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Investigating DSM Solutions' Applicability in the GCC Environment

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Collaboration between the EU and GCC started more than three decades ago, in 1988, with the progress so far, as described by several authors,[1] falling short of initial expectations. According to Briani (2006), it seems that the political and cultural contacts between the two regions are not strong enough, resulting in a steady relationship of low intensity.[2]

The Gulf Cooperation Council (GCC) was set up in 1981 as a regional organization aiming to enhance coordination, integration and inter-connection among its members, namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates. All GCC members are also members of the Arab League, while Qatar, Saudi Arabia, Kuwait and the United Arab Emirates (UAE) are also prominent members of OPEC.[3]

Relations between the EU and GCC are based on the 1988 Cooperation Agreement which seeks to:

1. G. Luciani and T. Schumacher, "Relations between the European Union and the Gulf Cooperation Council – Record and Promises for the Future" (Dubai: GRC, 2004); V. Kostadinova, "What is the Status of the EU-GCC Relationship?" GRC Gulf Papers, 2013.
2. V. Briani, Report of the workshop on "Fostering EU-Italy-GCC Cooperation. The Political, Economic and Energy Dimensions," Istituto Affari Internazionali, 2006.
3. A. Papadopoulou, N. Al Hosany, Ch. Karakosta, J. Psarras, "Building Synergies between EU and GCC on Energy Efficiency," *International Journal of Energy Sector Management* 7, no. 1 (2013): 6-28.

- strengthen stability in a region of strategic importance
- facilitate political and economic relations
- broaden economic and technical cooperation
- broaden cooperation on energy, industry, trade and services, agriculture, fisheries, investment, science, technology and environment.

The Agreement provides for annual joint councils/ministerial meetings (between the EU and the GCC foreign ministers) and for joint cooperation committees at senior officials' level. The last two meetings were held in Luxembourg in 2012 and Bahrain in 2013.[4]

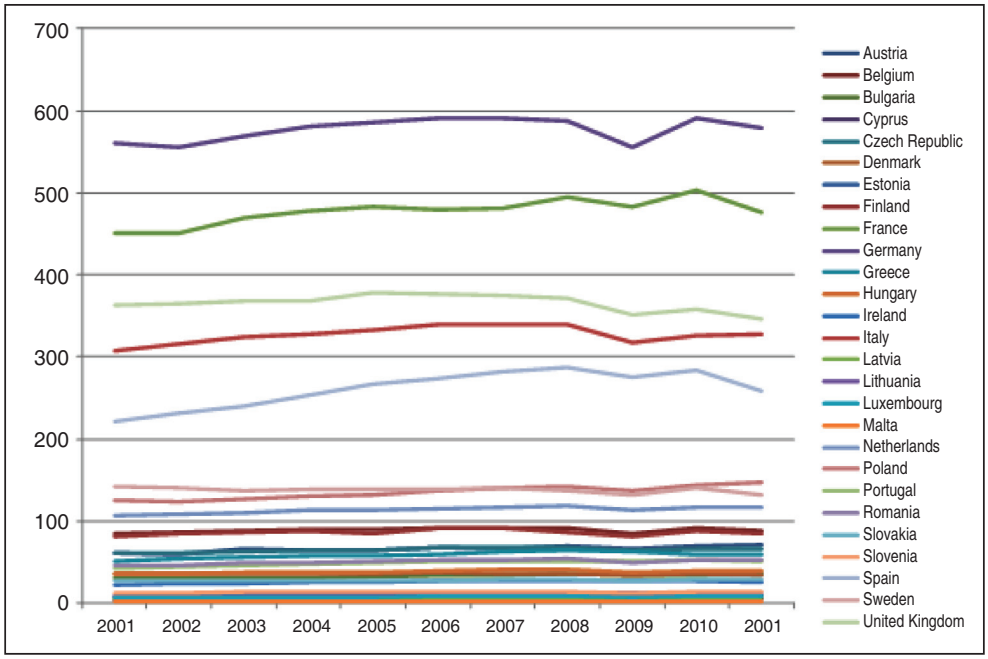
The EU and the GCC agreed on a Joint Action Programme for 2010-13, setting out a roadmap for closer cooperation on issues such as ICTs, nuclear safety, clean energy, research, and economic dialogue.[5] Cooperation between the EU and GCC on clean energy issues has been promoted through a number of projects financed by the EU, the most recent ones being the "EU-GCC Clean Energy Network"[6] and "Promoting Deeper EU-GCC Relations"[7] projects, while the "Sharaka"[8] initiative was targeted at the promotion of EU-GCC relations in general, including the energy sector. The projects were focused on the exchange of know-how on technologies and policies between the two regions, so that both may benefit from each other's experiences.

The EU countries are characterized by high electricity consumption trends, which, however, have stabilized during the past decade, with relatively small variations. Fig. 1 shows the electricity consumption in EU-27 during the decade 2001-2011.

It is evident that these countries have already reached the peak of their consumption, since their economies are already developed and mature and show little variations. Of course, the countries comprising the biggest economies in the EU (Germany, France, Italy, and the United Kingdom) account for the highest consumption. A slight drop in the consumption during the years of the global economic crisis is observed, with 2008 being the year where this reduction is most evident.

4. European Union External Action (2013), "EU Relations with the Gulf Cooperation Council." (available at: http://eeas.europa.eu/gulf_cooperation/index_en.htm).
5. Ibid.
6. EU-GCC Clean Energy Network, http://www.eugcc-cleanergy.net/.
7. Promoting Deeper EU-GCC Relations, http://eu-gcc.kcorp.net/.
8. Enhancing Understanding and Cooperation in EU-GCC Relations (Sharaka project), http://www.sharaka.eu/.

