MedReg
Mediterranean Energy Regulators

SMART GRIDS IN THE MEDITERRANEAN COUNTRIES

LEAFLET

DECEMBER 2018

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MEDREG is the Association of
Mediterranean Energy Regulators,
which gathers 25 energy regulators from
across 21 countries, spanning the European Union,
the Balkans and North Africa.

We aim to set the conditions for the establishment of a Mediterranean Energy Community by promoting a transparent, stable and compatible regulatory framework in the Mediterranean Region. We foster electricity and gas market integration, renewable energy development, infrastructure investments as well as consumer protection.

Based on a bottom-up approach, MEDREG acts as a platform that enables Mediterranean regulators to cooperate and exchange knowledge and experience.

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This leaflet is based on a report elaborated by MEDREG in 2018, which discusses smart grids in the Mediterranean countries.

It introduces the notion of smart grids and offers an overview of the 14 different typologies of this new technology, which has been experimented in 11 countries, as well as their implication on generation, transmission and distribution networks, and consumers.

Smart grids will play a critical role in facilitating renewable energy transition, and regulators will have to actively accompany its development. By sharing case studies from across the Mediterranean, MEDREG aims at enabling its members to assess the most suitable option, if any, in the light of their local circumstances.

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1. CONTEXT

New technologies and renewable energies call for smart solutions to supply energy

The development of **renewable energy sources** and the **objective of reducing CO2 emissions** are two factors driving important evolutions in the energy sector.
Technological improvements have supported a strong improvement in renewable energies' competitiveness and new options for **demand side management** have also emerged.
At the same time, the deployment of the Internet and information technology offers new potentials for developing **smart solutions to energy supply problems**; **digitalisation** is expected to bring high benefits in the future.
Smart grids (SGs) represent an **articulation of these different elements**, supporting the idea of a **new relationship between individuals and centralised systems**.

Smart grids in a few words

Smart grids are **electricity networks that can "intelligently" integrate the actions of users connected to it** in order to efficiently deliver sustainable, economic, and secure electricity supplies.
Smart grids are not just a collection of smart meters, wind and solar, or plug-in electric vehicles, but a series of technologies allowing operators, consumers and companies to integrate, interface with and intelligently control all of these innovations.
Smart grids are expected to **allow bi-directional flows of electricity and information**, enabling effective monitoring of developments and events all along the value chain, including power plants, consumer preferences and individual appliances/equipments.

What is the novelty and advantages in using smart grid?

Smart grids cover different realities, and **integrating information technologies lies at the heart of its infrastructure** in order to improve its reactivity to **cope with the hazards of production and consumption**.
The objective is to build upon real-time information and near-instantaneous balance of supply and demand at the device level.
For example, the massive introduction of renewable energies at the distribution level requires improving the management of distribution networks, which are generally "passive" in a context of centralised production. This means having tools that can provide information on the state of the system in real time and access to driving tools that can be located at the consumer level (consumption report for example) or at the level of the infrastructure (electricity storage).
The notion of smart grid, however, remains largely in the field of **innovations in progress**. The countries in the Mediterranean proceeded to experiment various smart grid systems, which MEDREG has collected in order to share some of these experiences, evaluate the state of play of this technology in the region and identify to the best possible level the actions that need to be undertaken. In its strategy, MEDREG intends to **start from an assessment of needs and constraints**-in particular, technological and economic-**and to promote options that are more consistent with the specific situations in different countries**.

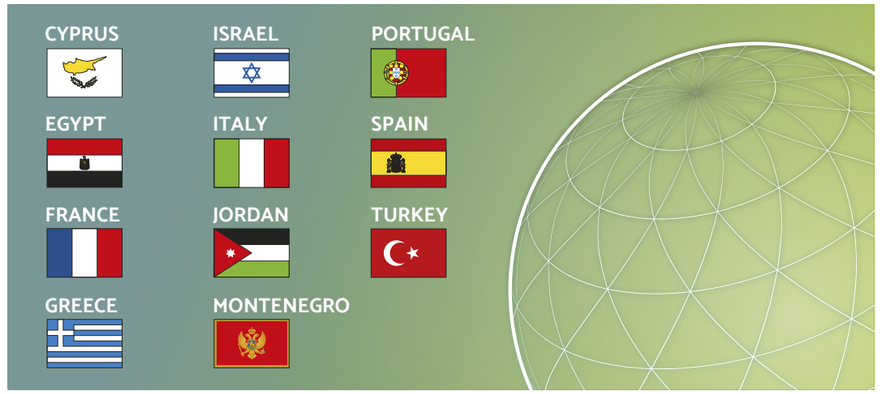
Smart grids: A solution for all?

