# Environmental Benchmarking as a tool for rational use of energy and water resources by small and medium enterprises in the Mediterranean Region

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## ABSTRACT

The present work discusses and presents Internet based "environmental performance evaluation" and "benchmarking" procedures for improving the competitiveness of SMEs. The monitoring of the environmental performance of SMEs started in 2002 and included a large number of SMEs in the dairy, textile and hotel sectors along the Mediterranean Basin. The results obtained have shown that there is a great potential for both energy and water resources savings. Substantial cost savings could also be achieved if an integrated water and energy management strategy is implemented.

## 1. INTRODUCTION

Over the last century, economic growth has largely contributed in improving the living standards and social development in most of the regions around Mediterranean. Industrialization was the major driving force behind processes usually termed as "social transformation" and "modernization". There are at least three pathways through which industry helps the social development, by (UNIDO, 1998):

- Contributing to economic growth and thus creating a large portion of resources needed to fund social development programmes;
- Creating employment and hence generating income in other sectors as well, such as agriculture and services, through their linkages to industry;
- Promoting various aspects of social integration through its general thrust towards modernization and by making a specific contribution to the integration of women in the production process.

Industrial activities resulted in localized environmental impacts, such as air pollution or surface, but also in global scale impacts, such as ozone depletion and climate change. Overexploitation of energy resources for the sake of short-term economic prosperity, increase of pollution levels in water bodies, ecosystem degradation, dependence on oil and climate change are just few examples of the need for protecting environmental and natural resources.

In the past decades, sustainable industrial development has emerged as a core societal goal, of a powerful socio-political and social dimension, which can facilitate long-term growth, prosperity and employment. As WBCSD states (2001) *"Pursuing a mission of sustainable development can make our firms more competitive, more resilient in shocks, nimbler in a fast changing*

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*world, more unified in purpose, more likely to attract and hold customers, and the best employees and more at ease with regulators, banks, insurers and financial markets"*.

In view of the above, industries are being increasingly forced by governments, international organizations, policy makers and society, to apply environmental protection practices and improve their environmental performance. This has resulted in an ever-increasing pressure on enterprises to report on the environmental impact of their activities. Although in the past, the SMEs environmental behavior was mainly driven by legal compliance, today, it is widely recognized that there are a lot of potential benefits by behaving more consciously and proactively in this area. As J. Ladd Greeno and S. Noble Robinson stated (1992): *"Demands on companies to measure, document and disclose information about environmental performance will become more invasive [...] environmental performance will increasingly become a critical factor to scrutinize"*. Measuring environmental performance enables a level of transparency not previously possible in environmental reporting and provides a powerful tool to evaluate whether businesses are doing the right things (effectiveness) in the right way (efficiency).

Environmental performance measurement quantifies and tracks the relevant environmental aspects and impacts of enterprise activities. Environmental Performance Evaluation (EPE) is the process of selecting environmental indicators and measuring, analyzing, assessing, reporting and communicating an organization's environmental performance against well-defined criteria (ISO, 1999). Environmental performance indicators must exhibit specific characteristics, such as relevance, comparability, a sound scientific basis, reliability, and acceptability and must be based on accessible data and understandable by everyone (Ellipson, 2001; Earth Council, 1997).

Multiple initiatives, of different scope and perspective have been undertaken for the development of environmental performance measurement and reporting frameworks, such as the Global Reporting Initiative (GRI, 2002), the National Academy of Engineering (NAE, 1999), the World Business Council for Sustainable Development (WBCSD, 2000), the International Organization of Standardization (ISO, 1999). The need for a standardized set of Environmental Performance Indicators and a scheme for measurement and reporting has led a large number of companies and relevant associations to undertake initiatives for the development of such indicators (ISO 14031 International Standard; NAE, 1999; MEPI project, funded by the European Commission).

All approaches exhibit remarkable convergence in a set of environmental performance indicators, which include:

- A rather restricted set of generally applicable environmental indicators, complemented by a few sector or company specific indicators, and
- Environmental indicators expressed as ratios of environmental variables (e.g. consumption of water or energy, emissions to air) to output (physical or financial) variables.