Fig. 1: Electricity consumption trends in EU 27 (TWh)

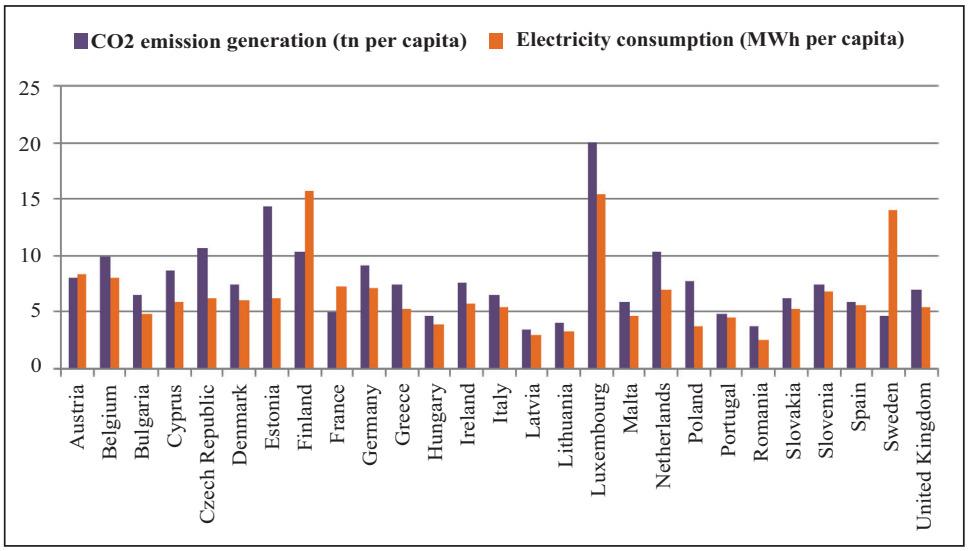


Source: IEA 2013.

The trends if examined on a per capita basis, as presented in Fig. 2, clearly display a more accurate view on the countries that are the leaders in electricity consumption and total CO_2 emissions per capita. It should be noted at this point that the CO_2 emissions are not only from the energy sector, but also include the total emissions at the country level divided by the population. However, this number still remains representative of the energy sector's contribution to the overall carbon dioxide emissions.

Luxembourg, Finland, and Sweden present the highest electricity consumption per capita; however, due to their different energy mix, which for Finland and Sweden is largely based on RES, the overall CO_2 emissions per capita are significantly lower. Estonia, the Czech Republic, Netherlands, and Finland follow closely on the emission generation per capita.

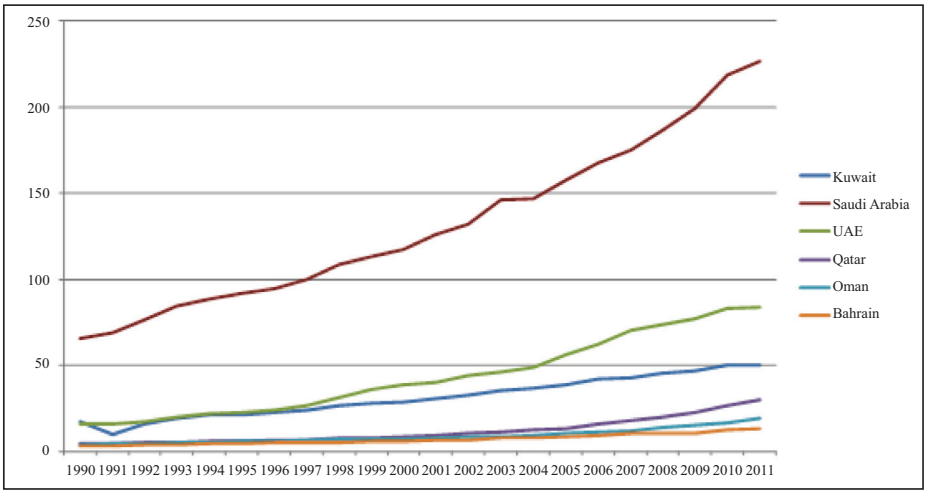
Fig. 2: Electricity consumption and GHG per capita trends in EU 27 for 2011



Source: IEA 2013.

As regards the GCC, a more clear idea on the prevailing situation in the region can be obtained through the following figures. Fig. 3 shows the trends in electricity consumption for the GCC countries for the period 1990-2011. Although all countries show high electricity consumption, Saudi Arabia's consumption is almost two times that of the next country in line, namely the UAE. Since these countries' economies are still considered developing, and they have experienced a large population increase, these electricity consumption trends are expected to continue rising, even with lower increase rates.

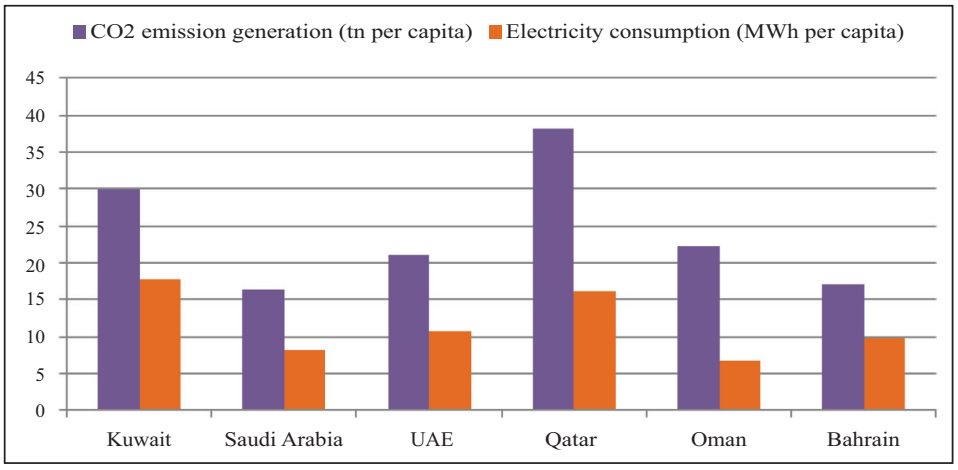
Fig. 3: Electricity consumption trends in the GCC countries (TWh)



Source: IEA 2013.

Electricity consumption per capita in the GCC is almost two times higher than the EU average, while the GHG emissions are over three times higher.

Fig. 4: Electricity consumption and GHG generation per capita in GCC countries



Source: IEA 2013.

