



Empowering Mediterranean regulators for a common energy future.

Joint Report

Electricity Working Group (ELE WG)

&

Renewable Energy & Energy Efficiency Working Group (RES WG)

Smart Grids in the Mediterranean Countries



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About MEDREG

MEDREG is the Association of Mediterranean Energy Regulators, bringing together 25 regulators from 21 countries, spanning the European Union, the Balkans and North Africa. Mediterranean regulators work together to promote greater harmonization of the regional energy markets and legislations, seeking progressive market integration in the Euro-Mediterranean basin.

Through constant cooperation and information exchange among members, MEDREG aims at fostering consumer's rights, energy efficiency, infrastructure investment and development, based on secure, safe, cost-effective and environmentally sustainable energy systems.

MEDREG acts as a platform providing information exchange and assistance to its members as well as capacity development activities through webinars, training sessions and workshops.

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Executive summary

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 of RES competitiveness and new options for demand side management have emerged. At the same time, the deployment of Internet and information technologies offer new potentials for developing smart solutions to energy supply problems, digitalization is expected to bring high benefits in the future. Smart grids represent an articulation of these different elements, supporting the idea of a new relationship between individuals and centralized systems.

Actually, 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. Therefore, smart grids are not just a collection of smart meters, wind, solar, or plug-in electric vehicles, but also 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 to effectively monitor developments and events all along the value chain, including power plants, consumer preferences and individual appliances/equipment. The objective is to build upon real-time information and near-instantaneous balance of supply and demand at the device level.

In sum, smart grids cover different realities, which consist of integrating information technologies at the heart of the infrastructures in order to improve their reactivity to cope with the hazards of production and consumption. 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 centralized production. This means having tools providing information on the state of the system in real time and driving tools that can be located at the consumer (consumption report for example) or at the level of the infrastructure (electricity storage).

The notion of smart grid remains however largely in the field of innovations in progress. As the countries of the Mediterranean proceed, for many, to experiments in various fields, the aim of this work is to share some of these experiences in order to evaluate the state of the art and to make it possible to target as best as possible the actions 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 of the different countries.

In a regulator’s perspective, smart grid development is not only a technological question. Actually, beyond the issue of innovation, which can be stimulated via specific tools (such as cost coverage guarantees and financial incentives), it is crucial to trigger operators to selecting the most appropriate options in terms of costs and benefits according to the technological “state of the art”. For instance, systems with low performances in terms of losses of dispatching may not get significant benefits from sophisticated distribution technologies. Assuming the sometimes-high cost of these solutions, another aspect relates to the ability of consumers to pay for these technologies as well as their expectations in terms of quality of supply. Quality standards go with the usages of electricity and can largely differ from a country to another. Concepts of maturity of energy systems are thus relevant to mobilize, in order to best target the asset developments. Benefitting from the results of

experiments conducted in other countries is therefore extremely useful but should be interpreted in the perspective of local circumstances.

This report 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 are investigated. Fourteen (14) case studies are presented focusing on seven different technologies/topics from eleven Mediterranean countries, namely Montenegro, Greece, Egypt, Spain, Cyprus, Jordan, Portugal, Italy, Turkey, France, and Israel.

The first section of this report is about smart metering – it describes smart meters and compares it with conventional meters on how they operate. There are two cases provided by our members. In the case of Montenegro, the country has a long-term plan that the DSO will establish the Smart Meter System by January 1, 2022. Closing with 31.12.2017, the coverage of smart meters amounted to 73,04%. 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.

Demand Side management (DSM) is the second section in which a brief description of DSM is given and a comparison between two cases is done. Following the Egypt case, electricity law 87/2015 set an obligation on the distribution companies to provide free DSM studies to consumers. EgyptERA has to review these studies by law and most of the consumers who received DSM studies applied the introduced solutions. Meanwhile in Spain, the mature wholesale market, the high number of new entrants and new offers, and the smart meter deployment together with PVPC are factors that could set the grounds for the development of DSM.

The third section is self-generation, which is the use of power generated on-site by an energy consumer in order to reduce, at least in part, the purchase of electricity from the grid. “Prosumer”, “self-generator” and “self-consumer” are words sometimes used interchangeably (equally “self-generation” and “self-consumption”). Following the Egypt case, electricity law allows private production of electricity for self-generation and third party sales. In total, self-generation corresponds to 187 Bn kWh.

