,2	50,3	48,2	50,9

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Table 9.9: Employment rate (INE, Anuário Estatístico da Região Alentejo 2006, 2009, 2010, 2016, 2017)

As for unemployment rate it grew both in Portugal and Alentejo Region from 2006 to 2016 (**Table 9.10**). In 2017, this indicator presented a decrease for both levels of analysis in relation to the former year.

Year	2006	2009	2010	2016	2017
Portugal	4	9,4	10,8	11,1	8,9
Alentejo Region	6,9	10,5	11,4	12,1	8,4

Table 9.10: Unemployment rate (INE, Anuário Estatístico da Região Alentejo 2006, 2009, 2010, 2016, 2017)

According **Table 9.11**, youth unemployment rate increased both at national and regional level from 2006 to 20016. In 2017, there was a decrease in both levels of analysis in relation to 2016.

Year	2006	2009	2010	2016	2017
Portugal	16,3	20,0	22,4	28,0	23,9
Alentejo Region	15,1	20,7	28,9	30,8	24,4

Table 9.11: Less than 25 years old unemployment rate (INE, Anuário Estatístico da Região Alentejo 2006, 2009, 2010, 2016, 2017)

- ## National and Regional Economic Structure/Employment by Sector

In Portugal and Alentejo Region, in 2018, most people worked in the tertiary sector (**Table 9.12**). As for the primary sector both Alentejo Region and Portugal had a low proportion of people working in this sector in the same year.

	Sector		
	Primary	Secondary	Tertiary
Portugal	6%	25%	69%
Alentejo Region	11%	20%	68%

Table 9.12: People employed by sector of activity 2018 (in thousands) (Pordata, 2019)

Most of the Alentejo Region is dedicated to agriculture becoming increasingly mechanized, facilitated by the larger size of farms in the region (with an average size of more than 60 hectares) (EURES, 2018). Forestry (and, in particular, cork oak and cork extraction) is also an activity of particular economic importance for the Alentejo Region: this is the region with the most important area of cork production in the world. In this sense, and in spite of the losses of employment in the agricultural sector in recent years, this activity represented 11%, of employment in the region in 2018(EURES, 2018). In Alentejo Region, the secondary sector, represented almost 20% of the employed population in 2018. There is a certain level of industrial specialization, associated with agro-food industries (manufacture of cheese,

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wines and smokestacks, with DOP certification), chemicals and petroleum products (the latter associated with the Sines industrial complex), components for automobiles and airplanes and electronic components(EURES, 2018).

• National and Regional Export Rate and Trading Partners

According to INE (2019) (**Table 9.13**) the coverage rate of imports by exports has been increasing in Portugal from 2013 to 2018. As for Alentejo Region this indicator presents slight variations from 2013 to 2018 recording a maximum value of 135,63% in 2016 and a minimum value of 129,27% in 2015.

Year	2013	2014	2015	2016	2017	2018
Portugal	82,97	81,4	82,25	81,46	78,95	77,24
Alentejo Region	134,08	129,65	129,27	135,63	129,85	132,68

Table 9.13: Coverage rate of imports by exports from 2013 to 2018 (INE, 2019)

In 2010, 2017 and 2018 Portugal's main export and import partners were Spain and Germany (**Figure 9.3**) (**Figure 9.4**). France is also an important exports partner for Portugal.