From a regulator's perspective, smart grid development is not just a matter of technology. Beyond the issue of innovation, it is crucial to orientate operators in their choice for **the most appropriate options in terms of costs and benefits depending on the technological "state of the art"**.
For instance, systems with low performances in terms of losses in dispatching may not get significant benefits from sophisticated distribution technologies. Another aspect relates to the ability of consumers to pay for these costly technologies as well as their expectations in terms of quality of supply. Quality standards depend on the usage of electricity and can largely differ from one country to another. Concept of **maturity of energy systems** must therefore be taken into account as well to identify the most suitable asset development.

Gauging the benefits based on the **results of experiments** conducted **in other countries** is extremely useful but the results **should be interpreted in the perspective of local circumstances**.

Informing energy regulators about Smart Grid through a collection of 14 case studies from 11 Mediterranean countries

MEDREG's report on smart grids **shares information about the implementation of technological solutions,** which can be seen as **part of smart grids**. In particular**, their implication on generation, transmission networks, distribution networks, and consumers has been investigated**.
14 case studies focusing on 7 different technologies from **11 Mediterranean countries** have been presented:



MEDREG's recommendation

In order to ensure a quick and smooth transition, regulators must play an active role in the development of SGs. Incentives need to be provided to early adopters of SG technology to encourage quick development. For this reason, MEDREG plays a mediating role among the regulators of Mediterranean countries by sharing case studies and information regarding the implication of SG activities and the effects of SG.
We provide both a theoretical and a practical point of view in order to explore SG, in addition to an overview of the technologies and a collection of national case studies.

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2. THE REPORT IN BRIEF

Introducing smart grids

Smart Grids (SGs) are **electricity networks that can "intelligently" integrate the actions of all users** connected to it **in order to efficiently deliver sustainable, economic, and secure electricity supplies**.

SGs can **facilitate the connection and operation of generators of all sizes and technologies**, allow consumers to play a role in optimising the system operation, and maintain or improve the levels of system reliability, and quality and security of supply. SGs concept builds on the technologies already used by electric utilities and adds two-way communication (IT), self-generating capabilities, and the advantage of new technologies (forms of distributed generation, storage, electric vehicle and smart metering).

These **smart grid characteristics can be divided into two broad categories** of functional capabilities: **those that enable informed consumer participation in markets**, and **intelligent and informed consumer use of energy**; and **those that support improved utility performance**.

In other words, an SG is a holistic solution that employs a broad range of information technology resources, such as smart metering, demand side management, etc., and **allows existing and new gridlines to reduce electricity losses** and energy costs.

SGs will act as a critical foundation for the incorporation of renewable energy into the electrical grid. Since renewable energy sources like solar and wind are variable, it will be critical to have a demand-responsive electrical grid that uses energy efficiently.

BENEFITS OF THE SMART GRIDS

SUPPLY SIDE	• Optimize the facility's utilisation and reduce the need for exceeding capacity that peak load power plants provide • Improve the connection between and operations of generators of all sizes and technologies • Reduce the entire electricity supply system's environmental impact	*Increase or maintain the:* • Reliability; • Security; • Power quality; • Resilience; • Energy and economic efficiency; • Environmental sustainability; *of the energy system.*
ELECTRICITY NETWORK	• Preventive maintenance and remote grid management through better monitoring and control features • Minimize energy losses through efficient energy routing • Increase the degree of automation and "self-healing" responses to system disturbances • Incorporate DERs and PHEVs effectively	
DEMAND SIDE	• Provide consumers with better information • Increased responsiveness and demand flexibility • Enhanced efficiency through better management options and greater awareness of energy consumption • Give consumers a more participative and active role • Enable innovative services and applications	