In the meantime, in Cyprus, there is a number of policies aiming to promote the development, installation and use of RES for the purposes of self-generation.

Distributed generation (DG) is the fourth section in which DG is described and a two-case comparison is given. 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.

The fifth section is about storage systems in which a brief description is given and two case studies are compared. Following the Jordan case, the country expects to sign a contract with the aim of establishing an electricity storage station. 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.

Electric vehicles are another section that provides a brief description and a comparison

between two national cases. The Italian Regulatory Authority for Energy, Networks and Environment (ARERA) launched a first public consultation on EV charging infrastructures in line with the AFI Directive article 4. While in Turkey, due to the increase of the widespread use of EV, Turkey has begun to study on a proper regulation for establishing the necessary infrastructure in terms of charging the EV. There are studies in progress on the draft, which expected to be completed soon.

In the final section, the Distribution System Operator (DSO) is described and two national cases are compared. Following the France, there are 166 DSOs of various sizes, the DSOs have to be independent from their mother companies (if any), neutral, transparent and with no confusion about the trademarks. However, in the case of Israel, IEC^(B) operates, as a single combined, coordinated system that engages in the supply of electricity to consumers, from the stage of generation of the electricity to its transmission, distribution, supply and trade.

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1. Introduction to 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 optimizing the system operation, and maintain / improve levels of system reliability, 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 DGs, 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.

<p>Supply side</p>	<ul style="list-style-type: none"> - Optimizing the facility's utilization and reducing the need for exceed capacity that peak load power plants provide - Improving the connection between and operations of generators of all sizes and technologies - Reducing the entire electricity supply system's environmental impact 	<p>Increase or maintain the:</p> <ul style="list-style-type: none"> - Reliability; - Security; - Power quality; - Resilience; - Energy and economic efficiency; - Environmental sustainability; <p>of the energy system.</p>
<p>Electricity network</p>	<ul style="list-style-type: none"> - Preventive maintenance and remote grid management through better monitoring and control features - Minimizing energy losses through efficient energy routing - Increasing the degree of automation and “self-healing” responses to system disturbances - Incorporating DERs and PHEVs effectively 	
<p>Demand side</p>	<ul style="list-style-type: none"> - Providing consumers with better information - Increased responsiveness and demand flexibility - Enhanced efficiency through better management options and greater awareness of energy consumption - Giving power consumers a more participative and active role - Enabling innovative services and applications 	

Figure 1. Benefits of the Smart Grids

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

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

Therefore, in order to ensure 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. In order to explore SG not only in a theoretical point of view but also in a practical one, the technologies and national case studies will be discussed thoroughly in this paper.

1.1 Case studies methodology

The report updates and completes the information collected through the 2011 report performed by the ELE WG on this same topic and the 2014 report made by the RES WG on net metering. The analysis is based on the collection of several case studies presenting insights on the application and development of smart grids in countries of both shores on the Mediterranean.

The highlights of these case studies will allow to derive key regional trends and pave the way for common guidelines that should be applied in the development of smart grids in the Mediterranean countries in order to improve their efficiency.

Technologies/Topics		Country 1	Country 2
Smart metering	<ul style="list-style-type: none"> - roll-out (deployment) - functionalities - remote management by DSO 	REGAGEN - Montenegro	RAE - Greece
Demand side management	<ul style="list-style-type: none"> - hourly metering - information of prices in advance - voluntary management of consumption - automatic control of consumption - retail company - participation on ancillary services (aggregator) 	EgyptERA - Egypt	CNMC - Spain
Self-generation	<ul style="list-style-type: none"> - net self-consumption - net metering (energy) - net billing (money) - communities of energy 	EgyptERA - Egypt	CERA - Cyprus
Distributed generation	<ul style="list-style-type: none"> - renewables - cogeneration - small and large scale 	RAE - Greece	CERA - Cyprus
Storage	<ul style="list-style-type: none"> - batteries - flywheel - molten salt 	EMRC - Jordan	ERSE - Portugal
Electric vehicles	<ul style="list-style-type: none"> - individual charge - collective charge 	ARERA - Italy	EMRA - Turkey
Distribution System Operator regulatory oversight	<ul style="list-style-type: none"> - integration all distributed equipment - contribution of DSO to innovation and deployment of ITs - cost coverage and incentives 	CRE - France	PUA - Israel