The objective of MEPI project was to develop a framework for standardized environmental performance indicators, which could be applied across firms of all sectors. This framework aimed to give a reliable, complete, transparent and verifiable measure of firm's environmental performance.

According to MEPI approach, performance indicators are estimated on the basis of *performance variables*, which are distinguished in *organizational* variables (management and business

variables) and *environmental* variables (Table 1). *Performance variables* are data on performance provided by companies.

**Table 1. Organizational and environmental variables**

| | | |
|---|---|---|
| **Organizational variables** | *Management variables* | ISO registration |
| | | Number of non-compliance events |
| | | Environmental investment reported |
| | *Business variables* | Total sales |
| | | Profit |
| | | Number of employees |
| | | Raw material |
| | | Products |
| **Environmental variables** | *Waste* | Total solid waste |
| | | Recycled waste |
| | *Air emissions* | $CO_2$ |
| | *Wastewater emissions* | COD |
| | | BOD |
| | *Water consumption* | Total Water Consumption |
| | *Energy consumption* | Total Energy Input |

The above variables are used for *performance indicators* estimation. Indicators are *normalized measures of performance*, in essence simple *ratios of two variables* (Tyteca et al., 2002). The most common variables used as denominators to construct performance indicators are:

- Units of production for a given sector (e.g. tones of product),
- Total sales for as given company,
- Number of employees,
- Value added (total value of sales minus total cost of materials purchased).

As environmental performance information expands and becomes more consistent in quality and scope, it is possible to compare the performance of individual organizations against aggregated trends. Standardization of environmental information enables international comparisons and benchmarking of environmental performance. Often, the term *Environmental Benchmarking* simply refers to comparing or ranking environmental performance of different organizations. This is the case of environmental NGOs when trying to compare air emissions or waste generation from different companies or countries. However, benchmarking should also be understood as a tool providing guidance for improving environmental performance, by identifying the gap between company performance and a given performance (European Environmental Benchmarking Network, 2000). Furthermore, Szekely et al (1996) notes that business and environmental performance are intricately linked. In summary, Environmental Benchmarking allows organizations to:

- Identify their environmentally “weak” activities/processes;
- Understand the best practices for the specific activities;
- Improve their production processes and environmental practices;
- Design and implement environmentally effective policies

- Get competitive advantages in the global or regional market.

The objective of this communication is to present a methodology framework and an Internet application for the evaluation of environmental performance and benchmarking of small and medium enterprises. The focus is on the investigation of their energy and water needs and the estimation of the existing potential for cost savings through an integrated energy and water management strategy.

The communication also presents data and results from the hotel sector from 10 countries around Mediterranean. An assessment of the energy and water needs is attempted and the main conclusions, in terms of quantities and costs are presented.

## 2. METHODOLOGICAL APPROACH

The environmental performance indicators and benchmarking was applied through a research project funded by EUMEDIS Initiative, the SMITE project. The goal of the project was to support SMEs to improve their competitiveness and thereby their position in the market, by adopting prevailing environmental policies and practices, using newly developed information technologies through the Internet.

The main objective of the SMITE project was to establish a Web–based System for the SMEs and a communication platform for all stakeholders pertaining to three important economic sectors, the textile, food and hotel sectors in the Mediterranean area. In particular, the SMITE interactive, multimedia and multilingual Web–based System:

- Provides SMEs with up–to–date diagnostic tools for the evaluation of environmental performance of the firms, by entering key operational data online and in return receive automatically generated self-assessment reports;
- Provides information on Environmental Management practices, good examples and best available technologies, and proposes the most appropriate measures for improving environmental performance
- Allows firms to benchmark their environmental performance at the regional and international levels and to make rough estimations of the deriving economic benefits
- Enhances networking activities between businesses, consultants and other stakeholders.

In the SMITE approach, a set of generic indicators, complemented by sector specific ones, was considered as a reliable representation of a company's environmental performance. This set of indicators has been proved to be not only representative, but also reduced complexity while maintaining flexibility.