Due to the high electricity consumption, there is plenty of scope for energy-efficient technologies and programs in the GCC region. In general, energy efficiency has been an essential area of focus for the European energy-importing countries at the legislative as well as the policy level through a number of research activities.[9] On the other hand, the energy-exporting countries, such as the GCC, have shown little effort so far towards energy conservation, mainly due to the abundant and relatively cheap access to energy resources. While no harmonized policy on energy efficiency exists in the GCC states, recent developments show some changes at the individual country level. The large untapped potential for energy efficiency and demand side management (DSM) programs in the GCC region is therefore evident.[10]

1. Barriers Inhibiting the Penetration of DSM Programs in the GCC

Internationally, according to Arimura et al. (2009), the average levelized cost of electricity saved in most DSM programs is within the range 1.6-6.4 US cents per

9. H. Doukas, A.G. Papadopoulou, J. Psarras, M. Ragwitz, B. Schlomann, "Sustainable Reference Methodology for Energy End-Use Efficiency Data in the EU," *Renewable and Sustainable Energy Reviews* 12, no. 8 (2008): 2159-2176; H. Doukas, A.G.Papadopoulou, C. Nychtis, J. Psarras, N. van Beeck, "Energy Research and Technology Development Data Collection Strategies: The Case of Greece," *Renewable and Sustainable Energy Reviews* 13, no. 3 (2009): 682-688.
10. A. Papadopoulou, H. Doukas, C. Karakosta, I. Makarouni, R. Ferroukhi, G. Luciani, J. Psarras, "Tools and Mechanisms Fostering EU-GCC Cooperation on Energy Efficiency," in World Renewable Energy Congress 2011 Proceedings in Linköping, Sweden, Linköping University Electronic Press, Linköping, 2308-2315.

saved kWh.[11] IEA (2012) states that a significant share of the economic potential of energy efficiency – four-fifths in the buildings sector and more than half in industry – remains untapped, mostly due to non-technical market/regulatory barriers.

In principle, there are three basic categories of barriers inhibiting the promotion of energy efficiency: structural, market and behavioral barriers. The structural and market barriers correspond to those barriers that are beyond the control of the end user, while behavioral barriers describe the parameters affecting the end user's decision making procedure, which may interact with the structural barriers. All these categories of barriers based on studies[12] are presented in Table 1 and are analyzed in this section.

Table 1: Basic categories of barriers inhibiting the promotion of DSM programs

Structural Barriers	Market Barriers	Behavioral Barriers
Low energy prices	Lack of energy data	Risk of energy efficiency investments
Lack of labels and standards	Lack of measurement and verification protocols	Lack of awareness
Limited access to capital	Lack of life cycle methodology	Misplaced incentives
	Weak price elasticity	Bounded rationality

More specifically:

- **Low energy prices.** In the GCC region, energy is considered social wealth, and as such it is available to the GCC residents, nationals and foreigners, at subsidized prices, which are lower than the actual cost of production. Thus, the prices that GCC consumers pay for fuels do not reflect either the production cost, since they are heavily subsidized, or the environmental (CO_2 emissions, etc.) and social costs associated with the fuels' production, conversion, transportation, and use.
- **Lack of know-how, codes and standards.** The GCC states have been very active in the last decade in their efforts to adopt cutting-edge technologies and to gather researchers and scientists from all over the world in their universities,

11. T. Arimura, R.D. Newell, K. Palmer, "Cost-Effectiveness of Electricity Energy Efficiency Programs," 2009.
12. E. Hirst and M. Brown, "Closing the Energy Efficiency Gap: Barriers to the Efficient Use of Energy," *Resources, Conservation and Recycling* 3 (1990):267-281; A.B. Haney, T. Jamasb, L.M. Platchkov, M.G. Pollitt, "Demand Side Management Strategies and the Residential Sector: Lessons from International Experience," Cambridge Working Paper, 2010; Abu Dhabi's Executive Affairs Authority, "Comprehensive Demand-Side Management Study," Private Communication, 2009.

in order to boost research into these thematic areas. However, research is focused largely on RES, and less on energy efficiency, in line with the GCC states' policies and goals. Moreover, the research currently being carried out still remains mainly behind university walls or whenever integrated in the legislation, does not have an obligatory character (e.g., building codes).

- **Limited access to capital.** Although not one of the most significant barriers for the region, the lack of Public Private Partnerships (PPPs) or similar frameworks to facilitate energy efficiency financing is an impediment. Moreover, the GCC countries currently emphasize on the promotion of RES, similar to the EU attitude in the 90s, rather than energy-efficient technologies and programs. Thus, although funds may be readily available, they are not directed towards the promotion of energy efficiency.
- **Lack of energy data.** In order to apply DSM programs, one should be able to quantify their anticipated benefits. Thus, the lack of proper energy data to constitute the energy baseline, based on which the savings will be calculated, makes it more challenging for the utilities to launch such programs.
- **Lack of measurement and verification protocols.** In addition to the above, the lack of proper measurement and verification methodologies and protocols for the calculation of savings also constitutes a barrier.
- **Lack of life cycle methodology.** There does not exist a standard life cycle cost/carbon calculation methodology for the determination of cost-optimal levels of energy efficiency.
- **Weak price elasticity.** Due to the extreme climate conditions in the region, the use of air conditioners is a vital necessity. Since no alternative energy source apart from electricity exists for their operation, this makes the problem of their use more intense.
- **Risk of energy efficiency investments.** The risk of energy efficiency investments is mainly financial, due to the low energy cost.
- **Lack of awareness.** One of the major barriers for the promotion of energy-efficient technologies and programs is the lack of awareness of the benefits as well as the related risks deriving from adopting these technologies.
- **Misplaced incentives.** The problem in this category is mainly related to the different incentives of the engaged decision makers and users. For example, in the case of the construction companies or building owners, the motives for the selection of the technologies to be used in the buildings' construction are

mainly their initial cost, while for the users (building tenants in this case), the motives are mainly the low operation cost.

- **Bounded rationality.** This specific barrier describes the decision makers who either due to lack of available information, or due to lack of time, take decisions based on criteria which are not descriptive of the real situation as a whole.

Tackling these barriers is highly challenging, since it requires a coordinated effort from the government side, the utilities, as well as the citizens themselves. The following section focuses on some of the legislative measures that have been adopted in the EU, which could be a guide for the GCC states.