Figure 2. List of Technologies/Topics analyzed per country case

1.2 Smart metering

Smart metering supports a range of time-of-use tariffs, allows remote switching between payment modes, more agile switching procedures, provides remote turn on/off operations, permits users to monitor the power quality, and communicates with other smart devices at home¹. Many Mediterranean countries have rolled-out smart meters, in particular to facilitate billing and avoid “non-technical losses” (energy consumed but not paid). In this report, we focus on two examples, Montenegro and Greece.

¹ US National Energy Technology Laboratory, 2008

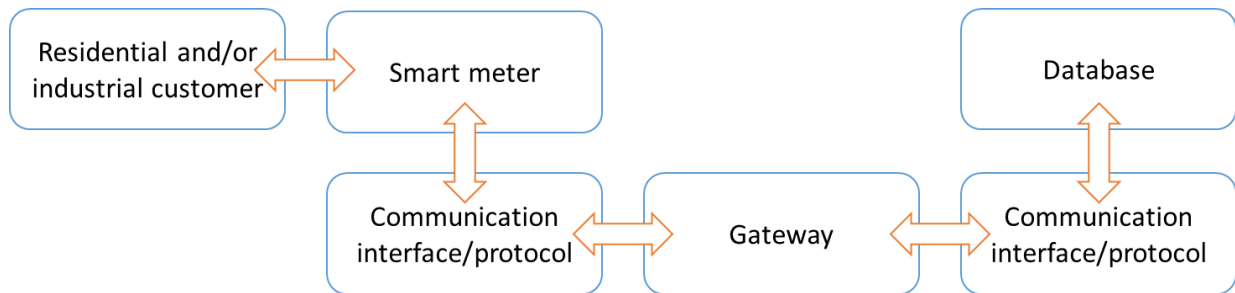


Figure 3. Metering architecture of smart meter

In the case of Montenegro, it is defined by the law that the Distribution System Operator shall establish the Smart Meter System by January 1, 2022. At present, the 2016 - 2018 phase approves the installation of another 45.000 meters. Closing with 31.12.2017, the coverage of smart meters amounted to 73,04%. When replacing old meters, the meters were moved to the property border, which, in addition to the reconstruction of the network, led to a reduction in possibilities for unauthorized use of electricity. The effects of the installation of new meters are also reflected in the reduction of distribution losses, as the total losses in the distribution network amounted to 15,62% at the end of 2017, and are lower than losses in 2012, when they amounted to 20,84%.

Other countries have also foreseen the involvement of the private sector. In Greece, HEDNO – the Hellenic Electricity Distribution Network Operator SA, locally known as DEDDIE² – 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. The need for a new business model was required due to the inefficiencies i.e. time and labor loss due to manual meter reading, electricity fraud, frequent power outages (blackouts) in high-consuming areas, and inefficient production allocation to existing generation plants.³ The pilot stage was launched in 2014, and since then it has been temporarily stopped by seven legal cases filed by three participating teams.⁴ Consequently, a new approach was created through collaboration between HEDNO and French network operator Enedis. HEDNO is now aiming to launch the project, based on the new business model, within 2018.⁵ At the end of the project, a total of 7,5 million smart meters will be installed until 2020. The project’s budget is currently estimated at 1,2 billion euros however, a drop to 800 million euros is expected due to an anticipated decline in prices for smart meter technology.

1.3 Demand side management

Demand Side Management (DSM) consists of technologies and initiatives that encourage consumers to optimize their energy use. There are mainly two benefits of DSM. First, by adjusting the timing and amount of electricity use, consumers can reduce their electricity bills. Second, due to the shift of energy consumption from peak to non-peak hours, the energy

2 Greek Energy News Portal: Energy Press 08.09.2017. <https://energypress.eu/smart-network-development-dominate-enedis-deddie-talks-today/>

3 Greek Energy News Portal: Energy Press 16.11.2017. <https://energypress.eu/procedures-7-5-million-smart-meters-begin-2018/>

4 Balkan Green Energy News 20.11.2017. <https://balkangreenenergynews.com/greek-hedno-planning-replace-7-5-million-meters-first-tender-2018/>

5 Greek Energy News Portal: Energy Press 21.02.2018. <https://energypress.eu/switch-private-public-sector-model-delayed-smart-meters-project/>

system can be effectively utilized.

