

CHAPTER II: Mining

I Introduction

Greece possesses substantial mineral wealth, consisting of a variety of minerals and ores with a large industrial interest. The high quality and the many specialized uses of minerals available in Greece, provide significant comparative advantages to the economy of the country. The mining industry (with the exception of aggregates) has strong outward-looking features, since exports account for more than 65% of sales, and for some minerals Greece holds a leading position in the global market. The mining and extractive metallurgy sector has been traditionally one of the most important and dynamic segments of the Greek industry. Today, mining companies are well organized and hold significant market shares in products such as bauxite, alumina, aluminum, nickel, caustic calcined magnesia, dead burned magnesia, raw magnesite, pumice, silica and ornamental stones (principally marble).

Greece is a major global supplier of several key industrial minerals, notably bentonite, magnesite, and perlite. The country's position as a leading producer of these minerals is well established. Greece is the only producing country of huntite, the leading global supplier of perlite, the second in the production of pumice and bentonite, and the first in the export of magnesium compounds within the EU. Greece is also the second largest producer in the EU, and the fifth largest worldwide, of lignite (brown coal). The West Macedonia Lignite Center, with a production of 62.5 million tonnes of lignite and overall solid material transportation of 340 million m³ in 2008 and the Megalopolis Lignite Center, with 13.2 million tonnes of lignite and overall material transportation of 40.1 million m³ in 2008, comes under the Public Power Corporations (PPC) Mines Division. These lignite mines supply twenty one (21) power plants with an installed capacity of 5,287 MW, which corresponds to 50% of the total installed capacity of the country. Lignite exploitation is still based on the continuous method of excavation - transportation - deposition. The mining procedure of a lignite deposit includes extraction, transportation and deposition of materials (lignite and co-excavated waste materials). The co-excavated waste materials are transported and put back mainly in the excavation voids in an effort to minimize the impact on the landscape.

Moreover, Greece has significant deposits of clay, limestone, slate, gypsum, kaolin, mixed sulphide ores (lead, zinc), olivine, pozzolan, quartz etc. Finally, there are significant mineral deposits which have not yet been exploited, or where exploitation has temporarily ceased (such as manganese, chromite, uranium, gold, oil, emery, salt etc.), as well as major geothermal energy potential, suitable either for power generation or for various thermal applications. The annual land uptake by mines, quarries and waste dump sites is estimated at 1984 ha/y.

The Greek mining/metallurgical industry constitutes an important sector of the economic activity of the country (it constitutes 35% of the GDP, with the inclusion of interrelated enterprises such as quarrying, processing and production of intermediate and final products) and supplies essential raw materials for primary industries such as cement, production of energy, non-ferrous metals (aluminum, nickel, etc), the industry of stainless steel etc. Estimated sales of the country's mineral industry and basic metallurgies, totals almost EUR 2.5 billion. Moreover, the industry provides a major source of employment in the country: approximately 20-23 thousand employees are employed in the sector (in mines, quarries, and the two basic extractive metallurgies of the country) and more than 90 thousand are employed in jobs dependent upon or associated with mining. In 2006, the mining sector employed approximately 0.4% of the Greek labour force. Furthermore, since - as a rule - the processing of these raw materials takes place in the region in which they are excavated, the industry contributes considerably to coveted regional growth.

Production data and best available estimates for various mineral commodities produced in Greece in the years 2008 and 2009 are listed in Table 2.1. For the first time after a long period of positive economic growth which stimulated increased output, in 2009 the minerals industry experienced a significant decline in production and sales. This decline followed the sharp fall in demand of raw materials in the fields of steel, construction, cement and concrete. Production levels of mineral commodities in Greece during 2009 have been reduced below the 2008 numbers by a percentage varying from 20-30%, and in some cases by more than 50%. However, it is anticipated that after a short recession period the raw materials field will come again to the forefront. In this respect, issues related to sustainable management, quality control, safety and environmental protection in the mining industry, constitute the most significant challenges, which are influencing the development of the mining industry and the evolution of its character.

**Table 1: Production of mineral commodities in Greece.
Metals, industrial minerals, mineral fuels and related materials.**