Smart metering

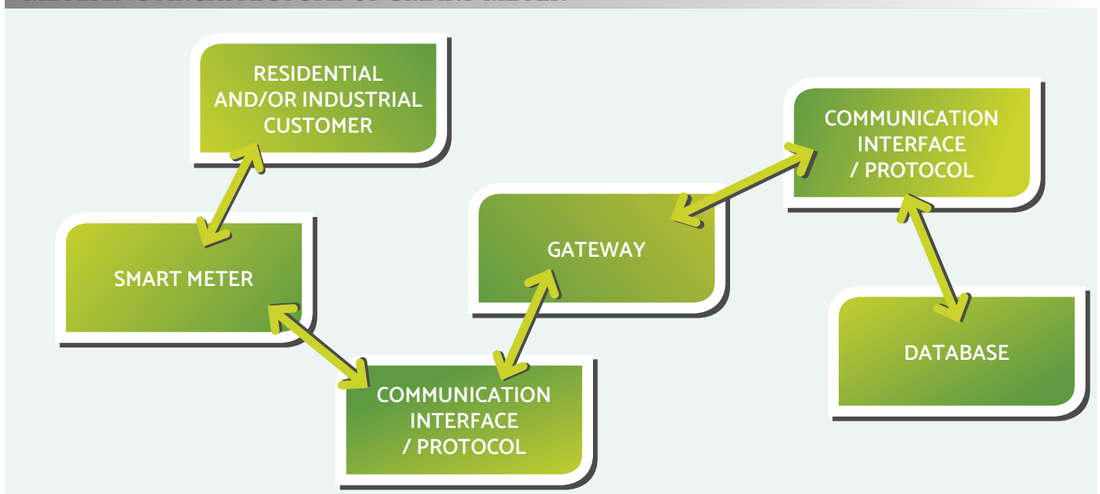
WHAT IS IT?

Smart metering is an **electronic system that can measure energy consumption**, providing more information than a conventional meter, and can transmit and receive data for information, monitoring and control purposes, using a form of electronic communication.

PURPOSE

Smart meters support a range of time-of-use tariffs, **allow remote switching between payment modes and more agile switching procedures, provide remote turn on/off operations**, permit users to **monitor the power quality**, and **communicate with other smart devices** at home.

METERING ARCHITECTURE OF SMART METER



EXPLORING NATIONAL CASES OF SMART METERING POLICES

Montenegro plans to establish the Smart Meter System by 1st January 2022 through its DSO. Closing on 30 September 2017, the coverage of smart meters amounted to 72.36%. This deployment is already reducing the distribution network losses, dropping significantly from nearly 21% losses in 2012 to 15% in 2017.

In **Greece,** HEDNO – the Hellenic Electricity Distribution Network Operator SA, locally known as DEDDIE – has worked on a new business model to bring together the private and public sectors for supply and replacement of the country's conventional meters with smart versions. At the end of the project, a total of 7,5 million smart meters will be installed until 2020.

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Demand Side Management

WHAT IS IT?

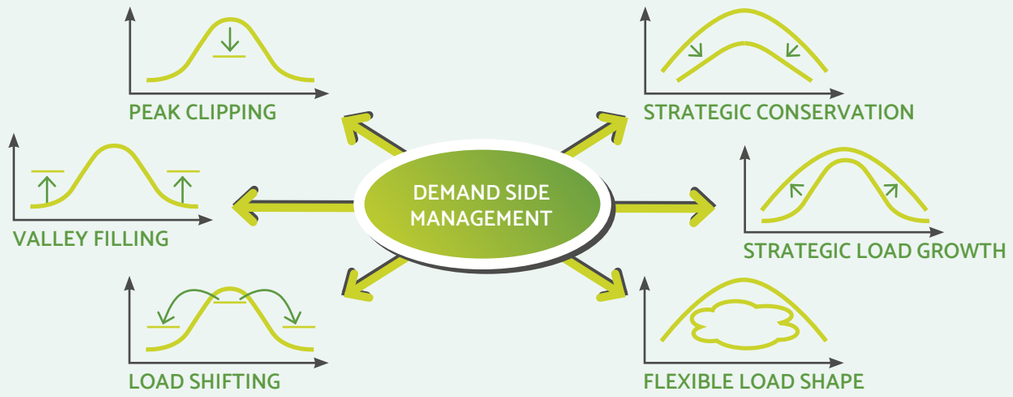
Demand Side Management (DSM) consists of **technologies and initiatives that encourage consumers to optimise their energy use**. There are mainly two benefits of DSM:

- consumers can reduce their electricity bills by **adjusting the timing and amount of electricity use**
- the energy system can be effectively utilised due to the **shift of energy consumption from peak to non-peak hours**.