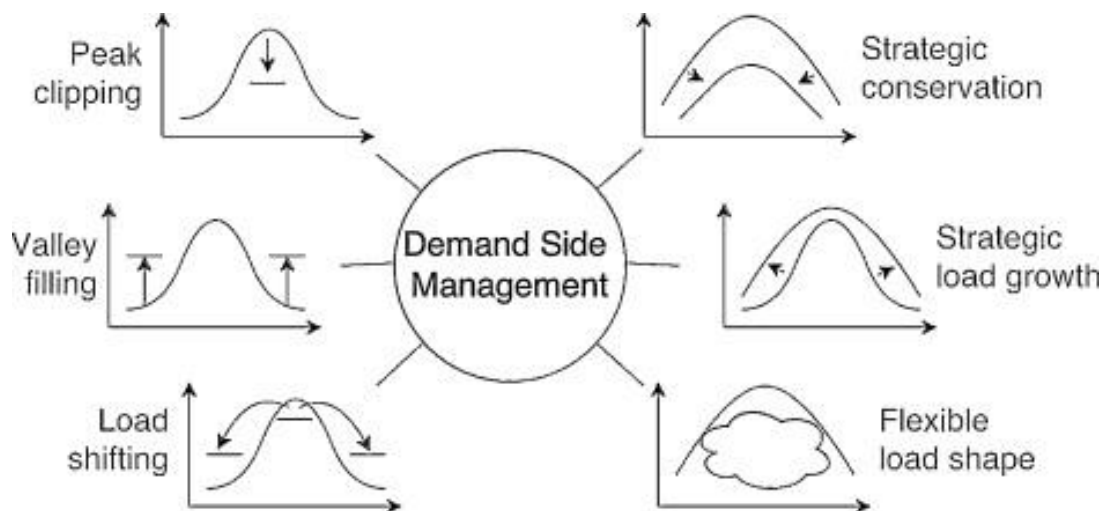


Figure 4. Types of demand side management

As it can be seen from Figure 2, 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 nighttime and weekends.⁶ 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 for 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 generation.⁷

Following the Egypt case, the Egyptian Electricity Transmission Company (EETC) is the TSO who implements the scheduling mechanisms through their control system. The dispatching activities are done semi-automatically by the Egyptian Electricity Holding Company (EEHC) and distribution companies, while EgyptERA set regulations and calculates the annual price for power factor and reactive power compensations. Electricity law 87/2015 set an obligation on the distribution companies to provide free DSM studies to industrial consumers. EgyptERA is obliged to review these studies by law and most of the industrial consumers who received DSM studies applied the introduced solutions. Additionally, distribution companies calculate load factors and draw load curves for consumers.

Meanwhile in Spain, the electricity wholesale market began working on 1998 and the retail market was fully liberalized on 2003. Since then, all consumers have been able to choose their supplier. There is a legal and functional unbundling in distribution activity and ownership unbundling for the transmission grid. After 2009, distribution unbundling was fully applied and thus distributors stopped their supply activity in favor of free suppliers. All consumers must pay the correspondent regulated access tariff plus the price of the energy in the wholesale market plus a commercial margin. Nevertheless, last resort suppliers and a last resort tariff were created for small consumers (below 10 kW), which can choose either free or regulated market. Since 2014, the last resort regulated tariff was replaced by the "Voluntary Price for Small

⁶ "Demand Management". Office of Energy. Government of Western Australia.

⁷ Lund, Peter D; Lindgren, Juuso; Mikkola, Jani; Salpakari, Jyri (2015). "Review of energy system flexibility measures to enable high levels of variable renewable electricity". *Renewable and Sustainable Energy Reviews*. 45: 785–807. doi:10.1016/j.rser.2015.01.057.