The multiple dimensions of environmental performance evaluation and assessment makes the decision on whether to or not proceed in the production of aggregated measures of environmental performance one of the most difficult issues. Comparison is further complicated by changes over time (products or processes) that will affect environmental indicators for individual industries. It is argued that environmental performance cannot be compared because companies are different. However, the same could be said of company finances, yet the reporting of financial performance is a matter of routine. Distinctiveness should not stand in the

way of comparison between competitors, be it in terms of profitability, market value or environmental performance" (MEPI, 2001).

The SMITE approach is based on a restricted set of environmental indicators, calculated for each individual enterprise, for the current and previous periods. The multidimensional evaluation of environmental performance was avoided, through the separate presentation of the different performance indicators. The challenge was to produce simple environmental indicator figures, which would allow for comparing the performance of individual industries at the regional and international level.

Environmental performance evaluation is followed by benchmarking. Enterprise are invited to compare their current performance to the *median values* of the same set of indicators, for the same sector in their region (*national* or *regional benchmarking*). Regional values of environmental indicators produced and updated by the model, on the basis of the data being inputted in SMITE.

Benchmarking is based on *BAT values*, which represent the state of the art performance (*International Benchmarking*). BAT values are provided by the relevant literature and case studies at the international level, and they are sector specific.

Following the environmental evaluation and benchmarking, technical interventions and practical measures are suggested by the Web–System which could help reducing environmental burden and consequently improve user competitiveness through cost savings. The basis for recommendations is the present environmental performance, as recorded, and the comparative evaluation with best practices and target values. For each indicator, there is reference to an "*Opportunity Bank*" containing suggestions on how to improve performance. The Opportunity Bank serves as a guide for the SMEs aiming to improve environmental performance by means of cleaner technology.

Finally, and as a last step in the environmental performance evaluation and benchmarking, the enterprise are informed on excessive costs related to their present environmental performance, and the potential cost avoidance achieved when applying BAT. Cost savings are presented for each individual performance indicator and their sum represents the total potential cost savings.

# 3. APPLYING ENVIRONMENTAL BENCHMARKING IN THE MEDITERRANEAN

## 3.1 The Internet based approach

The SMITE methodology was applied to SMEs of the three targeted sectors, which received training and were asked to provide their operational data for two consecutive periods. The survey was based on a 3–part structured questionnaire, which could be filled on-line or submitted offline, with the support of regional SMITE partners, in order to record their business profile and their environmental performance.

The first part of the questionnaire addressed the registration of the SMEs. The collected information was related to firm profile, size, processes and products. For the case of hotels, several details on hotel characteristics and provided services were registered.

The second part of the questionnaire aimed at recording the environmental variables of the registered SMEs, in order to assess their environmental performance and implied costs. Table 2 presents the information submitted by the SMEs.

**Table 2. Data collected for the evaluation of the environmental performance**

| Category | Data collected |
|---|---|
| Energy consumption | Forms of energy<br>Annual consumption<br>Cost of energy |
| Water consumption | Quality of water<br>Annual consumption<br>Cost of water |
| Raw materials consumption | Materials used<br>Annual consumption<br>Cost of raw materials |
| Production size | Primary products<br>Annual production<br>Production cost **or** overnight guests |
| Solid Waste production | Total waste produced<br>Hazardous waste<br>Recycled waste<br>Cost of disposal of each category |
| Wastewater | Produced volume of wastewater<br>Wastewater parameters<br>Cost of treatment/ disposal |

The last part of the questionnaire investigated aspects of the administrative operation of a firm that have an impact on the environmental performance. For that purpose, both qualitative and quantitative information was collected. The survey focused on the following issues:

- Environmental investments and cost savings;
- Environmental training of the personnel;
- Reported environmental accidents and contingency plans;
- Information related to the environmental policy and management.

All qualitative information was quantified with the aid of weighting factors.

Each record in the SMITE database contained data on the performance of an individual firm for a specific period. Each category of performance data was standardized to a particular unit of measurement (e.g. kWh of electricity consumed per year, mg COD /l in wastewater). In total, 44 variables were calculated, which were classified as follows:

- *Environmental variables*, (energy consumption, water consumption, chromium emissions, etc.)
- *Administrative variables*, (environmental accidents, environmental cost savings, etc.)