PURPOSE

The main goal of DSM is to **encourage the consumer to use less energy during peak hours** or to **move the time of energy use to off-peak times,** such as night-time and weekends. Peak demand management does not necessarily decrease total energy consumption, but could be expected to reduce the need for investments in networks and/or power plants for meeting peak demands. A newer application of DSM is to aid grid operators in balancing intermittent generation from wind and solar units, particularly when the timing and magnitude of energy demand does not coincide with the renewable energy generation.

TYPES OF DEMAND SIDE MANAGEMENT



CONCRETE EXAMPLES OF DSM POLICIES IN MEDREG COUNTRIES:

In **Egypt**, an electricity law adopted in 2015 set an obligation on the distribution companies to provide free DSM studies to consumers. The Egyptian electricity regulator EgyptERA had to review these studies and most of the consumers who received DSM studies implemented the introduced solutions.

In **Spain**, factors such as the mature wholesale market, the high number of new entrants and new offers and the smart meter deployment, together with time of use tariffs[1], could set the grounds for the development of DSM.

1 The PVPC is a last resort tariff for domestic consumers with hourly prices linked to the spot prices. It covered around 40% of the consumers by the end of 2017. Also there are increasing market offers linked to the spot prices.

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Self-generation

WHAT IS IT?

Self-generation (SG) is the use of **power that is generated on-site** by an energy consumer.

PURPOSE

Self-generation **allows to reduce**, at least in part, **the purchase of electricity from the grid**. Words such as **"prosumer"**, **"self-generator"** and **"self-consumer"** are sometimes used interchangeably for such consumers.

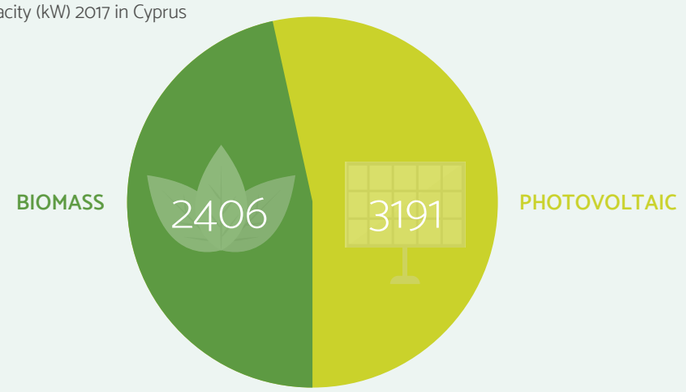
NATIONAL EXAMPLES OF SELF-GENERATION

In **Egypt**, the electricity law allows private production of electricity for self-generation and third-party sales. In total, self-generation corresponds to 187 Bn kWh.

In **Cyprus**, there are a number of policies that promote the development, installation and use of Renewable Energy Sources (RES) for the purposes of self-generation.

SELF-GENERATION OF RENEWABLE ENERGY (RES-E)

Installed capacity (kW) 2017 in Cyprus



Distributed generation

WHAT IS IT?

Distributed generation refers to the installation of a **variety of technologies that generate electricity at or near the location where it will be used**, such as **solar panels**, **wind turbines**, **mini hydro**, **combined heat and power**, etc.
Distributed generation may serve a **single structure**, such as a **home or business**, or it may **be part of a micro-grid** (a smaller grid that is also tied into the larger electricity delivery system), such as at a **major industrial facility**, a military base, or a large college campus.

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PURPOSE

When connected to the electric utility's lower voltage distribution lines, distributed generation can **help support delivery of clean, reliable power to additional consumers** and **reduce electricity losses along transmission and distribution lines**.

NATIONAL EXAMPLES OF DISTRIBUTED GENERATION

In **Greece**, the distributed generation policies are linked only to the installation of PV plants. There are two methodologies in place: Feed-in-Tariffs and Net Metering.

In **Cyprus**, distributed generation power plants are relatively small, usually in kW to MW range, and are generally connected to the grid at substation, distribution feeder or consumer loads at consumer premises.