COMMODITY PRODUCTION	Quantity in Metric tons unless otherwise specified	
	2008	2009
Bauxite	2,174,000	1,935,000
Aluminium, primary (Foundry Line)	162,339 ¹	134,737
Alumina, calcined (Al ₂ O ₃)	771,769	718,797
Alumina, hydrated (Al ₂ O ₃)	807,500	795,500
Mixed sulphide ore	264,299	225,054
Galena, PbS (metric tons of concentrates)	23,314	17,027 ²
Zinc blend, ZnS (metric tons of concentrates)	46,532	34,255 ³
FeS ₂ (metric tons of concentrates)	176,335	116,706
Nickeliferrous ores (laterites)	2,261,637	1,400,000
Ferronickel:		
Gross weight	87,664	42,423 ⁴
Ni content of ferronickel	16,640	8,269
Slag by-product (coarse)	85,345	62,022
Slag by-product (fine, -5mm)	90,180	52,696
Magnesite, crude	455,069	250,234
Dead-burned magnesia	48,719	22,370
Caustic-calcined magnesia	70,545	55,545
Basic monolithic refractories	35,617	31,634
Asbestos fibres	0	0
Bentonite, crude	1,500,000	844,804 ⁵
Attapulgite clay ⁶	28,584 ⁶	81,382 ⁶
Huntite, crude	19,600	10,652
Pozzolan, Santorin earth	1,059,000	830,000
Pozzolan, specific use (not cement industry)	NA	21,532 ⁷
Kaolin, crude	4,360	0
Perlite, crude	1,000,000	862,935 ⁸
Perlite, treated	600,000	398,451 ⁹
Pumice	828,000	381,000
Silica (SiO ₂)	64,521	37,905
Gypsum and anhydrite, crude	1,000,000 ¹⁰	730,000 ¹⁰
Olivine	37,150	48,050
Amphibolite	57,500	25,902
Calcium Carbonate (CaCO ₃), processed all sources	126,357 ¹¹	580,000 ¹²
Feldspar	62,000 ¹³	28,617 ¹³
Quartz	16,201	10,909
CO ₂ [liquid]	12,200	8,000
Talc and steatite, crude	NA	NA
Lignite	64,521,000	61,800,000
Crude oil, in barrels	477,679	628,278

Salt, sea salt	220,000*	189,000*
Mineral Aggregates (sand, gravel, crushed stones etc.)	85,000,000*	65,000,000*
Marble, rough blocks in cubic meters	347,526 ¹⁵	255,516 ¹⁵
Marble, rough shapeless blocks	451,505	254,491
Marble chips	1,218,056	761,933

NA: not available, *: estimated

¹ electrolysis line 163.934 tn (for 2008) ?a? 129.774 tn (for 2009)

² Metal content: Pb: 11.479 tn, Ag: 26.988 Kg, Au: 27,92 Kg

³ Metal content: Zn: 16.815 tn, Ag: 3.189 Kg, Fe: 3.726 tn, As: 353,8 tn

⁴ 19,49%Ni Larco GMMSA

⁵ Bentonite: S&B Industrial Minerals S.A., BENTOMINE S.A., Sud Chiemie Hellas, Greek Mining Ltd., Mavroyiannis.

⁶ attapulgitis/palygorskite plus smectite/saponite clay

⁷ Pozzolan for specific use: construction pozzolanic mortars, fillers, e.g.

⁸ Perlite: S&B Industrial Minerals S.A., EEKOM SA, Aegean Perlites S.A., ?ILOPAN S.A.

⁹ S&B Industrial Minerals S.A.

¹⁰ Gypsum: Interbeton Construction Materials SA., Lava Mining and Quarrying Co, BPB HELLAS SA (BPB group), Knauf Gypsopoiia SA

¹¹ only amorphous CaCO₃ included, IONIAN KALK S.A

¹² Calcium Carbonate (CaCO₃) products, both amorphous and crystalline: construction mortars, fillers, marble powder, adhesive and sealant, marmoline, alfamix, iokal etc.

¹³ feldspar: MEVIOR SA., PHILKERAM JOHNSON S.A (2008), MEVIOR SA. (2009)

¹⁴ Normal cubic meter (Nm³) is the Cubic meter measured at standard conditions (0 °C and 1 atm)

¹⁵ squared rough blocks plus slate stones

Sources: (a) Ministry of Environment, Energy and Climate Change / Mineral Resources Policy Directorate, and (b) Greek Mining Enterprises Association (GMEA)

Policy and Regulations

Main features of national mining codes or mineral industry code

The extractive mining activity in Greece is controlled by 'The Mining Code' (Legislative Decree 210/1973 as amended by Law 274/1976) and a number of Laws and Ordinances on technical and procedural issues, such as (a) Law 669/1977, on the exploitation of ornamental rocks and industrial minerals, (b) Law 1428/84 as amended by law 2115/93, on the exploitation of aggregates, (c) The Regulation on Mining and Quarrying Activities (Health and Safety Regulation on Mining and Quarrying) etc. The above set up the most important legislative provisions for all significant mineral resources and cover all aspects of mining, including health and safety, management of water, environmental issues and the challenges of sustainable development. This comprehensive system has been strengthened several times during the past 20 years, with the transposition into the Greek national legislation of new European legislation related to environmental and health and safety issues of the extractive industries, including the transposition of the EU Environmental Impact Assessment (EIA) Directives 85/337/EC and 97/11/EC, the Habitats directive 92/43/EC, the Water Framework Directive (WFD) 2000/60/EC, the EU Mining Waste Directive 2006/21/EC etc.