The calculation of the environmental indicators is performed through the normalization of all variables to a specific measure, relevant to the specific sector (i.e. the annual production of dairy products for the dairy sector, or the total number of overnight guests for the hotel sector). Table 3 summarizes the performance indicators, for each sector, calculated on the basis of the collected data and information.

**Table 3. Performance indicators per sector**

| Performance Indicators | Hotel | Textile | Brewery | Dairy |
|---|---|---|---|---|
| Air emissions | – | ✓ | ✓ | – |
| Chromium emissions | – | ✓ | – | – |
| COD emissions | – | ✓ | ✓ | ✓ |
| Energy Consumption | ✓ | ✓ | ✓ | ✓ |
| Water Consumption | ✓ | ✓ | ✓ | ✓ |
| Waste Production | ✓ | ✓ | – | – |
| Community Complaints | ✓ | ✓ | ✓ | ✓ |
| Environmental Accidents | ✓ | ✓ | ✓ | ✓ |
| Environmental Cost Savings | ✓ | ✓ | ✓ | ✓ |
| Environmental Investments | ✓ | ✓ | ✓ | ✓ |
| Environmental Training Cost | ✓ | ✓ | ✓ | ✓ |
| Environmental Training Hours | ✓ | ✓ | ✓ | ✓ |
| General Awareness on Environmental Issues | ✓ | ✓ | ✓ | ✓ |

Despite the efforts, it has not always been possible to obtain all the required data by each registered SME. Table 4 shows that the most frequently reported environmental variables were those related to the energy and the water consumption, as all companies receive the respective bills from the relevant utilities, which are in most of the cases available.

**Table 4. Completeness of indicators sets – Environmental Performance**

| Environmental Performance Indicators | Hotel | Textile | Brewery | Dairy | Total |
|---|---|---|---|---|---|
| Air emissions | – | 66.7% | 75.0% | – | 67.6% |
| Chromium emissions | – | 0.0% | – | – | 0.0% |
| COD emissions | – | 26.7% | 25.0% | 33.3% | 29.7% |
| Energy Consumption | 93.0% | 73.3% | 100.0% | 80.0% | 85.1% |
| Water Consumption | 93.0% | 73.3% | 100.0% | 80.0% | 85.1% |
| Waste Production | 66.7% | 33.3% | – | – | 55.2% |

The response of the SMEs was relevant to the market size of the sector in each country. Tourism and all related activities are very important for the Mediterranean region, and as a result the hotel sector was addressed in all 10 countries. The textile sector, with the exception of Turkey, Tunisia and Egypt, is declining, and the response was limited. From the food sector, only the dairy and brewery sub–sectors were contacted, with the latter exhibiting a very limited response, as brewery large plants are very few.

In the following paragraphs, a presentation of the Environmental Performance of the hotel sector is attempted, with focus on energy and water consumption.

## 3.2 Environmental Performance of the Hotel Sector in the Mediterranean Basin

From the registered enterprises in the hotel sector (in total 94 hotels were approached), 80 provided data for their specific energy and water consumption. Evaluation results are shown in Figure 1 and Figure 2. The solid line indicates the average behavior of all the SMEs, which corresponds to the regional benchmarking value. Average behavior is expressed as the statistical median of all individual performances. The dashed line indicates the consumption corresponding to *Best Practices*. For the hotel sector BAT value for energy consumption is 0.104 GJ/overnight guest and BAT value for water consumption is 0.611 $m^3$/overnight guest.

It is clear that a large number of the SMEs that participated in the SMITE initiative has already undergone a series of energy and water saving measures resulting to the substantial improvement of their energy and water performance. However, there is still a large potential for savings all over the Mediterranean Region.

