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Evaluation of the environmental performance of the Natural stone industry based on Sustainable Indicators

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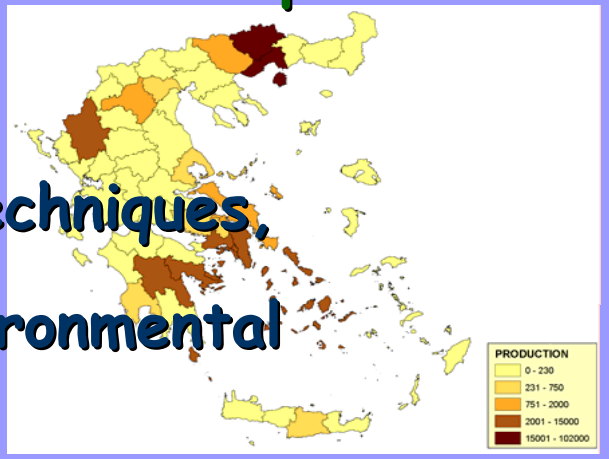
Outline

1. Introduction, Natural Stone-I-STONE
2. *SDIs for the Extractive Industry*
3. SDIs to assess the natural stone quarries environmental performance
4. Application of the Eco-Label Criteria in stone quarries- Case Studies in Europe
6. Discussion- Conclusions

Natural Stone Industry in Europe

- Main stone products used as ornamental stones : marble, granite and limestone
- Dynamic extraction sector, comprising mainly of SMEs (60,000 companies/500.000 employees)
- Main EU producers: Italy, Spain and Portugal
- Greece, 2.1 Mt marble, represents 7% of European quarry production
- Recognized difficulty to apply novel techniques, innovations, holistic operational and environmental management strategies



I-Stone:

"Re-Engineering of Natural Stone Production Chain Through Knowledge Based Processes, Eco-Innovation and New Organizational Paradigms"

- EU Integrated Project funded by the 6th FP
- Aiming to contribute in the improved performance of the Natural Stone Industry
- Project Objectives: Re-engineering of the stone production chain. Increase efficiency and productivity and minimise the amounts of waste disposed

2. SDIs for the Extractive Industry, including the Natural stone sector

Extractive Industry/Natural Stone sector

Goals

- Rationally develop mineral health
- Provide economic prosperity, environmental protection and social equity
- Transfer skills and technology
- Provide employment
- Develop local infrastructure
- Enhancement of national trade balance

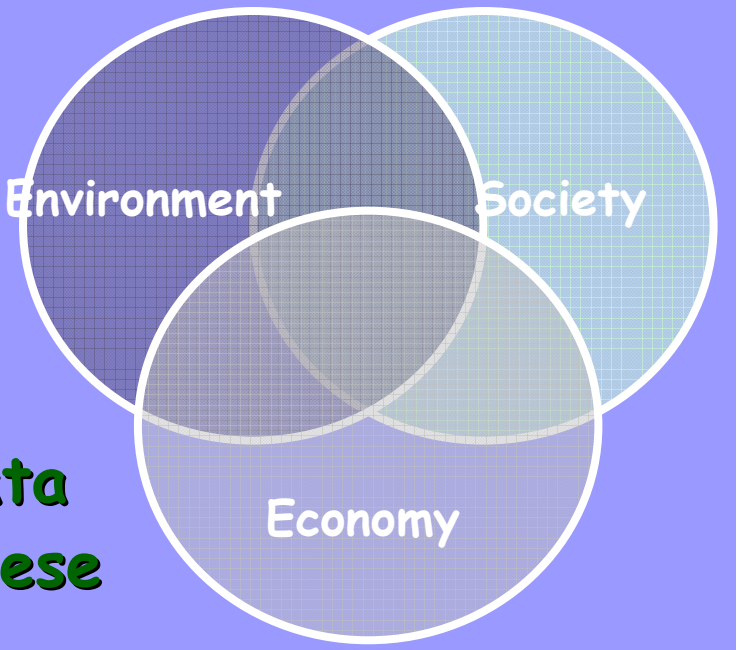
Challenges

- Non renewable nature of natural resources
- Increased energy consumption
- Land take
- Potential impacts on soil and water

Requirement for a holistic approach, effective sustainable planning and operation, SDI tools to monitor, assess,compare and report performance