According to the Greek mining and quarrying legislation, minerals are classified into two categories, namely (a) **quarry minerals** and (b) **ores**.

The **quarry minerals** are divided in three categories:

- i. Aggregates
- ii. Ornamental rocks, and
- iii. Industrial minerals

Ores include metals and their compounds (metallic minerals), radioactive and energy minerals, precious metal ores, sulfur, talc, fluoride, asbestos, feldspar, mineral salt, helium gas, natural gas, organic sediments, and others.

This classification is purely legal / conventional and is not always based on scientific data, but rather into mainly economic criteria. For example, many ores such as talc, fluoride, asbestos, feldspar, magnesite, are classified by the legislator into **ores**, taking into consideration their economic importance but also tradition. However, from a scientific, but also from a usage, point of view they are considered as industrial minerals.

The **quarry minerals** belong to the owner of the land, who has the exclusive right to explore and exploit them, under the presumptions and the limitations of the quarry legislation that demands issuing a special "exploitation permit". This permit is issued provided that it is first verified that no problems or disturbances are created to neighbors, archaeological sites, buildings and built-up areas, public works and the environment and provided that a specialized techno-economic study and an EIA study have been submitted to the competent authorities and evaluated. In the case of industrial minerals and ornamental rock quarries the initial "exploitation permit" is valid for a time period between fifteen and twenty five years and can be extended for an additional period of twenty five or fifteen years respectively, so as to reach forty years in total. In the case of aggregate quarries the initial "exploitation permit" is valid for twenty years and can be extended for two additional five-year periods, so as to reach thirty years in total.

On the contrary, the right for exploration and exploitation of **ores**, does not belong to the owner of the land, but either it belongs to the state and is leased or - in most cases - it is conceded with a Presidential Decree, under which the right of mine ownership is established (the so called concessions or private mines).

The right of exploration and exploitation of radioactive and energy minerals, emery, mineral salt, natural gases and organic sediments, belongs to the State. The same is true for the right of exploration and exploitation regarding other ores, that are being discovered in the Greek submarine area, the bottom of lakes, as well as in certain areas that are called "public mining areas", and which have come to the State's jurisdiction through various ways (donations, enemy fortunes after the World War II occupation, forfeited mine owners before 1973 etc.)

The right to mine ores that *do not belong to the State* is conceded in two stages:

(1) In the first stage, which is the stage of exploration, a license for mining exploration is issued to the first applicant, with three years duration, and which is valid for a maximum area of 10.000 sq. meters. This is issued with a decision from the Prefect of the area, provided that the following are verified:

- a. The application complies with the conditions of the law.
- b. The site under application does not coincide with other valid mining titles, or other pre-existing valid applications, or public mining areas". In the case of partial coincidence, the license is issued for the remaining site.
- c. There are no reasons of Public interest preventing the issue of the license.

(2) The second stage is the stage of the mining concession. This is achieved by a Presidential Decree, through which the right of mine ownership is established for the holder of the license of mining exploration on the ores that exist in the site of concession, and it is issued after a consultation by the Ministry of Environment, Energy and Climate Change (YPEKA), provided that certain procedures are kept, and after it is verified that the interested party has certified the existence of the exploitable deposits, based on a techno-economical study.

After obtaining the mining concession and in order to start the exploitation activities, the holder should get the required permits and approvals, foreseen by current legislation. The most important permits and approvals are the following:

- a. Approval of the EIA study
- b. Approval of the technical study (concerns issues of rational activity, safety of workers and neighboring residences, etc.).
- c. Approval by the forestry department, in the case of forest areas.

The right of mine ownership has the following characteristics:

1. It is a self contained real right, completely distinct from the land ownership.
2. The right which results from the license of mining exploration is restricted in duration (three years), as well as in its content which is restricted only in the exploration of the area. On the contrary, the right of mine ownership that results from a concession, is valid for fifty years and can be extended for

two additional twenty five year periods, based on the judgment of the Minister of Environment, Energy and Climate Change, taken on the basis of the rate of exploitation, the degree of treatment - elaboration of the ore mined, the size of the installations and the quantity and quality of the deposits.

3. The concession provides to the holder the exclusive right for exploration and exploitation of all the ores that exist into the surface and the underground area of the concession, with the exception of those that have been exempted on behalf of the State.

4. The right of mine ownership is transferable and can be leased, with a notarized document, and can be inherited naturally after the approval of the Minister of Environment, Energy and Climate Change.