Consumer” (PVPC) system. The mature wholesale market, the high number of new entrants and new offers, and the smart meter deployment together with PVPC are factors that could set the grounds for the development of DSM. A very simplified exercise was conducted in order to estimate the level of consumers’ potential savings in case of shifting partially their demand. Potential savings⁸ range from 39-77 €/year for a domestic consumer with a 5.000 kWh/year consumption, with a typical annual bill of around 800-1.000 €. Meanwhile for access tariffs with higher consumptions and more related to big households and SMEs the estimated savings vary between 66-270 €/year, with bills that could range from 1.500-3.000 €.

1.4 Self-generation

Self-generation is the use of power generated on-site by an energy consumer in order to reduce, at least in part, the purchase of electricity from the grid.⁹ “Prosumer”, “self-generator” and “self-consumer” are words sometimes used interchangeably (equally “self-generation” and “self-consumption”).

Following the Egypt case, electricity law allows private production of electricity for self-consumption and third party sales. More than 7.600 km² of public land has been allocated for implementing renewable energy projects. The basic regulatory building blocks for self-consumption are in place. In total, self-generation corresponds to 187 Bn kWh as it can be seen from Table 1.

<i>Self-generation</i>	187,0 Bn kWh (covers all the consumption of Egypt)
<i>Net self-consumption</i>	179,1 Bn kWh
<i>Net metering (energy)</i>	171,2 Bn kWh

Table 1. Self-generation, self-consumption and net metering in Egypt.

In Cyprus, electricity from renewable sources is promoted through subsidies. Furthermore, there is a transitional “feed-in” tariff scheme in place. Access of electricity from renewable energy sources to the grid shall be granted according to the principle of non-discrimination. With regard to the use of the grid renewable energy shall be given priority. Grid development is a matter of central planning.¹⁰ There is a number of policies aiming at promoting the development, installation and use of RES installations and one of them is self-generation. Self-generation for the purposes of the scheme is defined as the generation of electricity from power plants located in lawfully constructed premises located within the same block and/or adjacent to the premises of the commercial or industrial consumer. Energy is not injected into the grid but is used at all times for the sole purpose of own consumption and not for economic exploitation through network use. It is also possible to install a direct line to the premises in accordance with the provisions of the electricity legislation. In any case, the cost of the direct line will be borne by the applicant.

Figure 5 below presents the installed capacity of self-generation systems, both for PV and biomass for the year 2017.

8 Taking into account also the taxes costs and the loss coefficient pass on consumers.

9 Council of European Energy Regulators, CEER Position Paper on Renewable Energy Self-Generation, September 2016, p. 1.

10 Transmission Network Development Plan 2017-2026 by the Cypriot TSO.

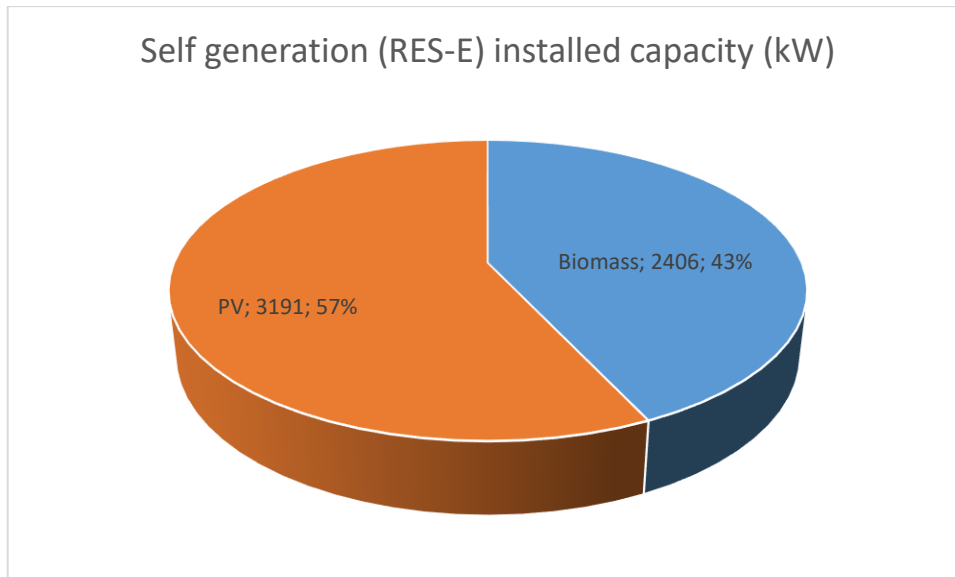


Figure 5. Self-generation (RES-E) installed capacity (kW) 2017 in Cyprus

1.5 Distributed generation

Distributed generation refers to a variety of technologies that generate electricity at or near 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. 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.