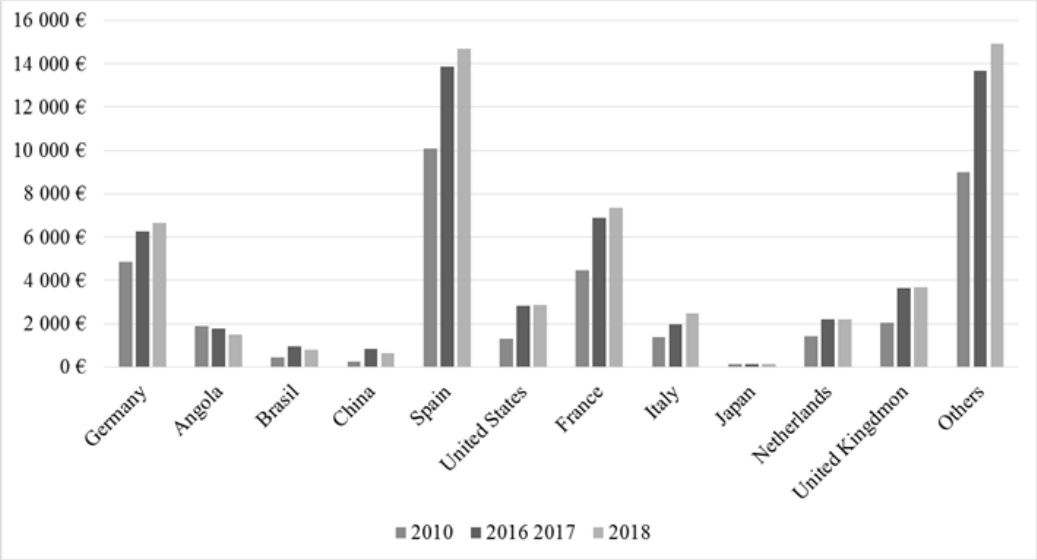

Figure 9.3: Exports of goods by major trading partner country (Euro – Millions) (Pordata, 2019)

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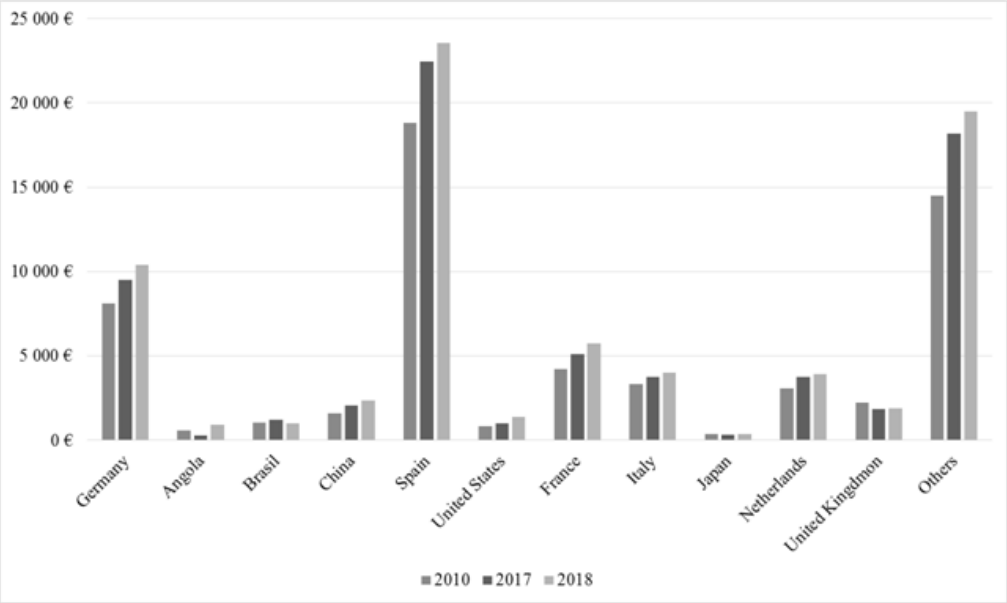

Figure 9.4: Imports of goods by major trading partner country (M €) (Pordata, 2019)

As for the value of exports of ores and other products of the extractive industries although these products show oscillation in the value exported (**Figure 9.5**) globally the value has increased along the years. Recently from 2013 to 2016 the value of export of ores and other products of the extractive industries has slightly decreased.