Storage

WHAT IS IT?

A storage is a **facility that can store electric energy when disconnected from its charging circuit**, so it can be used like a temporary battery, or like other types of rechargeable energy storage system.
Along with this growing share of renewable technologies, there has been a **growing interest in** the use of **energy storage systems** (ESSs) **due to the variable nature of most renewable energy sources**.
Based on the effort required to reduce CO_2 emissions and build a future power grid that is economically feasible and environmentally sustainable, renewable energy is being increasingly integrated into power systems. More specifically, according to the Blue Map scenario for power supply, electricity generation from renewable energy will make up for 22% of global electricity generation in 2050.

PURPOSE

Energy storage systems can **accommodate time shifting in renewable energy generation**, allowing the generated energy to match demand and avoid power curtailment. An example is the use of energy storage units to **store energy during off-peak hours** and **discharge them during peak hours**. These systems can also be used to **mitigate transmission congestion** and hedge forecast errors. In this context, appropriate siting and sizing of storage systems is essential not only for power system operation but also for economic consideration.

NATIONAL CASES OF ENERGY STORAGE SYSTEMS

Jordan is expected to sign a contract with the aim of establishing an electricity storage station with a capacity of at least 30 MW.

In **Portugal**, a pilot project – Storage InovGrid – was launched by EDP and Siemens in January 2016, in which lithium-ion battery technology was implemented to supply electrical energy for Évora University.

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Electric vehicles

WHAT IS IT?

An electrical vehicle (EV) is a vehicle which is **based on an electric propulsion system**. **No internal combustion engine is used**; all the power is based on electric power as the energy source.

PURPOSE

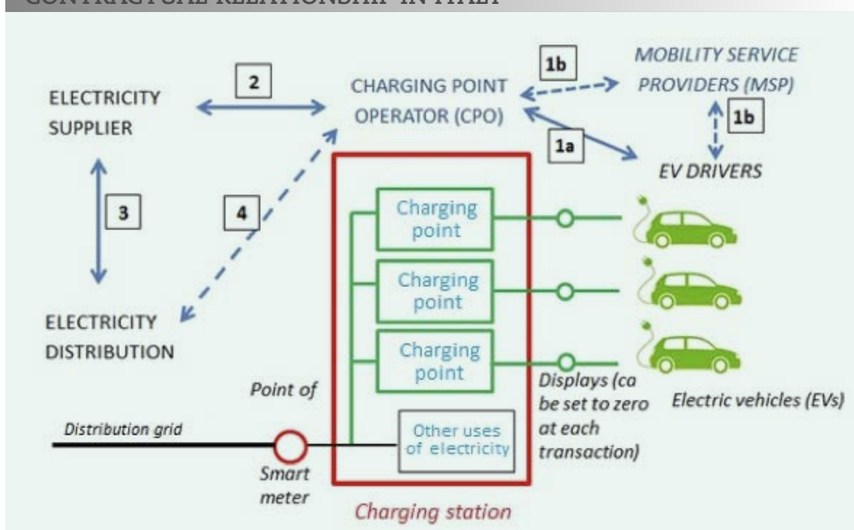
The main advantage of an EV is its **high efficiency in power conversion** through its proposition system of an electric motor. Recently, there has been massive research and development work reported in this area in both academic and industrial domains. Commercial electric vehicles are also available now. Many countries provide incentives to EV users through lower tax or tax exemption, free parking and free charging facilities.

NATIONAL EXAMPLES OF ELECTRICAL VEHICLE INFRASTRUCTURE

The **Italian** Regulatory Authority for Energy, Networks and Environment (ARERA) already launched in 2010 a first public consultation on electrical vehicle charging infrastructure. For the moment, ARERA will focus on the integration of EV recharge in power system transformation.

In **Turkey**, due to the increased use of electric vehicles, the country has begun to study its proper regulation for establishing the necessary infrastructure in terms of charging the vehicles. These studies are in progress and are expected to be completed soon.

CONTRACTUAL RELATIONSHIP IN ITALY



CONTRACTUAL RELATIONSHIPS:

- **1a** EV Driver – CPO (directly)
- **1b** EV Driver – CPO (intermediated by MSP)
- **2** CPO – Electricity Supplier
- **3** Electricity Supplier – DSO
- **4** DSO – CPO (only for connection)

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Distribution System Operator (DSO)

WHAT IS IT?