2. EU Legislative Framework

The EU region is a frontrunner in tackling climate change and energy efficiency issues. During the '90s, the EU placed emphasis mainly on RES, and significantly less on energy efficiency. However, initial efforts and subsequent measures from that period in the direction of energy efficiency include:

- Adoption of efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels (Directive 1992/42/EC)
- Indication by labeling and standard product information of the consumption of energy and other resources by household appliances (Directive 1992/75/EC) and consequent directives between 1992-2002 for its application on specific household electricity consuming equipment (lamps, washing machines, dishwashers, air conditioners, electric ovens).
- Adoption of Minimum Energy Performance Standards (MEPS) for the ballasts designated for fluorescent lamps.

During the '00s, the Lisbon Strategy aimed at making Europe more dynamic and competitive to secure a prosperous, fair, and environmentally sustainable future for all citizens. The energy efficiency directives adopted during this period were mainly focused on the following four pillars: buildings, cogeneration, internal electricity market, and energy end use efficiency.

Related directives from that period include the following:

- Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand
- Directive 2006/32/EC on energy end use efficiency and energy services. Achievement of an indicative energy saving target of 9 percent by 2016. Of particular interest regarding DSM are:

- ✔ Promotion of 'the adoption of real-time demand management technologies such as advanced metering systems'
- ✔ Billing of actual energy consumption and informative billing (provision of comparisons with an average normalized or benchmarked user of energy in the same user category, or user's consumption data for previous periods)
- ✔ Energy distributors, distribution system operators and/or retail energy sales companies provide on request aggregated statistical information on their final customers to the designated body
- ✔ Removal of those incentives in transmission and distribution tariffs that unnecessarily increase the volume of distributed or transmitted energy

- Directive 2003/54/EC concerning common rules for the internal market in electricity. Details of the tendering procedure for Energy Efficiency (ENEF)/ DSM measures must be published in the *Official Journal of the European Union* at least six months prior to the closing date for tenders
- Directive 2002/91/EC on the energy performance of buildings:
  - ✔ Adoption of Minimum Energy Performance Requirements for the buildings at the national level
  - ✔ Classification of the buildings' energy performance and issuance of a certificate
  - ✔ Major renovations of existing buildings above a certain size (1,000 sq.m.) should incorporate energy efficiency measures
  - ✔ New buildings are required to meet the set energy performance standards
  - ✔ Mandatory inspection of boilers and air conditioning systems at regular intervals depending on their rated output
- Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishes a framework for the setting of ecodesign requirements for energy-using products and amends Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council. 'Ecodesign' means the integration of environmental aspects into product design with the aim of improving the environmental performance of the product throughout its whole life cycle. In principle, the framework directive applies to all energy-using products that are placed on the market. It also covers parts that are intended to be incorporated into products that are placed on the market as individual parts for end users, the environmental

performance of which can be assessed independently. All energy sources are covered, in particular electricity and solid, liquid and gaseous fuels. It applies to all products placed on the EU market and to imported products. Means of transport (vehicles) for people or goods are excluded. In 2009, Directive 2009/125/EC, the recast of the Ecodesign Directive 2005/32/EC, was adopted (extension to energy related products).

- Directive 2010/30/EU on labeling and standard product information of the energy and other resources' consumption by energy-related products. Entry into force July 2011, repealing standing Directive 92/75/EEC
- Directive 2010/31/EU on the energy performance of buildings. Nearly zero-energy buildings by 2020, leading role for the public sector, minimum energy performance requirements, regular inspections of HVAC systems and independent control systems for energy performance certificates and inspection reports. Entry into force mid-2012, repealing standing Directive 2002/91/EC

In an effort to establish a common methodology for the calculation of cost-optimal levels for buildings' minimum energy performance requirements, the EU has issued the guidelines accompanying the Delegated Regulation (EU) No 244/2012, which supplements the Energy Performance of Buildings Directive (EPBD).

The methodology specifies how to compare energy efficiency measures, measures incorporating renewable energy sources and packages of such measures in relation to their energy performance and the cost attributed to their implementation, and how to apply these to selected reference buildings with the aim of identifying cost-optimal levels of minimum energy performance requirements.

The cost-optimal framework methodology is based on the net present value (global costs) methodology. The calculation of global cost considers the initial investment, the sum of annual costs for every year, and the final value as well as disposal costs if appropriate, all with reference to the starting year. For the calculation of the macroeconomic cost optimum, the category of global costs is to be expanded by a new category, the cost of greenhouse gas emissions defined as the monetary value of environmental damage caused by CO_2 emissions related to the energy consumption in a building. EU energy policy till the '20s derives from the EU 2020 Strategy (replacing the Lisbon Strategy) that promotes the 20-20-20 targets, namely 20 percent energy savings, 20 percent RES, and 20 percent reduction of GHG emissions.

A new Directive 2012/27/EU on energy efficiency, amended directive 2010/30/EU on labeling and standards and repealed directives 2004/8/EC on cogeneration and 2006/32/EC on energy end use efficiency. The main changes introduced include:

- Establishment of a long-term strategy for mobilizing investments in the renovation of the national building stock
- Specification of annual renovation rates of public buildings
- Purchasing of only high energy efficiency products by public bodies
- Energy distributors and retailers undertake the responsibility of achieving end use savings
- Promotion of cogeneration and district heating and cooling for heating and cooling purposes

Moreover, this Directive actually opens the road for Holistic Energy Management and highlights the importance of Energy Management Systems (for example, ISO 50001:2011) as monitoring tools for increasing energy efficiency in organizations. The same directive also advises the use of energy service companies and the concept of energy performance contracting to finance energy efficiency activities.