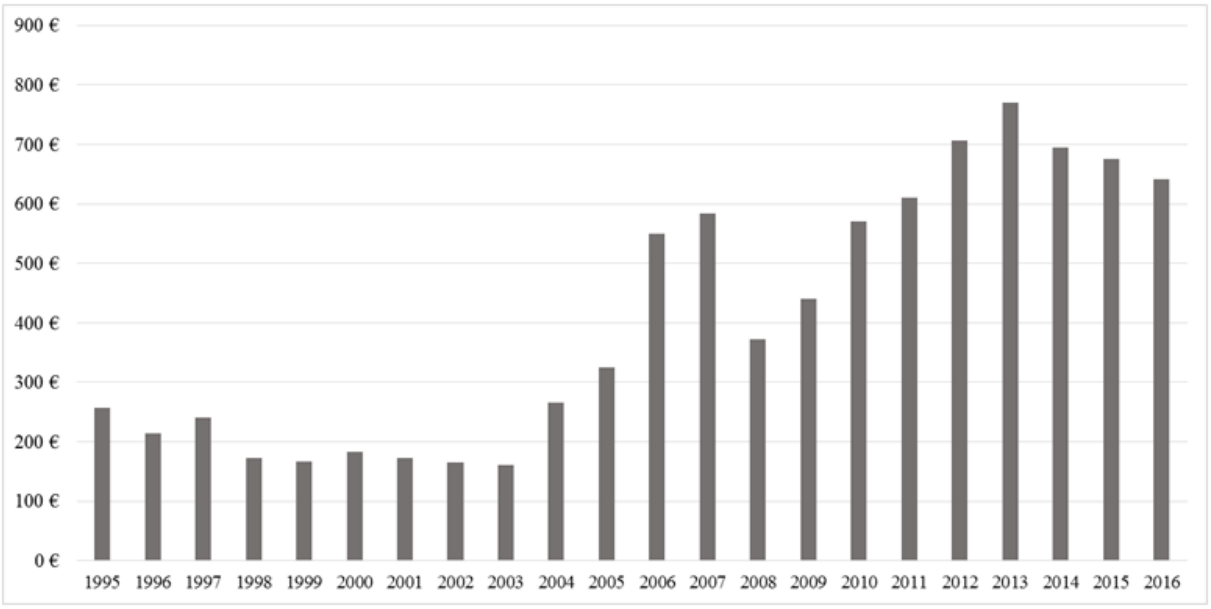

Figure 9.5: Exports of ores and other products of the extractive industries in M € (Pordata, 2019).

In Alentejo Region, Almina was awarded the prize for best Large Export Company Transactible Goods in 2018. In terms of markets, the copper produced by Almina goes mainly to Asia, with special emphasis on China. As for the exports of zinc they are mostly sold in Europe, and just a smaller percentage goes to China. [4]

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[4] Retrieved from https://www.jornaldenegocios.pt/negocios-iniciativas/premios-exportacao---internacionalizacao/detalhe/almina-uma-aposta-dupla-no-cobre-e-zincoaccessed in 20 May 2019

• National and Regional Number of Registered Company

Portugal presents a decrease in the number of companies between 2009 and 2010 and from that period on the number of companies grew until 2017 (**Figure 9.6**).

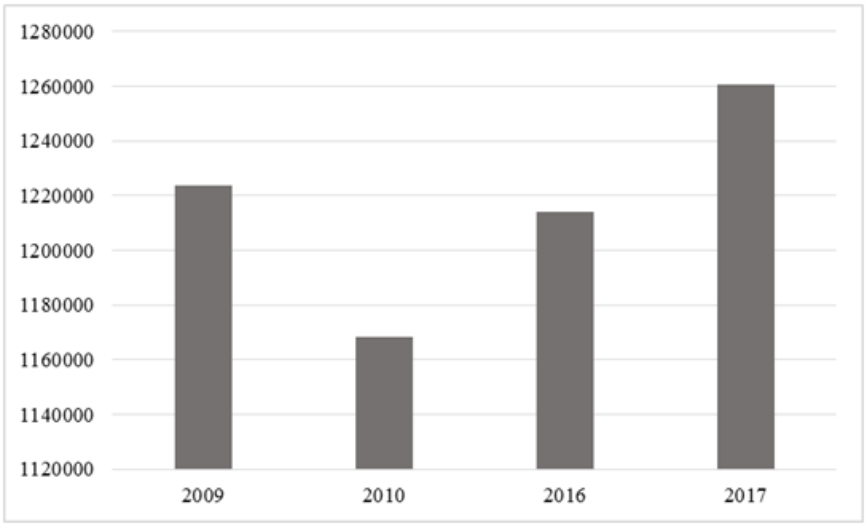

Figure 9.6: Evolution of the number of companies in Portugal (Pordata, 2019)