5. The right of mine ownership can be contributed, evaluated and become an asset of the corporation.

6. The concession Decrees, as well as the contracts for transfer of title, leasing of the rights of mine ownership, together with the approved Ministerial Decisions, must be transcribed to the pertinent land registration office, as mines are considered real estate.

Land use planning follows relevant national legislation and urban planning studies. A structured national mining plan does not exist at strategic and operative level. Therefore, mineral and aggregate resources are not mapped in detail, unless the local industry association has specifically made inputs to the national or regional development plans. YPEKA is the pertinent authority for minerals planning at a national and regional level. The mining legislation includes provisions for the establishment of mining areas, but up to now mining areas have been established in Greece only in relation to aggregates' exploitation planning. Land use planning for aggregate production / consumption is done at the prefectural level. In this respect the prefecture is assisted through appropriate area selection committees in which all relevant authorities are represented. "Quarrying areas" are determined in accordance to criteria set by YPEKA. Local authorities / municipalities may in their local land use plans also allocate areas to secure future supply of - for instance – aggregates.

Fiscal policies for investments and counteracting market fluctuations

No specific financial incentives or counteracting market fluctuation mechanisms are established in order to support investments in the mining sector.

Regulations and mechanisms for compliance and monitoring

Regarding regulations and mechanisms for compliance and monitoring, there is an adequate system of environmental and health and safety requirements implemented and enforced through a system of administrative acts and a whole set of mechanisms for compliance and monitoring.

Mining activities are subject to an authorization procedure including the granting of an exploration/exploitation concession or exploitation "permit" that confers the exclusive right to explore or exploit the mineral resources specified in the permit.

The mine/quarry owners are in general obliged :

(1) To acquire the required permits and approvals, foreseen by current legislation, for performing their activity (otherwise no activity is permissible). "Exploitation concession" (or "Exploitation permit" for quarry minerals) is the most important but there are others e.g. permits for construction and operation of electromechanical installations and processing factories, permits for the disposal of liquid and solid waste, approval of fire protection systems and others.

To get the required "exploitation permit", the most important permits and approvals are the following:

a. Approval of the technical study. This is submitted to YPEKA and should include details on the type, quality and quantity of minerals to be extracted, minerals reserves, operations plan, technical specifications on the execution from the beginning of exploration to the reclamation of land surfaces used by mining, updated drawings (mine plans) for every extraction working phase, duration of the project etc.. Based on this description the mining authority will assess the project with respect to operational safety and protection of workers, surface protection, prevention of public damage and other issues.

b. Approval of the EIA study. This is submitted to YPEKA or to the regional government, depending on the classification of the operation from an environmental point of view. If the site is in an area designated as a Protected Area (e.g. Natura 2000 site), a Joint Ministerial Decision (JMD) has to be co-signed with the Ministry of Rural Development and Food to approve the EIA. Also, no extraction operation is permitted without the written consent of Ministry of Culture and Tourism, due to the

abundance of archaeological sites in the country. The EIA approval is accompanied by a financial guarantee to ensure the fulfillment of the obligations under the mining law, especially restoration.

c. Approval by the forestry department , concerning interventions into forest areas.

(2) To demonstrate the activity foreseen by the mining legislation (exploration or exploitation of the conceded mine). The activity is examined by the authorities and in the case that it is not the foreseen, the mine owner is forfeited, without compensation, of his rights of mining ownership.

(3) To carry out concrete mining activities in a rational manner, or otherwise, they will face administrative fees and penalties and – in certain cases - the penalty of forfeiture, without compensation, from their mining ownership rights.

(4) To comply to the terms of the concession Decree (or the terms of “exploitation permit”), to the terms of EIA and to “The Regulation on Mining and Quarrying Activities” . In particular, to those terms that are connected with the safety and health of workers, neighboring dwellers, as well as the safety of neighboring buildings and other works. The violation of the above could cause administrative fines and penalties and possibly the temporal or permanent interruption of works which is ordered by a simple administrative act.

Guidelines for artisanal, small and medium-sized mining

The above provisions, requirements and procedures apply to all mine operations irrespective of their size. Therefore, there are no specific provisions for artisanal, small and medium-scale mining operations.

Public / stakeholder consultation and participation in decision-making related to mining

A consultation and participation process for decision-making related to mining is already provided at the “permit” granting level. Before deciding on an application for an exploration or exploitation permit, the mining authority must consult the authorities safeguarding local public interests.