3. Legislative Framework and Proposals for the GCC

No harmonized policy exists in the GCC countries and changes occur at the individual country level. A brief overview of recent activities at the policy and legislative level in the GCC follows.[13]

- **United Arab Emirates:**
  - **Abu Dhabi.** Long-term program for the privatization of the electricity sector, Plan Abu Dhabi 2030. "Estidama" initiative on green building guidelines, utilizing the Pearl Rating System. A DSM strategy for electricity and water consumption within the Emirate is underway. An additional recent effort realized in the Emirate of Abu Dhabi is the Comprehensive Cooling Program. Clearly, from both the energy conservation point of view and the peak demand reduction point of view, the Emirate's demand side management efforts should be initially focused on air conditioning. That is the rationale behind the Comprehensive Cooling Program (CCP) launched by the Executive Affairs Authority of Abu Dhabi in 2012. The CCP aims at reducing electricity consumption from air conditioning by 30 percent in the Emirate by 2020.
  - **Dubai.** Adoption of a sustainable development policy ("Dubai Strategic Plan 2015"), introducing green building standards and water and energy conservation

13. A more detailed analysis may be found at Papadopoulou et al. (2013).

- **UAE.** New energy efficiency label and standard scheme has been launched in an effort to reduce country's environmental impact. It was introduced in 2010 by the Emirates Authority for Standardization and Metrology.

- **Kuwait:** Ministry of Electricity and Water has developed a code of practice for energy conservation in buildings, placing emphasis on HVAC, since 1983. A revised version of the code was issued in 2010.
- **Oman:** Electricity companies trying to implement certain DSM programs are facing difficulties such as large subsidies offered for tertiary sectors' tariffs.
- **Qatar:**
  - Qatar Green Building Council (QGBC) has the mission to educate and increase awareness and develop a set of green building best practice guidelines.
  - Qatar Sustainable Energy and Water Utilization Initiative is a project to improve desalination technologies and promote public awareness of sustainable use of energy.
  - National Vision 2030 on sustainable development is supported by Dohaland, introducing new urban living concepts, aimed at delivering sustainable development that is energy-efficient, high in performance and low in wastage.
- **Saudi Arabia:**
  - Ministry of Water and Electricity has systematically promoted DSM, by founding the Energy Conservation and Awareness Department, imposing limits to the maximum power that can be delivered to electricity consumers, establishing DSM actions, and rationalizing the use of electricity.
  - Saudi Arabian Standards Organization adopted several standards aiming to limit the penetration of inefficient electrical appliances without however having the effective power to enforce these standards.
  - Joint implementation by KACST and UN/DESA of the National Energy Efficiency Program in 2003.
- **Bahrain:** A number of activities promoting energy conservation and DSM measures have been realized. These programs are targeted towards thermal insulation, energy audit, power factor, CFLs, labels and energy standards, load control, and awareness raising.

It is therefore clear that efforts are being realized in the GCC region, although these efforts are not unified as in the case of the EU. However, there are a number of experiences that the GCC could learn from the EU, to further boost the promotion of energy efficiency, as follows:

- The adoption of Minimum Energy Performance Standards (MEPS) in household and office appliances, through the promotion of standards and labels. So far, only the United Arab Emirates, Saudi Arabia, and Bahrain have made efforts to adopt standards and labels, without succeeding in promoting them into real market change. The adoption of readily available standards from the EU with regard to items such as white goods (refrigerators, freezers, ovens, washing machines) and recreational and other equipment (TVs, light bulbs etc.) could be an option. Emphasis should be placed on equipment with very different operational conditions, such as air conditioners, where EU standards are not considered appropriate.
- Since buildings are one of the biggest energy consumers in the GCC, efforts to promote energy efficient buildings should be a priority for the region. Indeed, Dubai and Abu Dhabi in the UAE, as well as Qatar, have adopted or are currently at the adoption stage of ambitious building codes, which set the building standards in the region. The problem with these initiatives is that on the one hand they are not mandatory, and that, on the other hand, they deal extensively with new buildings rather than focusing on the existing building stock. Based on EU experience, the mandatory nature of a measure is necessary to ensure its adoption in large numbers.
- Efforts to raise awareness and promote energy efficiency consciousness are existent but limited. Usually these programs are realized in the EU by large utilities, sometimes in the framework of other DSM activities. Due to the regulated electricity market and the lack of priority given to energy efficiency at the central policy level, DSM programs for residential consumers are scarce in the GCC region. However, in conjunction with the low energy costs that discourage citizens from adopting energy-efficient solutions from the financial perspective, these programs may be a true solution for the utilities. Rising electricity demand has forced the GCC states to continuously increase their thermal power plants' installed capacity, which results in a very high cost from the investment point of view, while it creates additional problems for the operation and stability of the grid. Moreover, in this investment cost the opportunity cost for those energy resources incautiously spent, if they were sold in the international market, should also be added. It therefore seems that

the DSM programs could be a certain solution towards the promotion of energy efficiency. In this context, a decision at the policy level for the utilities to adopt DSM programs for their customers should be a legislative priority.

- One of the sectors that has failed to get much attention in the GCC is the mechanisms for financing of energy-efficient and renewable energy investments. And although RES projects receive government and corporate funds since they are at the center of GCC energy policy, this is not entirely the case for RUE investments, which remain on the periphery of the region's energy policy. Thus to implement these mechanisms, it would be useful to look into the Third Party Financing option and the Energy Service Companies' concept. The main barrier for this activity remains the low energy cost that is heavily subsidized and does not include the environmental externalities, such as the CO2 emission cost.

4. Demand Side Management Programs: EU Experience and Suggestions for the GCC

Demand Side Management (DSM) programs address overall activities in three areas: energy conservation, improved energy efficiency, and demand response. The necessity for their implementation in the regulated US and EU markets was underlined following the need to reduce the installed capacity required to satisfy peak loads. Even in the deregulated markets that the majority of these countries evolved to with the passing of years, the successful implementation of DSM programs was considered cost effective, although the electricity companies' sales of end products were reduced. The avoided costs deriving from the increased energy savings relate to the following three categories:[14]

- **Capacity related costs.** The reduction of the overall peak load and energy demand results in lower investment cost for new installed capacity, as well as reduced costs for the overall infrastructure such as transmission and distribution lines.
- **Reduced environmental costs.** Reduced energy consumption closely relates to reduced GHG emissions, the cost of which if it exceeds the set values for the EU ETS plants burdens the utility. This cost is usually passed to the end consumers.