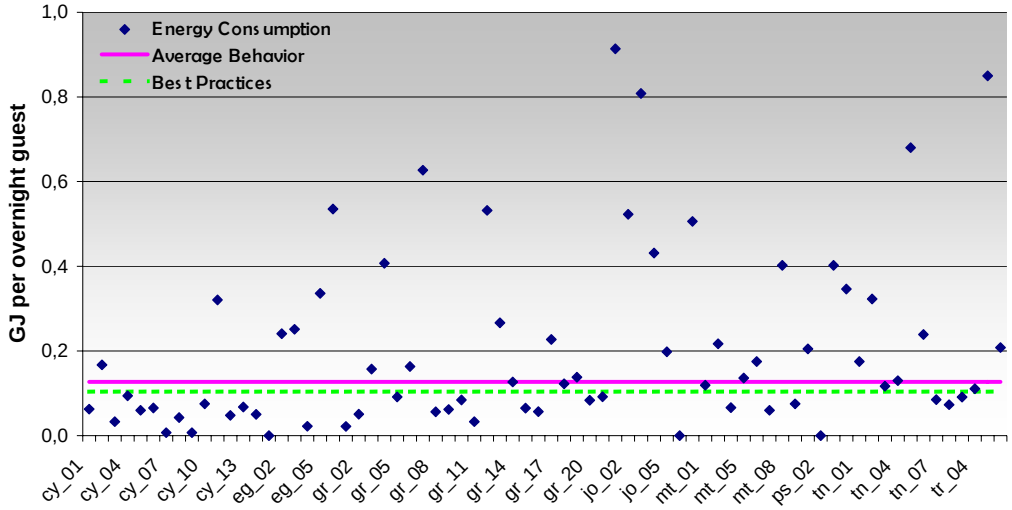


**Figure 1. Energy Consumption in the Hotel Sector around Mediterranean**

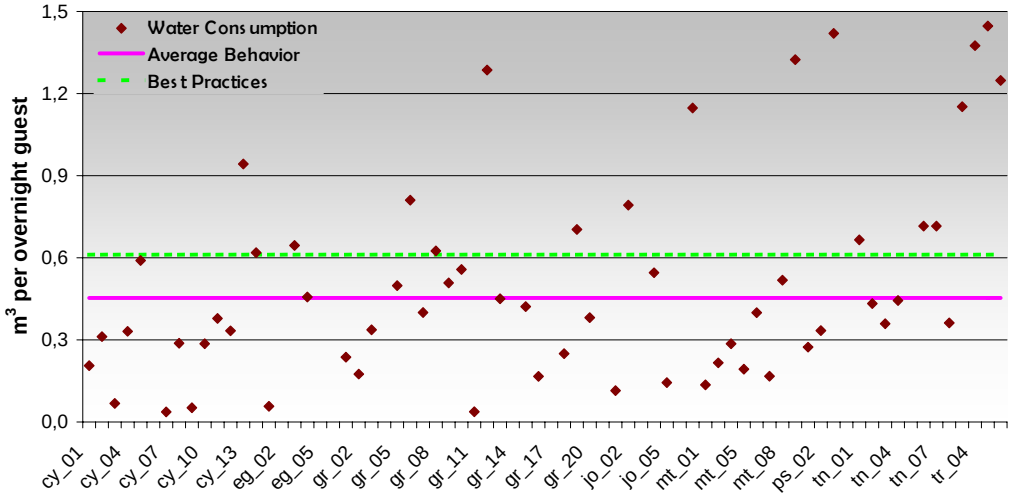


**Figure 2. Water Consumption in the Hotel Sector around Mediterranean**

As a second step, average consumption patterns for energy and water at national level were estimated, as shown in Figure 3. Minimizing the gap between the national and the regional average would result in substantial savings for the economies of the Mediterranean Region, and could lead to a great relief for the individual enterprises as well.