Furthermore , in order to guarantee the participation of the public and of all stakeholders, the approval of an operations plan with an EIA study by the mining authority is subject to public consultation. Before the beginning of any exploration / exploitation work that can have a significant impact on the natural environment, notice of consultation has to be made to the County administrative Board in accordance with the provisions of the Environmental Laws 1650/1986 and 3010/2002 and their subsequent amendments. The environmental assessment made by the prefect of the region (or in special cases by the central administration) allows balanced management of the resource, compatible with the different aspects of the natural environment concerned. Also, this procedure allows that all issues related to the activity are examined with all different administrative authorities and stakeholders concerned (local communities etc.).

Public governance and transparency in the mining sector

The procedures set out above guarantee a high level of public governance and transparency in the mining sector.

! Mining Best Practices

Environmental Impact Assessment (EIA) and monitoring of all phases of mining operation (exploration, project development, mine operation, and mine closure)

Law 1650/1986 as amended by Law 3010/2002 requires all mineral extraction applications to be accompanied by an environmental impact assessment (EIA), with specific provisions taking into account the dynamic character of mining activities. The assessment should provide the best possible data for decision guidance in relation to the project, from the point of view of environmental protection, natural resource management and health.

Law 3010/2002 came into effect with a number of Ministerial decisions which complement it, making specific reference to water resources management and other environmental issues. This law provides harmonization of the Greek legislation with European directives 96/61/EC and 97/11/EC.

Another major environmental protection Law is 998/1979 "Protection of forest lands concerning mining activity", which was established in order to protect forest areas. Law 3208/2003 is basically the new Forest Protection Law or Forest Code. It should be noted that the definition of forest is very loose, since it includes areas of scrub and heath and effectively covers approximately 80% of the country. The rules regarding mineral extraction are stricter in such areas.

Regarding the monitoring of the different phases of mining operations (exploration, project development, mine operation, and mine closure), as already noted, the Greek mining law system and the environmental legislation contain mechanisms for compliance and monitoring enforced by the mining and environmental authorities. There is a national and regional responsibility level for monitoring and enforcement and the enforcement powers include fines, revocation of permit, injunction and imprisonment.

YPEKA / Department of Energy and Natural Resources the competent authority for ensuring that mineral extraction is in line with the economic interests of the country. The same Ministry is controlling the technical and environmental impacts of the development of mineral activities. The Institute of Geology and Mineral Exploration (IGME) advises the Ministry on geological and technical aspects.

In practice, controlling mineral development is complicated: because of the nature of the permit system in force, a number of Ministries and governmental agencies are involved in the process. Other authorities which play an important role at the national level include the Forest Service, which has special responsibility for Protected Forest areas, and the Ministry of Finance. Furthermore, the prefectures play an important role for controlling the details of mineral development and for identifying preferred areas for aggregate production. Regarding mine inspection, the Inspectorates of Mines (a) of Northern and (b) of Southern Greece, supervise compliance with the provisions of the mining laws. They can order implementation of the measures needed to implement mining law and counter risks. At the regional level, these Inspectorates play an important role in controlling the day-to-day activities of mining activities.

Finally, the restoration of mines is the responsibility of the operator, regardless of the mineral rights ownership. At this aim certain guarantees are required by the legislation for quarry minerals, but not for ores; for the latter guarantees can be asked via the EIA studies. Law 2742/1999 (Official Journal of the Government (OJG) 207/07.10.1999) provides for rehabilitating abandoned (i.e. no longer in operation) quarries.

Private -Public Partnership (PPP) for sustainable mining

Public Private Partnerships are not applied as such in practice in the Greek mining sector, due to its mode of operation. With respect to the operation of mining activities, the existing legal framework assigns responsibility for mining activities to private companies. The State itself normally plays no active role in these activities but assures compliance with the legal framework.

Emergency response plans and preparedness at local level

According to the Regulation on Mining and Quarrying Activities, mine operators have the obligation to elaborate an emergency response plan in order to face any predictable industrial or physical disaster. Mining facilities with high risk of accidents, i.e. installations belonging to the scope of the Seveso II Directive, do not exist in Greece. Directive 2006/21/EC on mining waste management also prescribes external and internal emergency planning for category "A" waste management facilities, but there are no such facilities known in the country.

Risk assessment of mines and mining activities

To assess the possible risks, the conditions in the region where extractive activities will be carried out, the nature of the activities and their consequences are taken into account. The Regulation on Mining and Quarrying Activities and other related legislation contain detailed provisions on risk assessment of mines and mining activities, transposing the relevant EU Directives concerning Safety and Health in Mines. These provisions comprise concrete orders and prohibitions concerning both the deployment and the behavior of staff and the utilization of equipment.

Rehabilitation of affected communities and life-supporting ecosystems, including mine site decommissioning

Rehabilitation of mining sites represents an integral part of mining as mining activities are necessarily associated with impacts on the surface. Mine operators are required under law to rehabilitate worked-out sites, according to the EIA studies approved by the authorities. Depending on the conditions and the technologies applied, the rehabilitation is done in parallel with the extraction or after its completion. Extraction companies produce and periodically update the work plans for the rehabilitation of the affected land and the closure of the mining site.