Regarding the number of non-financial companies, the number decreased both in Portugal and in Alentejo Region from 2009 to 2016. Between 2016 and 2017 the number reverse this tendency both in Portugal and in Alentejo (**Table 9.14**).

Year	2009	2010	2016	2017
Portugal	1,199,843	1,145,390	1,196,102	1,242,693
Alentejo Region	84,630	81,427	81,853	84,139

Table 9.14: Total number of non-financial companies (Pordata, 2019)

However, in relation to the number of non-financial companies in the extractive industry, in the same period, it decreased both in Portugal and in Alentejo Region (**Table 9.15**).

	Extractive industry			
Year	2009	2010	2016	2017
Portugal	1,423	1,323	1,045	1,062
Alentejo Region	212	190	190	187

Table 9.15: Total number of non-financial companies in the extractive industry (Pordata, 2019)

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According to the National statistics office in 2017, in Portugal, 99,9% of the companies were SMEs. For the same indicator there is no regional data available.

REGIONAL INFORMATION IN M&M INDUSTRY

[Regarding the quantitative data varied throughout the years, it is recommended to present data from 2005, 2010, 2016 and 2017. The series of data is expected to provide an observable trend. The specific years are selected considering the global financial crisis in 2007/08 and the Eurozone crisis 2009/13.]

• Short Description of Regional M&M Sector

According to the available data from the General Directorate of Energy and Geology (DGEG) between 2011 and 2016 there were two active mines in Alentejo Region (**Table 9.16**).

District	Municipality	Company	Mine	Main substance	Collaborators
Beja	Aljustrel	ALMINA - MINAS DO ALENTEJO, S.A.	ALJUSTREL	Concentrates of copper ores	1050 in 2018[5]
	Castro Verde	SOMINCOR - SOCIEDADE MINEIRA DE NEVES - CORVO S.A.	NEVES CORVO	Concentrates of copper ores	1700 in 2017 (Lundin Mining, 2017)

Table 9.16: Mines in Alentejo Region (DGEG, 2019)

[5] Retrieved from https://youtu.be/Kx1s-Qi_hQY, accessed in 20 May 2019
Besides concentrates of copper ores Aljustrel and Neves Corvo mines are producers of zinc in the Alentejo Region, more specifically in the Portuguese sector of the Iberian Pyrite Belt, host of many giant metallic deposits (Martins, 2012).
A new mining site at Grandola promoted by REDCORP- EMPREENDIMENTOS MINEIROS, LDA. (85%) e EDM – Empresa de desenvolvimento Mineiros, SA. (15%) - Mina de Lagoa Salgada - is undergoing the environmental impact assessement. This mining site is expected to produce copper, lead, zinc, gold, silver, tin and other metal ores. [6]
[6] Data provided by CCDR-Alentejo in 30 May 2019

• Short Description of Obstacles for Establishing Mining Industry

Alentejo is a low-density region but with a high level of protected natural areas that induce special attention towards their environmental impact and to the social license to operate. Licenses are long technical and administrative procedures.[9]

• Support from Regional and/or National Government

In Alentejo Region, the Center for Geological and Mining Studies of Alentejo (CEGMA), belonging to the National Laboratory of Energy and Geology (LNEG) has an important role on supporting research activities[8]. CEGMA focuses its research applied to prospecting and has ongoing projects with Somincor and with Évora University. CEGMA has also been carrying out research on mining waste and, according to its director, this is one of the areas that may lead new collaborations in the region.
[8] http://www.lneg.pt/divulgacao/noticias-institucionais/218

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- **Number of Registered M&M Company**

- Number of registered M&M company
- SME percentage in the registered M&M company
- Giant M&M company in region
- Categorizing the companies by types, for instance, production service (consulting)

Although no data is available on the number of M&M companies registered in Alentejo Region, between 2014 and 2019. 22 prospecting and research license were granted to 13 companies in Alentejo Region (**Table 9.17**).

