Challenges and opportunities in the mining and metallurgical sector

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The Greek land houses a wide portfolio of minerals with countless uses in industry and daily life; many of them in leading position worldwide.

- **Lignite**
  2nd in the EU, 5th worldwide

- **Magnesite**
  Largest exporter in Europe

- **Perlite**
  1st worldwide

- **Laterite**
  One of the largest producers in Europe-key for the national ferronickel metallurgy

- **Marble**
  Global leader in quality, acquiring market share

- **Bauxite**
  Largest producer in Europe-key for the national aluminum industry

- **Bentonite**
  1st in Europe, 3rd worldwide

- **Aggregates**
  Key for the cement industry and construction

- **Gypsum / Pozzolan**
  Key for the cement industry
This variety of minerals is spread across many locations and site types – metallic mines, lignite pits, marble and aggregates quarries.
Leveraging these resources, Greece has always derived considerable value and competitive advantage through mining activity.

Mineral resource centered activity has traditionally been a key driver of economic development (through trade and innovation), employment (in urban centers but mainly in the periphery), trade, and ultimately competitive advantage for the Greek economy.
Even during the recent economic crisis, the Greek Mining Industry continues to thrive pushing the economy towards sustainable growth

- Accounts for 3% of the Greek GDP
- Generated a total value of €1.2 billion in 2014
- Extracts more than 30 different minerals, 10 of which in quantities larger than 300,000 tons per year
- Export value exceeds €1 billion – across several countries mainly to Europe
- Constitutes almost 5% of total Greek exports
- Employs directly 20,000 individuals and indirectly 80,000 individuals
- Top employer – especially in the Greek periphery – occupying 4% of the active population
- Investments lever in fixed assets and a magnet for equity investors: GMEA members are executing approximately €300 mio worth of investments per year

Source: IOBE, 2015
The Greek mining industry has weathered effectively the economic crisis thanks to a number of factors. The Greek Mining Industry managed to show resilience during the crisis thanks to the following key four factors: sound risk management practices, extroversion, financial credibility, and responsible operations.
The mining industry is a lever of sustainable development and growth…

...but this is not without challenges
Public opinion has also fluctuated but now embraced the industry as a driver of growth and competitiveness

While Greeks are not hopeful for the future, they view the mining industry favorably:

16% of Greeks think that the recovery prospects will improve in the next few months

93% of Greeks think that the government has not acted towards attracting investments

86% of Greeks think that the exploitation of mineral resources is key to economic development

50% of Greeks think that mining activity favors job creation

40% of Greeks think mining activity helps the local economy and community

73% of Greeks agree that there is no political will to exploit mineral resources

Source: RASS, 2/2017
Mining activity causes a temporary, visual disruption on the physical environment

- The majority of extractive activity in Greece concerns aggregates, industrial minerals, energy minerals and sulfur-free metals
- Current rehabilitation projects include the creation of forests, artificial lakes, museums, venue for cultural shows and arable land – post-mining land use
- Through the implementation of L998/1979, more than 65 thousand square kilometers have been rehabilitated (36% of land under exploitation)
- Since 2007, more than 2.6 mio trees have been planted
- Additional environmental challenges are created during the extraction and processing of sulfur-containing minerals as well as during lignite combustion for electricity production which are effectively managed using new technologies

Source: IOBE, 2015
A common debate: Tourism and Mining – friends of foes?

Examples of successful mining and tourism symbiosis

- **Hallstatt, Austria**
- **Carrara, Italy**
- **Lesbos**
Mineral industry and digitalization: threat or opportunity?

**Centuries-old industries, which went through former revolutions**

Very few newcomers, little interest from digital giants

**Materiality of mining and transforming minerals, physically or chemically,**

**Threat?**

No sign of digital disruption … yet

- Disruption has its own dynamics
- Visibility momentum may be already late to adapt

**Opportunity?**

Definitely yes, the question is “how does it serve our vision and strategy”?
From technological drivers to operational concepts

<table>
<thead>
<tr>
<th>Promised capabilities</th>
<th>Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyber-physical systems</td>
<td>Agility</td>
</tr>
<tr>
<td>Internet of things</td>
<td>Connectivity</td>
</tr>
<tr>
<td>Cloud computing</td>
<td>Power</td>
</tr>
<tr>
<td>Big data analytics</td>
<td>Agility</td>
</tr>
</tbody>
</table>

- **Agility**
  - Real-time

- **Connectivity**
  - Reliability
  - Predictability

- **Power**
  - Safety
  - Traceability

- **Adaptability**
  - Customization
  - Customer intimacy

- **Comprehension**
  - Digital mine
  - Smart factory
  - End-to-end integration

- Software commands and control the physical world
- Connected objects and sensors measure the world
- Computing power and space are available everywhere
- Artificial intelligence will outperform the human brain
- The machine can read through a gigantic amount of data
Three main types of programs:

**Industrial and commercial excellence programs: efficiency driven**
- Incremental improvements
- Based on identified room for improvement and risk-benefit analysis
- Traditional approach of industrial performance: mining, processing, supply chain, purchasing, etc.

**Innovation and strategy: growth driven**
- Based on innovation and “megatrends” analysis
- Stage-gate process for risk management
- Leading potentially to radical change and to new business models

**Early stage: pilot programs**
Key examples of pilot projects (1/3)

Mine fleet management
Refractory

- Embedded sensors and IT systems
- Early detection of issues: predictive maintenance
- Operating parameters and real-time supervision by standard KPIs

Machine learning
Kaolin

- Prediction of the refined product brightness
- From easy acquired but indirect data
- Using statistical computing and machine learning

➢ Safety
➢ Productivity

➢ Predictability
➢ Avoid loss of material
Key examples of pilot projects (2/3)

Automation in loading and dispatching

- Self-loading system, no operator
- Safety rules integrated
- Full documentation availability
- No manual data entry for drivers

- Process stability
- Efficiency
- Safety

Quality control Rotary kilns

- Quality control performed by fully automated robot (chemistry, mineralogy, particle size), big data treated to ensure quality and traceability from control room

- Consistency improvement
- Benchmark between all kilns
Key examples of pilot projects (3/3)

3D printing

Solutions for tableware and sanitaryware 3D printing - prototypes and short series
Possible developments in precision casting, special concretes, technical ceramics
- Fast and flexible
- Repeatable
- Waste reduction
- Plastic cartridges recycling

.opens a new area of value creation
• Revolution of the ceramic industries?
The physical world (still) needs physical solutions

Half of the world is exposed to vector-borne diseases
212 millions new cases of paludism in 2015
429 thousands died of malaria in 2015

Mechanical insecticides from amorphous silica have been developed (mineral: diatomite)
Non-chemical and affordable
The physical world (definitely) needs physical solutions

Over 500,000 children under 5 die each year from diarrheal diseases, caused by lack of clean water or adequate sanitation

ImerPure, a filtration cartridge was developed to clean water at ~ $0,04 per day and per family
Progress is about bringing solutions to the world

8 million tons of plastics end up in the oceans every year
80% of all litters in the ocean is made of plastic, causing dramatic damages to biodiversity
Only 20 to 30% of plastic waste is recycled (in Europe)

One of the UK’s leading plastic recycling companies recycles a wide range of rigid plastics, adding minerals, and resulting in compounds performing as well as original polymers, but from waste materials.

Game changer?
Thank you for your attention!

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