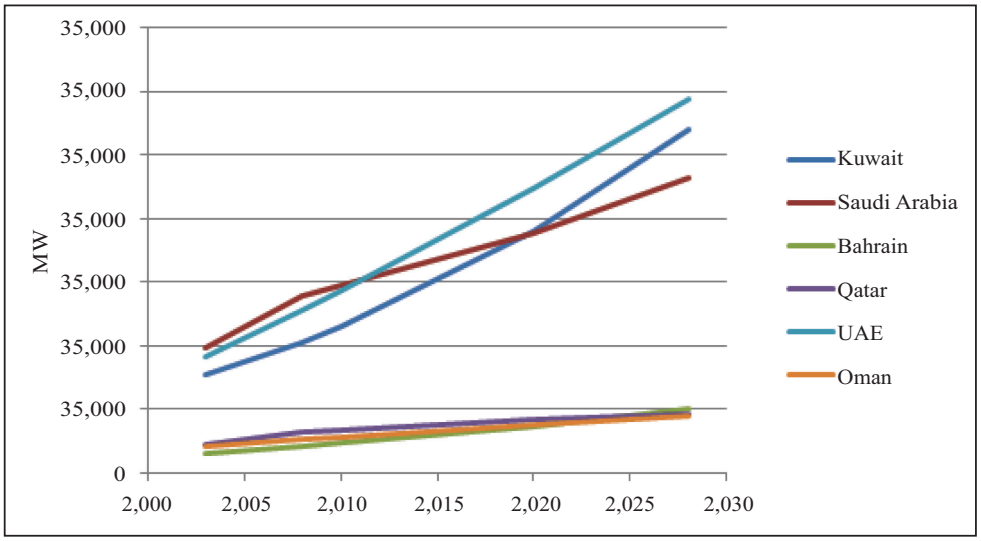
14. National Action Plan for Energy Efficiency, *Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers,* Energy and Environmental Economics, Inc. and Regulatory Assistance Project, 2008.

- **Energy related market costs.** The market purchase cost of the required primary energy source (oil, natural gas, fossil fuels etc.). This also includes the cost of the energy losses in the transmission/distribution network.

Of these three categories, only the second is not applicable in the GCC region, since no GHG emissions' restrictions exist. The third category mainly relates to the opportunity costs from the consumption of the energy resources that could be sold in the international market at current market prices. However, the most important avoided cost category for the decision makers in the region is capacity related costs.

Fig. 5 shows the projected increase of the installed capacity growth in the GCC region, according to Al-Mohaisen et al. (2006).

Fig. 5: Projected electricity demand growth for the GCC[15]



According to the authors, electricity demand growth in Oman and Qatar is projected to more than double by 2028 compared to 2003; for Saudi Arabia there will be an increase of 230 percent, Bahrain and UAE will exceed three times the capacity of 2003, and Kuwait is expected to reach 350 percent.

It should be noted that these data are expected to have been actually lower due to the ongoing economic crisis; however, no other available data seem to exist at the GCC level. When seen in combination with the energy data presented in the introductory section, it is evident that although the crisis has affected the electricity

15. Saudi Arabia demand supplied by SEC – ERB (represents about 38 percent of total load in Saudi Arabia). See A. Al-Mohaisen, S. Sud, "Evolution of the GCC Power Grid," ICF Congress, Chicago, October 2006.

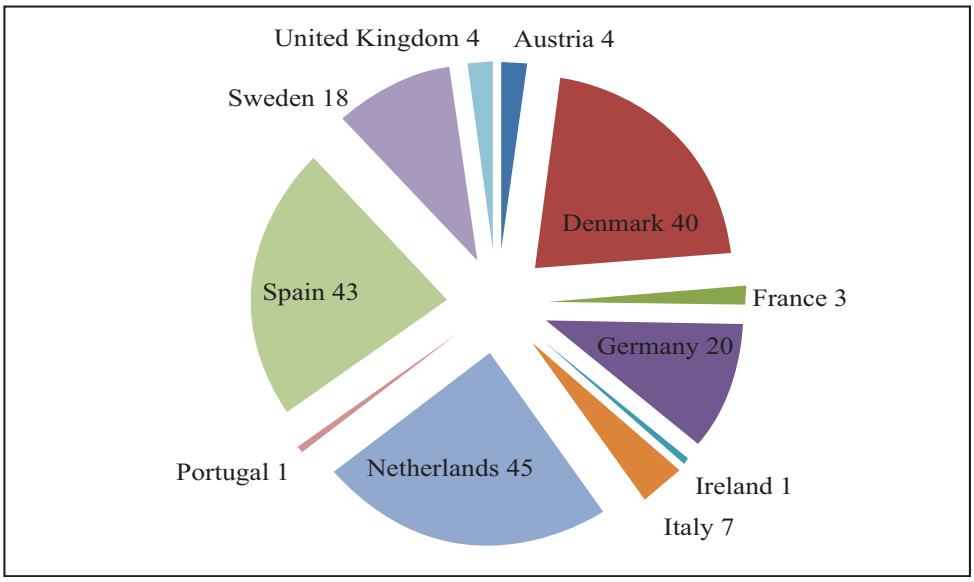
demand growth rates, there is still significant room for the implementation of DSM activities.

Since the GCC has now started its first efforts to implement DSM activities, though it currently has no accurate energy data to implement Demand Response programs, it is considered that increased energy efficiency and energy conservation programs will be more adequate for the region as a starting point.

Therefore, in the following paragraphs the EU experience is briefly examined to extract some basic assumptions on the DSM programs suggested by the authors' team to the GCC.

According to an overview report[16] regarding the framework of the IEA-DSM program and illustrated in Fig. 6, among the countries in the early '00s with significant experience in these programs were Spain, Denmark, and the Netherlands, followed closely by Germany and Sweden. Other countries included France, United Kingdom, Italy, and Austria, though they lagged significantly behind the frontrunners.