Prospecting Company	Municipality	Substance
Acúrcio Henriques Parra, Lda.	Monforte, Estremoz, Elvas, Vila Viçosa, Alandroal	Cu, Pb, Zn, Au, Fe, associated minerals
AHP- Acúrcio Henriques Parra, Lda.	Arronches e Portalegre	Zr, Hf, Ti, other metallic minerals
Almina — Minas do Alentejo, S. A	Aljustrel, Beja, Castro Verde e Mértola	Au, Ag, Cu, Pb, Zn, Sn and associated minerals
Aurmont Resources - Unipessoal, Lda.	Montemor-o-Novo, Évora e Vendas Novas	Au, Ag, Cu, Pb, Zn and associated metals
EDM - Empresa Desenvolvimento Mineiro e Participações, S.A.	Castro Verde e Aljustrel	Cu, Pb, Zn, Ag, Au, associated minerals
EDM-Empresa Desenvolvimento Mineiro e Participações, Lda.	Aljustrel, Castro Verde e Ourique	Cu, Pb, Zn, Ag, Au, associated minerals
EDM-Empresa Desenvolvimento Mineiro e Participações, Lda.	Alcácer e Grândola	Cu, Pb, Zn, Ag, Au and other metallic minerals
ePower Metals Inc.	Estremoz, Borba, Vila Viçosa e Alandroal	Au, Cu, Pb, Zn, Ag, Sn, W, associated minerals
Godolphin Mining Services LLC	Barrancos, Moura	Cu, Pb, associated minerals
Green Arrow Resources, Inc.	Moura, Portel, Vidigueira, Serpa	Zn, Pb, Cu, Ag, Au, Sb, Cd, Ga, Ge, In, Mg and other metals
Iberian Resources Portugal - Recursos Minerais, Unipessoal, Lda	Arronches, Campo Maoir, Elvas e Monforte	Au, Ag, Cu, Pb, Zn, Sn, W, Ta, rare earth elements, associated minerals
MAEPA — Empreendimentos Mineiros e Participações, Lda	Alcacer do Sal, Ferreira do Alentejo e Grandola	Cu, Pb, Zn, Sn, Ag, Au, associated minerals
MAEPA — Empreendimentos Mineiros e Participações, Lda	Alcácer do Sal, Ferreira do Alentejo, Grândola	Cu, Pb, Zn, Au, Ag and other metallic minerals
MAEPA — Empreendimentos Mineiros e Participações, Lda	Mértola, Almodôvar, Ourique, Castro Verde	Cu, Pb, Zn, Sn, Au, Ag and other metalic minerals
MAEPA — Empreendimentos Mineiros e Participações, Lda	Mértola e Ourique	Cu, Pb, Zn, Sn, Ag, Au, associated minerals
Matsa A Mubadala & Trafigura Company	Beja, Vidigueira, Cuba, Alvito, Serpa, Portel, Viana do Alentejo	Cu, Pb, Zn, Au, Ag,Fe, associated minerals
Matsa A Mubadala & Trafigura Company	Grandola, Santiago do Cacém e Sines	Cu, Pb, Zn, Ag, Au, associated minerals
OpusGreen - Agricultura e Exploração Mineira, Lda.	Évora	Au, Ag, An, Pb, Zn, Sn, Fe, Cu, rare earth elements
Ozdogu Portugal Mining and Exploration, Lda	Grandola, Santiago do Cacém e Sines	Cu, Pb, Zn, Ag, Au, associated minerals
Ozdogu Portugal Mining and Exploration, Lda	Odemira, Santiago do Cacém e Sines	Cu, Pb, Zn, Ag, Au, associated minerals
Ozdogu Portugal Mining and Exploration, Lda	Almodôvar, Mértola, Alcoutim e Loulé	Cu, Pb, Zn, Ag, Au, associated minerals
SOMINCOR - Sociedade Mineira de Neves-Corvo, S.A.	Castro Verde, Almodôvar, Mértola	Cu, Zn, Pb, Sn, Ag, Au and other metallic minerals