The interests of affected communities and ecosystems are taken into account at an early stage in the planning phase before extraction begins. In general, regional planning procedures must be carried out in advance of the development of mining activities.

Technological, institutional and social initiatives for protecting the health and safety of mining workers

Greek legislation on occupational health and safety has been harmonized to that of the European Union, mainly through a comprehensive law on "health and safety for workers" (Law 1568/1985) and several ensuing presidential decrees (17/1996, 159/99 etc.). It addresses a large number of occupations, occupational factors, working conditions, types of work and health disorders, including provisions regarding enforceable occupational exposure limits for chemicals, ergonomics, protection against carcinogenic substances and biological hazards. It also addresses issues related to work installations and equipment, occupational rehabilitation for the mentally ill, protection of underground workers, protection of pregnant women at work, night and shift work, employment in temporary and mobile work, group occupational health services, minimum hours of employment and qualifications of occupational health professionals. All the above concerns have been already incorporated in the Regulation on Mining and Quarrying Activities, which is currently under revision.

According to the law, the employer bears the primary responsibility for health and safety at the workplace. Proven offenders of occupational health and safety regulations have been convicted to pay fines. Employees afflicted by a work accident or an occupational disease are entitled to benefits or disability pensions on privileged terms and conditions. To improve law enforcement there is a need to ensure the availability of more (a) trained occupational physicians and appointed enterprise physicians, offering suitable, credible and adequate advice, and (b) state safety ("technical") and medical occupational health inspectors, providing guidance or bringing a charge when necessary. The active participation of workers is very important, for example in order to ensure the establishment of the Workers' Health and Safety at Work Committees in enterprises, allowed for in the law. The resources of Mine Inspectorates and inspectors constituting the established Corps of Work Inspectors at the Ministry of Labour and Social Security are expected to increase soon.

A multidisciplinary Institute, the Hellenic Occupational Health and Safety Institute (ELINYAE), provides the scientific and technical framework concerning work conditions and the prevention of occupational risks. Basic objective of the non-profit Institute ELINYAE is to detect, record, process, analyse and investigate the various hazardous agents and conditions in the working environment and their effects on the health and safety of employees. Also, to promote information, communication and education of all social partners on issues of occupational health and safety. An important element regarding ELINYAE is the consensus and co-operation between employers and employees during its foundation and their continual support.

Furthermore, Greek mining companies have put into action educational and management programs for promoting health and safety in mining activities (see following section).

Mine Closure Planning (land use plans and site rehabilitation, site safety, decommissioning, waste dumps and tailings, site water management, off-site infrastructure, community socio-economic programs and employees)

Mine closure planning is an integral part of the authorization procedure as it is included in the stage of EIA approval. In this stage, even before mineral extraction begins, the operator has to state in his operation plan the measures required for surface reclamation. The surface affected must be rehabilitated as soon as it is feasible, in parallel with the exploitation of the mine or quarry.

Rehabilitation does not necessarily mean restoring the surface to its original state. For example, if the proposed subsequent use is landfill, the obligations are fulfilled by forming the required cavity and making it safe. Regarding the infrastructure, roads and other traffic connections removed by the mining activities, these are not simply rebuilt in the same place but they are integrated within an overall package of measures for the reclamation of the area, in accordance with the relevant land use plans.

The precautionary and organizational measures for mine closure planning including land use, site rehabilitation and safety, decommissioning, site water management, off-site infrastructure, are laid out in detail in the individual operation plans under Laws 1650/1986, 3010/2002 and their subsequent amendments, under the legislation related to Water Resources Management and under the Regulation on Mining and Quarrying Activities. Moreover, the recently amended JMD 39624/2209/103/25.09.2009 contains detailed provisions on requirements relating to site safety, decommissioning, waste dumps and tailings ponds, thus transposing the EU Mining Waste Directive 2006/21/EC and integrating the standards of the Directive into the operations plan procedures.

Programmes and Projects

Sustainable Development Indicators (SDIs) for the Greek Mining Sector

The Greek Mining Enterprises Association (GMEA) adopted the "Code of Principles for Sustainable Development" in 2006 with the aim to actively promote the improvement of its members' performance in the economic, environmental and social dimensions of sustainable development. GMEA presented a set of SDIs, which were adopted by its members, for the validation and assessment of the overall sector performance. Each year, at the annual report, mining companies members of GMEA, provide a detailed account of their performance by completing a table with selected indicators and by reporting on best practices in relation to the implementation of the Code of Principles of Sustainable Development.