Fig. 6: DSM programs distribution in the EU countries in early 2000s

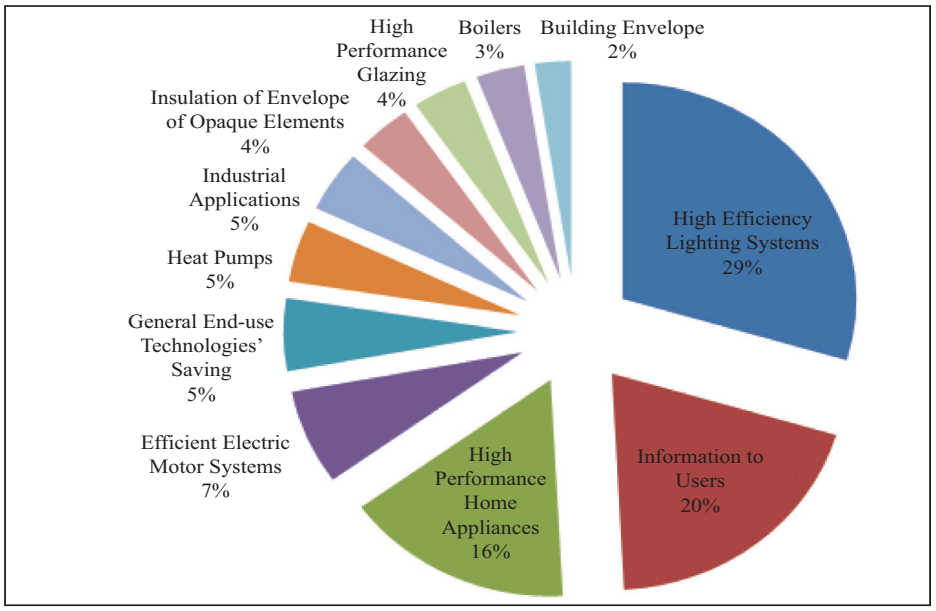


Source: IEA-DSM, Indeep Report, 2004.

A breakdown of these 186 programs on energy efficiency by category is presented in Fig. 7.

16. E. Van der Laar, H. Vreuls, INDEEP, Analysis Report 2004, International Energy Agency, 2004.

Fig. 7: DSM programs categorization in the EU countries in early 2000s



Source: IEA-DSM, Indeep Report, 2004.

The majority of the DSM programs implemented at the time focused on the residential level, on lighting, awareness raising, and home appliances due to:

- The generally lower cost
- Appeal to the largest target audience, having significant reduction potential
- Easier implementation

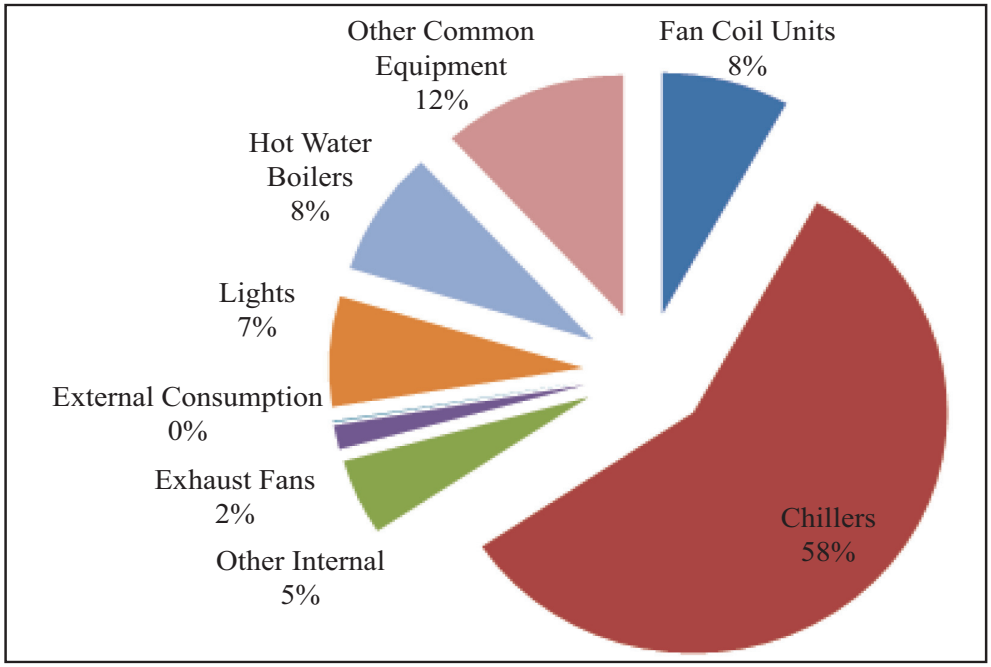
The impact of another significant legislative measure at the technical level which could not be incorporated in the utilities' programs, namely the integration of labels and standards in the household equipment, is reflected through the following example. During the early '90s, the average efficiency of new refrigerators and freezers was static or even declining prior to directives on energy efficiency labeling and standards. The 27 percent observed decline in the average electricity use of new refrigerators and freezers sold in the EU between the early 1990s and 1999 was attributed to labeling and standards.[17]

17. P. Waide, "Findings of the Cold II SAVE Study to Revise Cold Appliance Energy Labeling and Standards in the EU," Proceedings of the 2001 ECEEE Summer Study on Energy Efficiency 2 (2001), Paris: European Council for an Energy-Efficient Economy, 376-389; B. Boardman, "Achieving Energy Efficiency through Product Policy: the UK Experience," *Environmental Science and Policy* 7 (2004): 165-176.

In the GCC, the case of Abu Dhabi is an example.[18] The commercial sector with 32 percent leads in electricity consumption, followed closely by the government (28 percent) and the residential (27 percent) sectors. Industry is responsible for 10 percent of electricity consumption, and agriculture for only 3 percent.

Based on the above, it is evident that the building sector is mainly responsible for the high electricity consumption in the region. A decomposition of electricity end use in buildings is presented in Fig. 8.