Distribution system operator (DSO) means a natural or legal person **responsible for operating, ensuring the maintenance of and**, if necessary, **developing the distribution system in a given area.** And, where applicable, a DSO is also responsible for **its interconnections with other systems** and for **ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity or gas**.
In the electricity sector, **distribution means the transport of electricity on high-voltage, medium-voltage and low-voltage distribution systems** with respect to its delivery to consumers, but does not include the supplier (retailer).

PURPOSE

As SGs are developing dynamically, the **responsibilities of DSOs are changing and growing fast**. DSOs **must adapt to the transition towards more distributed energy resources,** which have a **higher production volatility,** and **play a more active role** accordingly.

➤ **The roll-out of smart meters is conducted mostly by DSOs, which includes their purchase, installation, operation and maintenance. Therefore, in most cases, smart meters are owned by DSOs.**

Many DSOs believe that they should play the role of a **market facilitator** under the following two conditions: strict rules on data use to **ensure end-user privacy** and a **non-discriminatory access to meter data for all parties** approved by the end user. Thus, DSOs role is critical as an integrator of the distributed resources and for managing network information (big data).

NATIONAL PICTURE OF DSOs

In **France**, there are 166 DSOs of various sizes who are independent from their mother companies (if any), neutral, transparent and with no confusion about the trademarks.

However, in **Israel**, IEC operates, as a single, combined, coordinated system that engages consumers in the supply of electricity, from the stage of generation of the electricity to its transmission, distribution, supply and trade.

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The changing role of Consumers: From consumers to "prosumers"

HOW DO SMART GRIDS IMPACT CONSUMERS' BEHAVIOUR?

The characteristics of a smart grid enable informed consumer participation in the market, as well as **intelligent and informed use of energy by the consumer**.
Consumers play a more **participative and active role** and they are provided with **better information**.
It is **mutually beneficial for producers and consumers** since it **increases energy efficiency**. Moreover, some consumers have started to become producers through self-generation, therefore, the line between producers and consumers is becoming blurry.
Also, the development of smart grids and the **transition from consumers to prosumers** has significantly **increased consumer awareness**. Additionally, aggregators and retailers are fundamental for the rest of consumers.

NATIONAL PICTURE OF THE CHANGING ROLE OF CONSUMERS

In **EGYPT**, electricity law allows **private production of electricity for self-generation and third-party sales**. In total, **self-generation** corresponds to **187 billion kWh energy** and consumer awareness among the prosumers is steadily increasing.

In **JORDAN**, the Ministry of Energy and Mineral Resources in partnership with the Energy and Minerals Regulatory Authority **seeks to reduce the waste of electricity** and its wrong use by **raising energy awareness among consumers** and informing them of the impact of energy misuse and its negative impact on their consumption.

BENEFITS OF SMART GRIDS FOR CONSUMERS

Smart grids can **allow energy savings**, reduction in outages, more **transparent and frequent billing information**, participation in the electricity market via aggregators, and a **better business case** for the **purchase of electric vehicles**, **heat pumps**, and **smart appliances**.

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3. CONCLUSION

Smart Grid: A challenge for the energy industry and consumers

The implementation of smart grid technology will be a **challenge for the energy industry** and the **consumers** of electricity. The ability to **manage self-consumption** based on pricing and need will help improve the reliability of the network by **easing peak demands and improving energy efficiency**.
However, in the long-term, the **implementation of smart grids** will likely require ongoing changes to the market rules and will significantly **increase operational complexity**. The implementation of smart grids will be accompanied by a significant increase in the volume of data that will have to be gathered and analysed, which will require more sophisticated solutions than those currently used. **New software programs and algorithms** will be needed for energy balancing and control functions.

Smart Grids require clear standards for interoperability

EU's vision about smart grid roles remains relatively vague. The primary reason for this is the **lack of clear standards for interoperability at a national level and at the "Mediterranean ring" level**. This challenge must be addressed in order to actualise the smart grid vision and bring the promised benefits to fruition within the Mediterranean countries.

➤ **Clear standards are absolutely necessary** if the vision of a smarter grid is actually going to be attained.