Table 9.17: List of companies with prospecting and research rights in Alentejo from 2014 to 2019[7]

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[7] Retrieved and adapted from http://www.dgeg.gov.pt/default.aspx?cn=733382528253AAAAAAAAAAAA, accessed in 20 May 2019

• Short Description of M&M Cluster and Association

In 2016, there was the institutional recognition of Portuguese cluster of Mineral Resources Association (ACPMR) (Peres et al., 2016). This cluster emerged as an evolution of the Portuguese Stone Cluster, where the clustering strategy demonstrated positive results during the Portuguese economic crisis, the main goal of the ACPMR is to spread the experience acquired in the stone sector and the Mineral Resources Economic Sector. In 2018, the Cluster of Mineral Resources had a membership of 38 associates and Innovation System; 2 Business Associations; 2 Other Associates and 10 other relevant partners. As new projects are submitted and new contacts being made, new partners have been integrated into the Partnership for Mineral Resources of Portugal (Peres et al., 2018).
The main objectives of the ACPMR are (Martins, 2017):

- Promote knowledge and sustainable economic value for mineral resources, boosting the export capacity and the added value.
- Deepening knowledge of the economic potential of resources, promoting R & D + I, improving productive investment conditions and access to markets, as well as increase skills (technical, technological, management) and stimulate intercompany and inter-institutional cooperation.

This cluster is more focused and started with dimension stone but increased their portfolio and currently works with metallic and non-metallic minerals (ACPMR, 2019).
Regarding national associations for the mining sector Portugal has National Association of Extractive and Manufacturing Industry (ANIET) and Portuguese Association of Marbles, Granites and Related Branches (ASSIMAGRA). ANIET, founded in 1975, is a business and public utility association, representative of the Quarries of Industrial and Ornamental Rock, both in its Extractive and Industrial Minerals Sector and the only Association with representation and Collective Labor Agreement for the Mining sector. [9] ASSIMAGRA is the Association that represents the Mineral Resources of Portugal. ASSIMAGRA has 194 associates from the extractive industry including mining and related business. [10]
The mission of ASSIMAGRA is [11]:

- Contribute to the technological and economic development of the sector.
- Intervene in a consolidated and structured way with the official bodies, in defense and representation of the sector.
  Promote the contact between the associates and their joint commercial activity, taking advantage of synergies and enhancing the capacity of commercial action in the market.
- Promote contact and interconnection with representative bodies and associations of upstream and downstream sectors.
- Promote collaboration with national and foreign counterparts.

[9] http://www.aniet.pt/pt/aniet/#title4
[10] http://www.bidaempresa.pt/Assimagra/pt/index
[11] https://www.assimagra.pt/a-assimagra/

• Industries Closely Related to M&M

Besides the mining business of Almina in Aljustrel, there are also business related to mining such as Orica Mining Services Portugal, SA that is a provider of commercial explosives and innovative blasting systems to the mining and a specialist provider of ground support services in mining and tunnelling .[12] And recently, in February 2019, the Swedish company Epiroc has entered into a purchase and sale agreement with the Municipality of Aljustrel for the acquisition of a plot of about 10,000 m^2 in the business area of this locality[13]. According to sources of the municipality, the investment of the Swedish company may ascend to 1.5 M € providing approximately 60 new jobs. Epiroc, linked to the Swedish multinational Atlas

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Copco, is a Swedish industrial company created in 2018 and operates in the mining industry in mechanical and industrial maintenance for the sector. [14]

[12] https://www.orica.com

[13] https://tribunaalentejo.pt/artigos/mineira-sueca-vai-investir-15-milhoes-em-aljustrel

[14] https://www.atlascopcogroup.com/en/investor-relations/all-information-epiroc-split