Educational and management programs for health and safety

Greek mining companies have put into action educational and management programs for promoting health and safety in mining activities. Two representative examples follow:

- a) The road safety education program, organized by the TITAN cement company: a training program on road safety aiming at all cement plants in Greece and the stations in Crete and Rhodes, for all company partners, silo owners and professional quarry drivers.
- b) The contractor safety management programme, organized by Heracles cement company (part of the Lafarge cement group): a program aiming to increase the involvement of all levels of management in safety issues, to reduce risk tolerance and, finally, to offer contractors the same health and safety standards enjoyed by company employees.

Mine closure planning

Some representative examples follow:

a) Rehabilitation

a1) Bauxite mines

Parnassos Mountain, in the Fokida region, is host to a successfully restored open cast bauxite mine (other bauxite mines are still operational in the vicinity). When operational, the maximum depth of the excavation was 40 m, leaving an area of two hectares in need of rehabilitation. Before the mine was opened, the site was a barren hill surrounded by fir tree forest. The basic idea of the site closure plan was to improve the landscape following extraction, by creating a new area of forest to complement that existing in the surrounding landscape.

a2) Lignite mines

- Planted regions: To date, more than 8 million trees (7.1 million trees in the West Macedonia Lignite Center and 850,000 trees in the Megalopolis Lignite Center) have been planted at restored areas, at a rate that exceeds 600,000 trees per year. The trees planted are: acacias, poplars, pines, Arizona cypresses, eucalyptuses as well as fruit bearing trees, such as apple trees, pear trees, plum trees, hazelnut trees, walnut trees and pistachio trees at selected locations of the mines.

- Creation of farmland: The creation of experimental grain cultivation with a view to testing the fertility of the rehabilitated land dates back to 1986. The crops selected are durum and soft wheat, which are usually cultivated in the region. According to the evaluation of the results so far, it seems that the productivity of the new land is at the same level as the productivity of the wider area and, in some cases, exceeds it. Apart from the cultivation of crops in the rehabilitated areas of the mines in the West Macedonia Lignite Center, a pilot greenhouse for hydroponic cultivations with the use of teleheating is being run in cooperation with the National Agricultural Research Foundation and the Technological Educational Institute of Florina. A model orchard has been developed in the internal deposition area of the Main Field of the West Macedonia Lignite Center with apple trees, pear trees, plum trees, cherry trees and other species, as well as a vineyard for wine production for the purpose of demonstrating to the farmers of the region the possibility of developing agricultural activities with increased added value. In the Megalopolis Lignite Center, there have been experimental cultivations of specific plant species (e.g. potatoes, beans, tomatoes) with satisfactory results for potential cultivation, while the experimental crops of grains, oats and vetch produced results similar to those achieved in the greater area. Finally, the West Macedonia Lignite Center Department has leased to the farmers of the area approximately 1,167 hectares.

b) Waste -rock and tailings management

The Stratoni mining installations are situated in Chalkidiki, northern Greece, and include the underground "Mavres Petres" Pb-Zn-Ag mixed sulphide mine and a flotation plant for silver / lead and zinc concentrates recovery. The annual run-off-mine (ROM) production averages to 250,000 tons, 25% of which is recovered as concentrates. The solid wastes produced include waste rock, flotation tailings and neutralization sludge from the neutralization of the mine water.

The tailing management scheme involves the classification of flotation tailings into a filtered coarse fraction and a slurries fine fraction, representing 85% and 15% of the total tailings weight, or equally 65% and 10% of the ROM weight, respectively. The coarse fraction is recycled on total as backfilling material, with 60% being used for backfilling the voids of the current activity and the remaining being used for the backfilling of the nearby old "Madem Lakkos" mine. The tailings slimes slurry is mixed with the neutralization sludge and filtered with the use of filter presses before disposal.

The waste rock produced from new main accesses and mine development, is used in total as construction material for road paving and construction after crushing. With the above tailings management scheme, for each ton of ROM produced at Stratoni, only 0.1 m³ of solid wastes (tailings slimes and neutralization sludge in almost dry form) need to be disposed on the surface.

In conclusion, the Stratoni waste management strategy with the beneficial use of the main residues (coarse tailings and waste rock) in combination with the use of innovative techniques for the dehydration of the remaining streams (filter presses for tailings slimes and the mine water sludge) has resulted in reducing, to the minimum possible, both the environmental risk and the cost of the mine closure.

c) Community social programs

c1) Ancient quarries of Dionyssos turned into Museum

The ancient quarries of Dionyssos, located at Pentelikon mountain, the source of the marble used to built the Parthenon, have been made accessible to the public through a series of paths built from the plentiful waste rock scattered at the site. A design team ensured that the artificial landscape dating back to the 5th century BC is preserved, giving the visitor the opportunity to comprehend the scale of operations and the challenges of working with minimal equipment in a remote area.