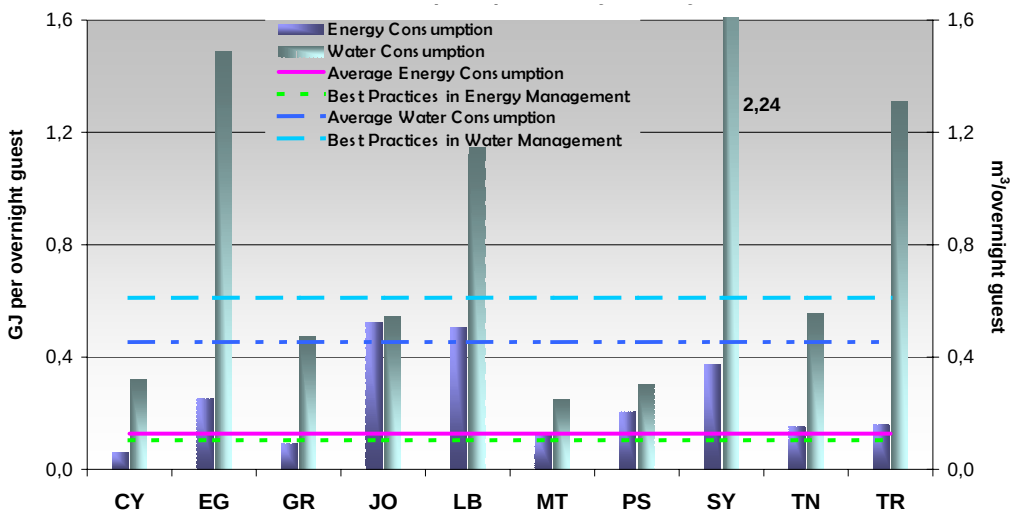


**Figure 3. Consumption patterns – Average energy consumption in the involved regions**

It should be made clear that energy and water consumption expressing the best practices in the hotel sector, correspond to consumption patterns recorded at large hotels (>150 rooms) with several additional recreational facilities, such as swimming pools, gardens, restaurants etc. Therefore, direct comparison with the establishments of the sample is not always feasible, as some of the latter are of the simple "bed and breakfast" type, in which both energy and water needs are minimal. This partly explains the inversion observed in Figure 3, where average water consumption of all the included hotels in the survey is lower than the performance corresponding to "best practices".

## 3.3 Potential for Resource Savings

The large potential for energy and water savings was investigated with the help of two scenarios. In both scenarios, potential savings in energy and water consumption have been calculated for each individual hotel and for the total of the 80 hotels. The first scenario is based on the average behavior of all the enterprises whereas the second scenario is based on the best practices in energy and water management.

As presented in Table 5 and Table 6, energy savings up to 44.5% and water savings up to 36.6% could be achieved for the whole region, if technical interventions and changes in the management practices are adopted.

**Table 5. Potential for Energy Savings**

| Country | Consumption (GJ/year) | Average Behavior Scenario | | Best Practices Scenario | |
|---|---|---|---|---|---|
| | | Margin (%) | Consumption (GJ/year) | Margin (%) | Consumption (GJ/year) |
| Cyprus | 187,252 | – | 187,252 | – | 187,252 |
| Egypt | 1,327,207 | 49.5 | 670,886 | 58.6 | 549,387 |
| Greece | 84,551 | – | 84,551 | – | 84,551 |
| Jordan | 51,579 | 75.7 | 12,529 | 80.1 | 10,260 |
| Lebanon | 1,314,933 | 74.9 | 329,955 | 79.5 | 270,199 |
| Malta | 87,959 | 0.4 | 87,614 | 18.4 | 71,747 |
| Palestine | 1,257,107 | 38 | 778,881 | 49.3 | 637,824 |
| Syria | 67,118 | 66.1 | 22,772 | 72.2 | 18,648 |
| Tunisia | 309,086 | 16.7 | 257,384 | 31.8 | 210,771 |
| Turkey | 5,739,307 | 20.4 | 4,569,856 | 34.8 | 3,742,244 |
| | **10,426,101** | **32.8** | **7,001,680** | **44.5** | **5,782,884** |

**Table 6. Potential for Water Savings**

| Country | Consumption ($m^3$/year) | Average Behavior Scenario | | Best Practices Scenario | |
|---|---|---|---|---|---|
| | | Margin (%) | Consumption ($m^3$/year) | Margin (%) | Consumption ($m^3$/year) |
| Cyprus | 845,299 | – | 845,299 | – | 845,299 |
| Egypt | 488,380 | 69.6 | 148,570 | 59,0 | 200,389 |
| Greece | 526,606 | 4.4 | 503,289 | – | 526,606 |
| Jordan | 95,682 | 17 | 79,464 | – | 95,682 |
| Lebanon | 140,200 | 60.5 | 55,362 | 46.7 | 74,671 |
| Malta | 162,859 | – | 162,859 | – | 162,859 |
| Palestine | 16,817 | – | 16,817 | – | 16,817 |
| Syria | 410,400 | 79.8 | 82,873 | 72.8 | 111,778 |
| Tunisia | 752,205 | 18.3 | 614,401 | – | 752,205 |
| Turkey | 1,134,331 | 65.5 | 391,805 | 53.4 | 528,461 |
| | **4,572,779** | **36.6** | **2,900,738** | **27.5** | **3,314,767** |