• Short Description of Networking Potential

From a national perspective, according to the ACPMR regarding the Metallic Mineral Resources, the evolution has not been the desirable one, being fundamental (Compete 2020, 2018):

- The recognition of the strategic importance of the sector and its potential contribution to the economic development of the Government, encouraging the full appreciation of the resource, especially in the development of the last stages of its value chain, final products, with clear value added;
- Improvement of geological knowledge of existing resources and development of new technologies and methodologies to find new deposits;
- Increase in the spectrum of exploration and exploration concessions;
- Diversification of exploited mineral resources, including some that are projected to be very important in the near future (e.g. lithium);
- Attracting new operators to the Portuguese market with the aim of increasing the exploitation of these resources.

As for Alentejo Region, according to the director of CEGMA, conditions have been created, especially in Aljustrel to attract investment in the Mining sector. Because of this, formal and informal partnerships have been established between public and private institutions related in mining.

According to the administrator of Almina, the challenges for the company's future include "continuous prospecting of new ore reserves and the implementation of a continuous process of improving productivity"(Fernandes, 2018).

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QUESTIONNAIRE FOR M&M INDUSTRIES (GREEK)

Επωνυμία Εταιρείας /

Name of the industry

Έδρα / Seat

Συνολικός αριθμός Εργαζομένων /

Total number of employees

Πραγματοποιούνται προγράμματα εκπαίδευσης στους εργαζομένους; /

Do you implement training programs for your employees?

○ Ναι ○ Όχι / ○ Yes ○ No

Αν ναι σε ποιον τομέα; / In which sector?

1. Διαχείριση Ανθρώπινου Δυναμικού / Human Capital Management
2. Χρήση & Πολιτική Τεχνολογιών Φορητών συσκευών / Mobility Technologies & Mobility Policy
3. Analysis of Mining financials
4. Υγεία & Ασφάλεια / Health and Safety
5. Ψηφιακές Ικανότητες / Digitalization
6. Επιστήμη των Υλικών / Materials Science
7. Σχεδιασμός εξορυκτικής δραστηριότητας / Mine planning
8. Σχεδιασμός Προηγμένων Εγκαταστάσεων Διάθεσης Απορριμμάτων / Advanced Tailings Facility Design,

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9. Κατασκευή, Λειτουργία και Κλείσιμο Ορυχείων και Λατομείων / Construction, Operation and Mine Closure

10. Περιβαλλοντικής Διαχείρισης – Σχεδιασμού και Διαχείρισης Ιστοσελίδων / Environmental Stewardship – Planning and Site Management

11. Περιβαλλοντικής Διαχείρισης – Απορρίμματα και Αποκατάσταση Τοπίου / Environmental Stewardship – Waste and Reclamation

12. Άλλος τομέας: / Another sector:

Ποιος είναι ο τομέας στον οποίο πραγματοποιούνται περισσότερα σεμινάρια/ εκπαιδευτικά προγράμματα; / In which sector do you implement more seminars / training programs?

Πόσες ώρες δαπανήθηκαν το 2018 για εκπαίδευση σ' αυτόν τον τομέα ανά εργαζόμενο; / How many hours do you waste in 2018 for each of your employees?

○ <100

○ 100 – 200

○ 200 – 400

○ 400 – 600

○ > 600

Υπάρχει ενδιαφέρον από τους εργαζομένους για κάποιους συγκεκριμένους τομείς; / Is there interest in a specific sector from your employees?

○ Ναι ○ Όχι / ○ Yes ○ No

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Αν ναι, σε ποιον τομέα/τομείς; / Which is their preferable sector?	
Συμμετέχετε σε προγράμματα χρηματοδότησης φοιτητών/τριών για ανώτερες και μεταπτυχιακές σπουδές; / Do you finance students to go to the university or to continue with a master?	○ Ναι ○ Όχι / ○ Yes ○ No
Αν ναι σε πανεπιστήμια του εσωτερικού ή του εξωτερικού; / In universities of our country or abroad?	

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