Dionyssomarble S.A. commissioned a landscape sculptress, aided by a group of architects to reconvert the old quarries into a public space. The aim was to create a landscape in harmony with its surroundings, revealing the various stages of its evolution in time, a succession of strata in which man's active participation is noticed, transforming the old complex of quarries to a living history museum. The museum essentially consists of a series of paths through the old quarry. For its construction marble was used from the piles of stone found at the foot of each hollowed-out rock face. Parts of the quarry face were buried by rubble, which was then removed to show the rock face. No mortar, concrete or other imported building materials were used; indeed, the quarry is inaccessible to machinery. The museum is set beside a ramped slide that survives from the original quarry.

Traditionally, stone was worked on in the quarry and then slid down the hillside on a prepared ramp, which has been preserved.

c2) Vagonetto Mining Park

Vagonetto Mining Park, located in Fokida, Central Greece, is an underground Theme Park built in a former bauxite mine site after closure. Vagonetto was created and is supported financially by S&B Industrial Minerals S.A. in its bauxite mining operations, at the 51st km of the Lamia – Amfissa National Road, and has been in operation since September 2003. More than 35,000 visitors have already visited the Park. A guided walk through the underground workings aided by sound, lightning and life-like figures of miners at their work posts, introduces the visitor to the mineral extraction process and the lives of those worked there.

The purpose of the Fokis Mining Park is not only to present the different phases of operations in the mine, but also to inform and educate - in a vivid and entertaining manner - the visitor about the history of bauxite exploitation in Fokis and of all those who worked in it. The idea for this project came from the people who worked in the mines and wanted to preserve and share their memories of the place – now inextricably linked with the bauxite mining process. A visit to Vagonetto is considered a valuable educational and entertaining experience for children, young people, teachers and families.

c3) Milos Mining Museum

The Milos Mining Museum is located in Adamas, the harbor of Milos island. It was established in 1998 on the initiative and financing of S&B Industrial Minerals S.A. and its goal is to honor and display the rich mining history & tradition of the island. Since 2007 the museum operates as a non-for-profit organization. The purpose of the Milos Mining Museum is:

- To present the social, economic and technological aspect of the mining activity and tradition of the island
- To become a place of interest and a point of visit for the traditional tourism of the island
- To become a place of attraction for the children and the youth of Milos
- To become an educational destination for schools & students and for tourists with specific interest in geological & volcanic activity regions

c4) Former Lignite mine turned into motocross track

Another good practice concerning mine rehabilitation is partial conversion by the PPC of the devastated landscape of a former lignite mine (in Megalopolis, Peloponnesus) to a motor cross track, covering an area of 60 hectares. The track has been qualified as a model track by major international bodies of this sport and has hosted international races.

c5) Wide range of uses of old lignite mines

At the West Macedonia Lignite Center in northern Greece 100 hectares of depleted lignite mine have been put to a wide range of uses by the PPC, including an exhibition centre, visited by more than 5,000 people per year, an artificial wetland, which is aimed for use as an environmental education reserve, an open-air theatre, a siviculture park, a railway history park, a biomass crop plantation, a small animal reserve and a leisure park and lake, attracting therefore a diverse set of visitors and developing multiple economic activities in a region that still hosts active lignite mines nearby. Respectively, at the Megalopolis Lignite Center, similar uses have been developed, including an Expo Center, a recreational park, artificial wetlands, the motor cross track and a runway used by ultra light aircrafts.

Recently, there is a growing interest for establishing Renewable Energy Plants (especially photovoltaic parks) in former lignite waste sites after closure or in abandoned (never rehabilitated) quarries. PPC has proposed specific operation plans for both the Kozani and Megalopolis lignite waste sites, aiming to turn the former significant CO₂ emissions producing lignite sites into large clean energy producing sites.

c6) Support for Reforestation of Fire-Devastated Areas

The TITAN Cement Group is assisting the regeneration of the natural environment in the areas of Greece devastated by forest fires. In response to the needs of these areas the Group – working in close collaboration with the Reforestation Directorate of the Ministry for Rural Development and Food, the local authorities and NGOs - has already provided 73,000 saplings for planting and has offered to provide a further quantity of various saplings for the next planting season.

c7) Setting water reservoirs to west Parnitha Mountain

The TITAN Group settled water reservoirs with capacity between 20-50 m³ at eight different points of the west Parnitha Mountain to strengthen the fire fighting work in a forest area that often suffers from fires. Seven reservoirs replenish directly through a network of permanent water supply. Two open-type tanks of 30 m³, designed for refuelling fire fighting helicopters, were located at positions designated by the municipality and the fire department.