Based on the cost data provided by the majority of the hotels, an average specific cost for energy and water was calculated, at country basis. The overall weighted average energy cost was estimated at € 3.05/GJ whereas the weighted average water cost is estimated at € 0.87/$m^3$. Using the results of the previous analysis, the potential cost savings for both scenarios were estimated.

Figure 4 and Figure 5 present the annual cost of energy and water for each one of the involved countries. The total potential cost savngs for the first scenario is estimated at 15.7 million € and the respective value for the second scenario is 20.4 million €. It should be noticed that energy and water savings potential and the corresponding cost savings have shown great differences among the countries of the region.

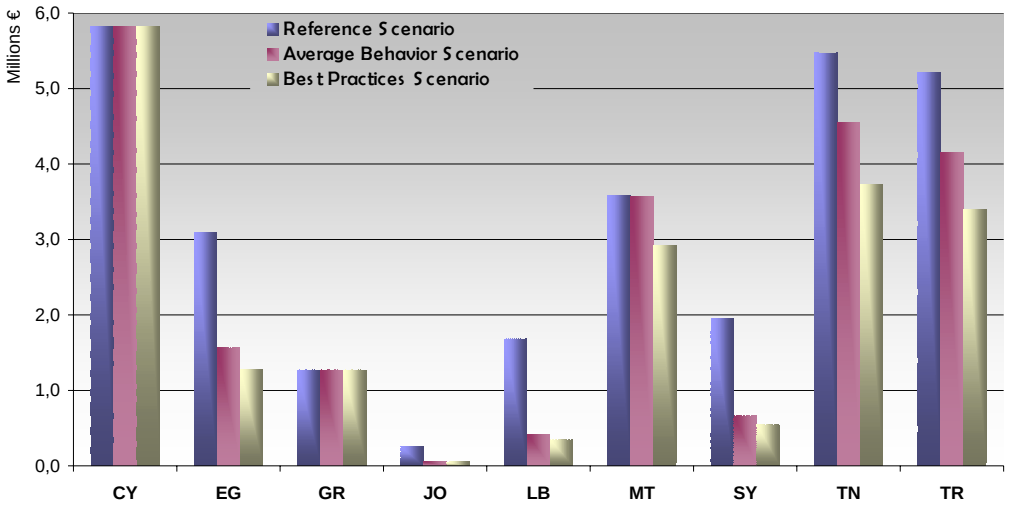


**Figure 4. Annual cost for energy for the reference state and the alternative scenarios**

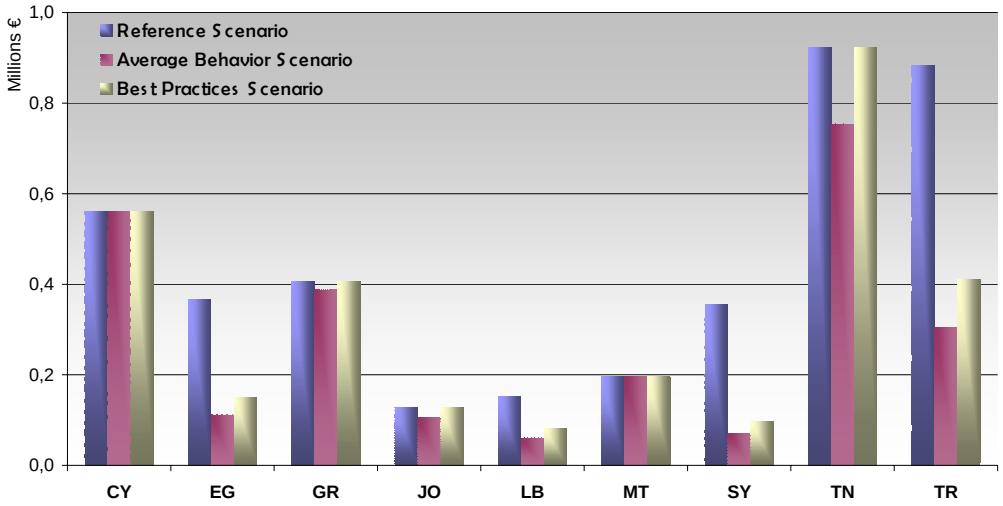


**Figure 5. Annual cost for water for the reference state and the alternative scenarios**

Finally, total cost for energy and water consumption was estimated for the entire sector. Cost comparison of the current consumption pattern, as depicted by the Web–based tools, versus the average behavior for selected countries in the Mediterranean Region is presented in Figure 6.

With the exception of Cyprus, there are possibilities for considerable cost savings ranging from some thousands Euros (the case of Greece) to approximately 25 million Euros in annual basis for Tunisia.

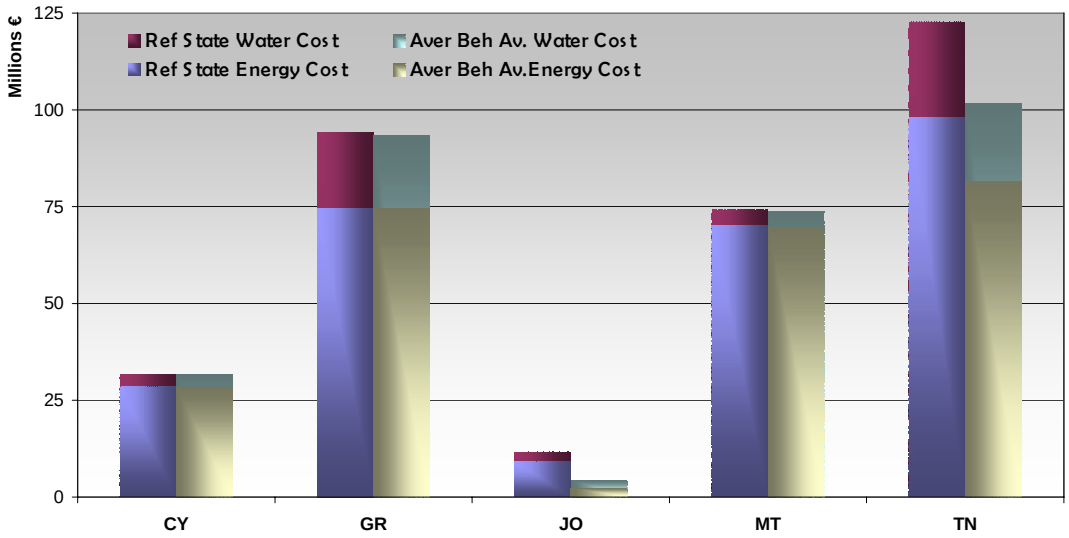


**Figure 6. Total potential cost at national level versus the reference state**

## 4. CONCLUSIONS

This paper has attempted to investigate the importance of environmental performance evaluation and benchmarking for both environment and business. The results obtained for the hotel sector in the Mediterranean region, have proved the great potential benefits for both energy and water resources and for the SMEs of the sector.

Tourism is one of the major sources of income for all the countries around the Mediterranean. New tourist facilities, as well as new types of tourism are constantly developed but environmental impacts of tourism activities are significant (e.g. consumption of valuable resources). Water consumption can be seen as a major threat because of the increasing scarcity in all Mediterranean regions and especially coastal resorts. Additionally, with the exception of Egypt and Algeria (which was not included in SMITE initiative), the entire region depends on oil and natural gas imports to meet the energy demand.

As a consequence, any feasible savings in water and energy consumption will be in favor of the economic prosperity of the Mediterranean countries. Any measure leading to better management of resources will be a great relief for the national economies and more specifically for the tourism sector.

A better environmental performance combined with large cost savings may improve the competitiveness of SMEs and substantially contribute to the regional sustainable development.

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