- Research conducted on the environmental management within the I-Stone project
- Focuses on use of sustainable indicators as a tool for the assessment of stone industry's performance
- Selection of indicators based on Commission Decisions and reported studies

Measuring/Reporting Sustainable performance



- Quantification of Environmental Indicators based on operational data
- Case Studies: Greek and Portuguese quarries

SDIs to assess the performance of natural stone quarries, Review

- Raw Materials Supply Group (RMSG), a group working on sustainability indicators for the EU mining industry published in 2004

- Sustainable Minerals Roundtable (SMR, 2003) covering US Mineral Resources Industry

- Global Reporting Initiative (GRI) that developed Sustainable Performance Reporting Guidelines with a draft section for the mining industry

SDIs used in I-STONE to assess alternative waste management schemes, G. Papantonopoulos, et al, 2007

Category	Indicator	Unit
Environmental	1. Specific volume of stone waste managed	t/m^3
	2. Indicative water consumption during treatment per tonne of stone waste	m^3/t
	3. Energy consumption	High/Low
	4. Chemicals/Reagents consumption	High/Low
	5. Use of dangerous substances (reagents, chemicals)	Yes/No
	6. Transport constraints (average transport distance from source to customers)	High/Low
	7. Environmental incidents (reportable)	Number
Economic	8. Overall indicative treatment and handling costs	High/Low
	9. Indicative capital costs of waste management facilities (if applicable)	€
	10. Indicative savings from landfill fees and rehabilitation costs	€
	11. Total R&D expenditure/turnover	%
	12. Profit making/Added value	High/Low
Social	13. Direct and indirect employment	Number
	14. Risk for accidents	High/Low

SDIs to assess the performance of natural stone quarries

Commission Decision 2002/272/EC, Establishing the Ecological Criteria for the Award of the Community Eco-Label to Hard Floor-Coverings

In addition to the above, the indicators provided in the Commission Decision were used for the quantitative, and comparative evaluation of the stone industry performance.

Matrix evaluating system consisting of 9 environmental indicators with a list of significant factors. Target values rates ranging from excellent to exclusion hurdle, **the maximum score is sought.**

SDIs to assess the performance of natural stone quarries

C. D 2002/272/EC, Establishing the Ecological Criteria for the Award of the Community Eco-Label to Hard Floor-Coverings

Apart from monitoring and improving performance, other **important drivers for the application of above criteria include:**

Recognition as responsible producer, market leader, improvement of international competitiveness, increased access to public procurement

Eco-Label Indicators system, Commission Decision 2002/272/EC

Indicator	Notes		5 (excel)	3 (good)	1 (sufficient)	Exclusion hurdle
I1. Water recycling ratio	(Waste water recycled/Total water exits the process) (m^3)		>95	95-85	84-80	<80
I2. Reh/litation simultaneity degree	m^2 compromised area (quarry front + active dump) / m^2 authorized area (%)		<15	15-30	31-50	>50
I.3 Block recovery	m^3 commercial blocks / m^3 extracted material (%)	Marbles Granites Others	>40 >50 >20	40-30 50-40 20-15	29-20 39-30 14-10	<20 <30 <10
I.4 Natural resource appreciation	m^3 usable material / m^3 extracted material (%)	Marbles Granites Others	>60 >60 >50	60-45 60-45 50-35	44-35 44-35 34-25	<35 <35 <25