Smart technologies associated with smart grids are already reaping benefits

The EU RES Directive will boost smart grids through distributed generation, prosumers, and communities of energy and the electrification of transport.
For instance, smart meters' deployment will lead to several benefits such as **reducing reading costs**, **network losses** and **electricity fraud.** The **MONTENEGRO** case indicated a reduction in network losses from 21% to 15% after a 72% deployment. Regulators should also be careful in the deployment of implementation mechanism to avoid legal issues that could lead to significant delays, as showed by the **GREEK** case.
Regarding demand side management, **consumers** with enough economic incentives (Time of Use tariffs) and proper information tend to **shift their consumption consequently**. In the **EGYPTIAN** case, distribution companies are obliged to provide free DSM studies to consumers, which are supervised by the regulator, resulting in most consumers applying the suggested solutions. On the other hand, in **SPAIN**, the mature wholesale market, the high number of new entrants and new offers, and the smart meter deployment together with time of use tariffs (and access tariffs that promote consumption during certain hours) are factors that could set the grounds for the development of DSM with a growing base of consumers adopting time discrimination tariffs (more than 1.5 million in 4 years).

Self-generation and net metering schemes have the potential to **create jobs**, **economic growth and reduce electricity costs** for thousands of residential, commercial and industrial consumers, like in the **CYPRIOT** case. Virtual net metering is another promotion scheme being implemented in **GREECE** that allows energy communities and public entities or the agricultural sector to benefit from net metering within a group of supply points. In both countries, policy reviews are being conducted.
Currently, in **GREECE**, the distributed generation policies are linked only to the installation of PV plants. In **CYPRUS**, distributed generation power plants are relatively small, usually in kW to MW range, and are generally connected to the grid at substation, distribution feeder or consumer loads at consumer premises. In additon to the previous supporting schemes (self-generation and net metering), in case of immature technologies, feed-in-tariff schemes showed effectiveness in distributed generation deployment, as the **GREEK** case of rooftop PV illustrates.
Storage is an interesting option to fully extract the potential of renewable energy, mainly in the solar and wind energy sector. The **JORDANIAN** pilot project for 30 MW storage that is being opened to developers this year is remarkable in order to achieve a wider demand coverage through renewable energy and thus, reduce their energy imports and lead to an improvement in its balance of payments. In the case of **PORTUGAL**, a pilot project – Storage InovGrid – was launched by EDP and Siemens in January 2016, in which lithium-ion battery technology was implemented to supply electrical energy for Évora University Campus through IEC (A) 60870-104 protocol.
Regarding the use of electric vehicle, charging points regulation seems critical, as, in both case studies, public consultations regarding charging infrastructures are being conducted. Regulatory issues should include a business model that ensures competition, network tariffs without discrimination, connection procedures, and the integration of EV recharge into power system transformation. In **ITALY**, EV charges are not only expressed in euro/kWh, but are often related to power/speed of the recharge, time of use, and mapping and booking of the connection point (CP). The different prices set by the CP providers allow them to manage the CP occupancy. In **TURKEY**, more than 500 charging stations have been installed, and regulation for procedures and principles of Electric Vehicle Charging Station have been opened to public opinion and industry evaluations.
The shared cases also illustrate different approaches for DSO regulation depending on the country's specificities. Therefore, these regulations, in the **FRENCH** case, could establish unbundling obligations, non-discrimination, and transparency dispositions, as well as an economic support to R&D policies of DSOs, or, as in the **ISRAELI** case, they could establish a fully integrated company (generation, transmission, distribution and retail).

Finally, data management is becoming increasingly important for regulation of smart grids and distribution system operators.

This report will be updated in the near future, with the latest developments occuring in the countries that contributed to the study, and with the addition of more countries in order to conduct a benchmarking analysis when applicable.

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info@medreg-regulators.org

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EDITORIAL PROJECT AND CONTENT
MEDREG Secretariat

DESIGN PROJECT AND PRODUCTION
Alberto Villa, www.villalberto.it

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MedReg
Mediterranean Energy Regulators

ASSOCIATION OF MEDITERRANEAN ENERGY REGULATORS

Corso di Porta Vittoria 27
20122 Milan, Italy

Tel: +39 02 655 65 537
Fax: +39 02 655 65 562

info@medreg-regulators.org
www.medreg-regulators.org

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