Fig. 8: Decomposition of the electricity consumption in buildings in Abu Dhabi



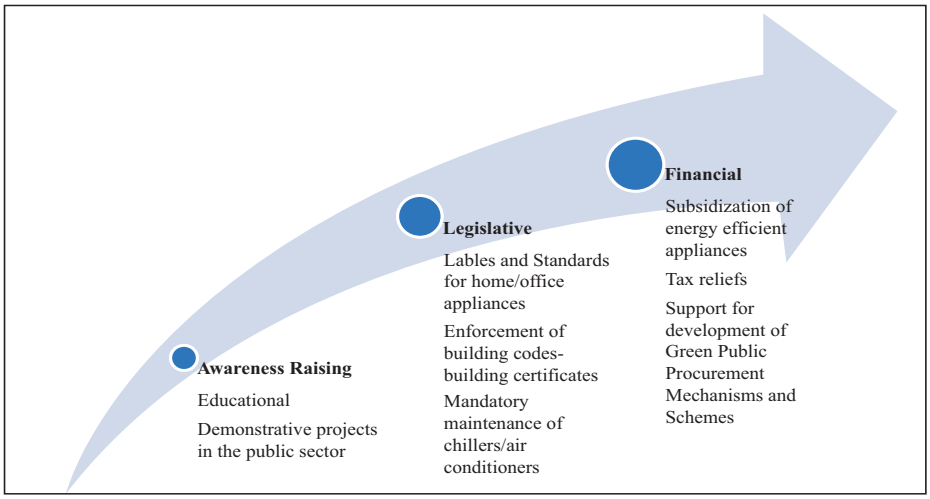
Source: Demand Side Management Study, Abu Dhabi's Executive Affairs Authority, 2009.

Keeping in mind the prevailing situation in the GCC and the existing barriers, the authors concluded that the most promising options for the region are the programs addressing energy efficiency and energy conservation (Rational Use of Energy). This is also in line with the suggestions by Al-Iriani (2005), who identified, in the case of the UAE, minimum efficiency codes and standards, building codes, information and education campaigns, energy efficiency assistance through public funds, and pricing measures targeting the electricity price per kWh as the most promising initiatives.

In line with the above, the main DSM activities suggested by the authors are presented in Fig. 9.

18. Abu Dhabi's Executive Affairs Authority, "Comprehensive Demand-Side Management Study."

Fig. 9: DSM activities suggested by the authors



These activities were discussed in detail during the workshop in Abu Dhabi, in which local experts also participated. The discussions led to the suggestion of policy initiatives mainly focusing on energy efficiency and rational use of energy, which are a priority for the region and are described in Table 2.

Table 2: DSM activities' priorities for the GCC

Energy Efficiency	Rational Use of Energy
Standards, Codes and Labeling for new buildings	Education for long-term effect
Energy Performance Certification of existing buildings, identification of energy saving potential and cost-effective renovations	Awareness raising
Public investments/ incentives to the private sector for interventions	
Training/Certification of energy professionals/technicians	
Market restrictions for appliances/products (Minimum Energy Performance Standards Labels)	

More specifically, it was agreed that the main priority for these programs to be successfully implemented in the region was a sufficient legislative framework.

In accordance with the authors' views, the experts agreed that the focus should be placed on the building sector, with policies that address both the existing as well as the new building stock. Following the experience of EU and the example of certain GCC countries, the majority of the local experts strongly support the adoption of a mandatory labeling and standardization system for new buildings, as well as the energy performance certification of existing buildings. Apart from energy labeling

of a building, the goal of a mandatory energy performance certification is to identify the potential for improvement so that future investments on energy efficiency will be cost-effective. The certificates must also be accompanied by recommendations for cost-effective improvement options to raise the performance and rating of the building. Moreover, the need for trained and certified blue collar workers and energy professionals, in order to optimize the performance of the installed energy equipment and facilities, was also discussed. The final suggestion focusing on the building sector was that market restrictions should be placed on domestic and office appliances. The lack of standards and labels for the GCC market has resulted in its flooding with inefficient appliances, mainly originating from Asia. Among these appliances, emphasis should initially be placed on air conditioners and chillers, which are responsible for the largest contribution to the peak loads during the summer.

These suggested initiatives are expected to significantly transform the existing situation in the region, towards more efficient behavior. However, since the electricity prices are very low and do not encourage the adoption of best practices and energy efficiency programs by the private investors, and because the government maintains policies of keeping energy prices low as a means of social policy, incentives of fiscal nature should be provided. One option could be the establishment of a public fund, which will subsidize the purchase of efficient equipment. Another option could be through tax reliefs for those private investors who allocate large monetary amounts to improving their buildings' energy performance.

As regards the rational use of energy, the citizens should embrace a different way of thinking regarding the energy resources available, since they are an asset for the generations to come. Towards this, awareness-raising campaigns should be launched, targeting the whole population. However, since behavioral changes are long lasting and bear results only when they are taught from a small age, programs in the form of annual courses should be incorporated in the basic educational syllabus for the children.

Conclusion

This paper focuses on the applicability of DSM programs and priorities in the GCC region. The paper highlights the large untapped energy efficiency potential, as well as the necessity to apply DSM policies in the region.

The most significant barriers inhibiting the implementation of DSM programs are of structural and market nature. Therefore, the significant priorities for their promotion in the region currently do not focus on the content of the technological options, but on the establishment of a proper legislative and fiscal framework, which will allow the further penetration of energy-efficient investments.

In this context, a number of opportunities for collaboration in energy efficiency between the EU and the GCC exist in the following areas:

- A specialized study for the promotion of ENEF in the GCC, analyzing the following three interrelated components:
  - ✔ The reform of the energy pricing system in the GCC
  - ✔ The investigation of financing options to foster ENEF measures (customization of the TPF, ESCOs activation)
  - ✔ The implementation of DSM programs
- Building retrofitting:
  - ✔ Use of "cool" materials in buildings, Building Energy Management Systems (BEMS), efficient lighting options
  - ✔ The elaboration of a life cycle methodology for the calculation of the benefits of energy efficiency investments in buildings, using as a model the cost-optimal levels for buildings' minimum energy performance requirements methodology of the EU
- Labels and Standards:
  - ✔ Cooperation among standardization organizations for revising/developing the Minimum Energy Performance Standards (MEPS), especially as concerns air conditioners
  - ✔ Collaboration on AC for highly efficient appliances, which can cope with harsh climates (high temperature and moisture), as well as for AC maintenance and AC technicians' certification
- Support policy and legislation:
  - ✔ National energy centers for clean energy policy support
  - ✔ Information platforms and development of standards
  - ✔ Market-based mechanisms to promote energy efficiency
  - ✔ Accreditation and certification schemes of technicians in the GCC – presentation of the respective results in workshops
- Joint research for the customization of RES and ENEF technologies to the GCC particularities (high temperature and moisture).

Disclaimer: *The ideas, information and opinions expressed in the manuscript are the sole responsibility of the authors and do not represent official ideas of their institutions.*

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