Eco-Label Indicators system, Commission Decision 2002/272/EC

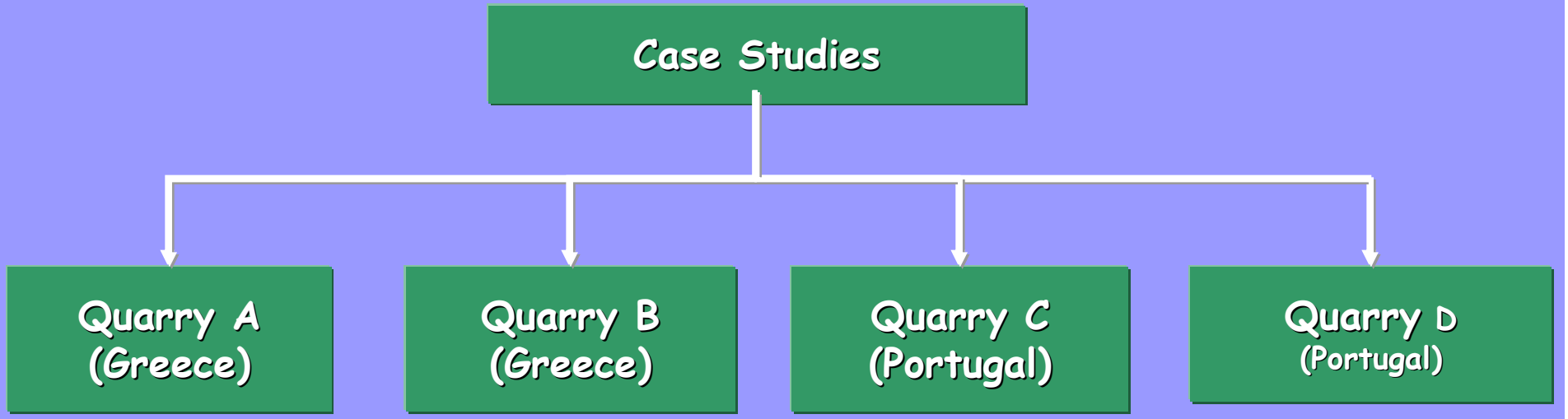
Indicator	Notes		5 (excel)	3 (good)	1 (sufficient)	Exclusion hurdle
I.5. Working conditions of operating equipment	Total number of worked hours / yearly production (h/m^3)	Wheel loader	<3.5	3.5-5.5	>5.5	
		excavator	<2.5	2.5-3.0	>3.0	
I.6. Air quality	Yearly limit value measured along the border of quarry area PM 10 suspended particles (μg / Nm^3)- Testing method EN 12341		<20	20-100	101-150	>150
I.7. Water quality	Suspended solids (mg/l) Testing method ISO 1996/1		<15	15-30	31-40	>40
I.8. Noise	Measured along the border of quarry area (dB(A) Testing method ISO 1996/1		<30	30-55	55-60	>60
I.9. Visual Impact	Percentage (%)		0-10	>10-20	>20-30	>30

Significance Factors, Commission Decision 2002/272/EC

If	Weight	Indicators	are multiplied by
The quarry is is located in notified sites of importance (e.g. NATURA 2000.)	W1	I.2, I.6, I.7, I.8, I9	0.3
Land use potentialities Classes I-IIL III-VI-VL VI-VII-VIII	W2	I.2, I.7	0.3 0.5 0.8
Population density is >100 hab/km^2 Population density is 20 to 100 hab/km^2 Population density is<20 hab/km^2	W3	I.2, I.6, I.7, I.8, I.9	0.5 (0.6) 0.7 (0.84) 0.9
The quarry interferes with surface water-bodies (average flow<5 m^3/s)	W4	I.1, I.7	0.5

Case Studies in Europe

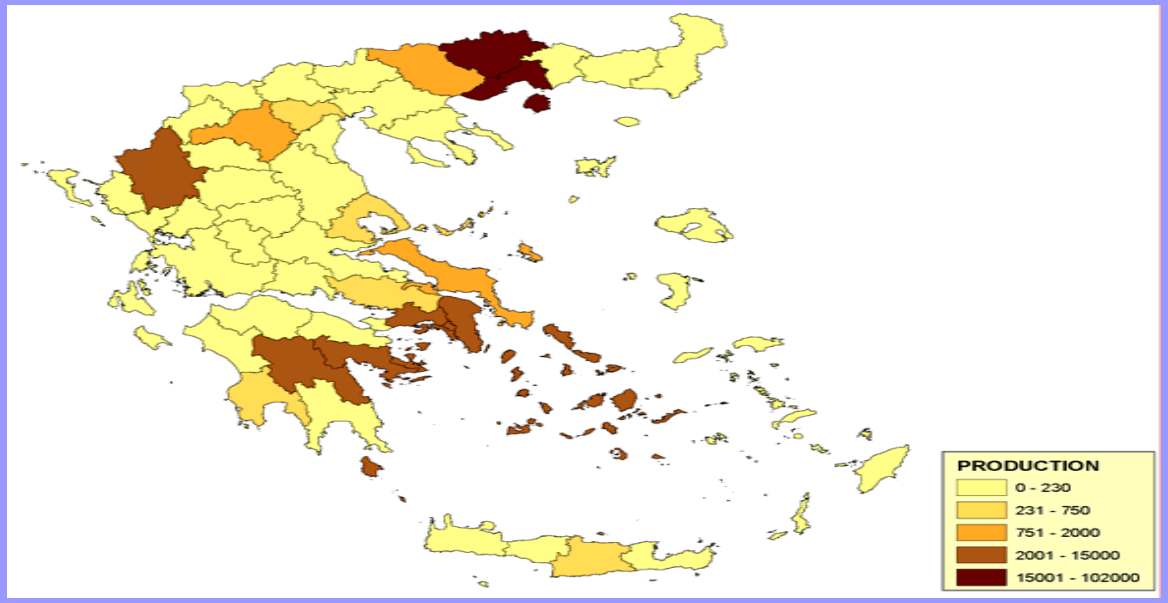
The above eco label criteria were used to assess the environmental performance of four stone quarries based on the respective operational data, where available



Case Studies in Europe

- Greek quarries A and B are related with **marble extraction**.

Major Greek producers. Quarry A constitutes part of a vertically organized activity, where almost all the extracted material are beneficially exploited. Quarry B located in the region where 56% of Greek marble production is originating.



Case Studies in Europe

Portuguese quarries C and D are related with marble and granite extraction respectively. Quarry C in Portugal includes both quarrying and processing activities

- Economic indicators reveal healthy production activities with essential contribution to national economy and environment for all 4 quarries
- Data collected from site visits, and cooperation with SEVALOR, Portugese I-STONE partners

Case Studies in Europe

Significance Factors

- All quarries are not located close to environmentally sensitive areas
- Land use potential is low
- Population density <20 or 20-100 hab/km^2
- No interference with water bodies

Thus, the available indicators values were multiplied with the less impact significance weights

Eco-Label indicators application in selected quarries

Indicator	Quarry A in Greece		Quarry B in Greece		Quarry C		Quarry D	
	Value	Score	Value	Score	Value	Score	Value	Score
I.1 Water recycling ratio (%)	<10	0	<10	0	50	0	50	0
I.2 Rehabilitation simultaneity degree (%)	69	0	98	0/Excl.	77	0	33	1/Suffic.
I.3. Block Recovery (%)	7	0	20	1/Suffic	5	0	50	3/Good
I.4. Natural resource appreciation	97	5/Excel	20	0	90	5/Excel	90	5/Excel
I.6 Air quality - PM10 ($\mu g/Nm^3$)	-	-	-	-	18	5/Excel	19	5/Excel
I.8 Noise (dB(A))	-	-	-	-	41	3/Good	38	3/Good

Discussion

- Data available for a number of criteria only
- Water Recycling Ratio (I.1): values recorded significantly lower than 80-95% set for satisfactory to excellent performance. Deviation may be attributed to the operating conditions prevailing in a quarry in a dry-hot climate
- Rehabilitation Simultaneity Degree (I.2): further improvement on the design of extraction is needed to comply with targets. Extraction in stone deposits is commonly performed at different benches in parallel

Discussion

- Block Recovery, improvement required in extraction method and equipment.
- Natural appreciation, Excellent in 3 out of 4 quarries, subsequent processing phases, where significant percentages of waste recovered
- Air or noise monitoring Performance Good or Excellent in Portuguese quarries/No data available on Greek operations/
- No data were available for the number of working hours, water quality and visual impact of quarrying operations (I.5, I7, I.9)

Summary- Conclusions

- Eco Label indicators proposed in the Commission Decision 2002/272/EC used to quantitatively assess the environmental performance of four Greek and Portuguese stone quarries

- Assessment of operational data demonstrated three of four quarries rated Excellent on Natural Resource Appreciation

Summary- Conclusions

- For indicators such as Water Recycling Ratio and Rehabilitation Simultaneity Degree, additional measures need to be taken to improve quarries performance

- However for these specific criteria it is also proposed that the target values set by the Decision need to be further examined versus the prevailing climatic conditions and the specific site conditions

Conclusions

- Low block recovery can be mitigated with the beneficial use of quarry waste material for the production of medium or high added value alternative products
- Quarry operations showed good/excellent performance regarding atmospheric and acoustic environment, when data available
- Need for systematic equipment working hours, air, water and noise monitoring
- Indicators combined with target values, benchmarking can be used by the stone industry to optimise their operation, environmental reporting and enforce the acceptance of the local communities

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Thanks for your attention