DG technologies have been available for many years. They may have been known by different names such as embedded generation, decentralized or on-site power systems. Certain DG technologies are not new, such as, internal combustion engines and gas turbines. On the other hand, due to the changes in the utility industry, several new technologies are being developed or advanced toward commercialization, such as, fuel cells and photovoltaic.¹¹

Currently in Greece, the distributed generation policies are linked only to the installation of PV plants. There are two methodologies in place, one that is the first implemented in 2009 that has a separate remuneration of the energy produced by the PV plant and the other where netting of the consumed energy by the connection point and the produced energy by the PV plant is carried out. The former was very successful in the beginning where the energy produced was remunerated at high prices based on Feed-in-Tariffs (FiT) and the latter has become more attractive in the last 2 years.

Cyprus has significant potential for distributed generation (DG) development especially from the sun and in less extent from wind. The last decade, DG technologies are rapidly developing in Cyprus. The government and the regulator took measures to promote and increase RES penetration in the energy mix of the island. These measures include the implementation of net metering and self-production schemes after a CERA decision in 2013. Taking into account the

¹¹ Andreas Poullikkas, Implementation of distributed generation technologies in isolated power systems; Renewable and Sustainable Energy Reviews 11 (2007) 30-56

evolution of the schemes and the very positive response of the public, it can be said that the whole effort has been crowned with success, resulting in the creation of numerous jobs, the growth of the economy and reducing the cost of electricity for thousands of residential, commercial and industrial consumers. Distributed generation is expected to become an important way for exploiting distributed energy resources or for supplying associated demands of electricity and heat (cogeneration) in Cyprus's electric power system of the future.

1.6 Storage

Based on the effort to reduce CO₂ emissions and build a future power grid economically feasible and environmentally sustainable, renewable energy has been increasingly integrated into power systems. Particularly, according to the WEO 2017 Sustainable Development Scenario¹² for power supply, electricity generation from renewable energy will provide a share of 67% of global electricity generation in 2040. 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. ESSs can accommodate renewable generation in time-shifting, 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.¹³ They can also be used to mitigate transmission congestion and hedge forecast errors, etc. In this context, appropriate siting and sizing of storage systems is essential not only for power system operation but also for economic consideration.¹⁴

In the case of Jordan, the use of EESs could be fundamental. As a net importer country, the ratio of imported energy to GDP is constantly growing, leading to great pressure on the balance of payments and to the constant need of foreign currency to finance the purchase of the Kingdom's energy needs. The country expects to sign a contract with the aim of establishing an electricity storage station in the Ma'an Development Area #1 with a capacity of at least 30 MW. The project will help to ensure that the country has green electricity day and night. The list of investors includes a number of local and international companies including Philadelphia Solar and Kawar Group, and companies and coalitions from Lebanon, the UAE, Bahrain, Cyprus, Saudi Arabia, Spain, Germany, Italy, the Netherlands and Japan, as well as qualified contractors such as Tesla, Toshiba, ABB and other companies.

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. This lithium-ion battery technology is combined with a storage capacity of over 360 kWh until the end of the project's life cycle.¹⁵ In spite of the ESS standalone nature, this system is connected to EDP Distribuição dispatch center, through IEC^(A) 60870-104 protocol. Certainly, the above mentioned lithium-ion pilot project brought

12 WEO 2017 Sustainable Development Scenario

13 "Demand-side energy storage system management in smart grid". 2012 IEEE Third International Conference on Smart Grid Communications (SmartGridComm): 73, 78, 5–8. doi:10.1109/SmartGridComm.2012.6485962. ISBN 978-1-4673-0910-3.

14 Optimal Planning of Energy Storage Systems Considering Uncertainty. Doctoral Dissertation of Nhi Thi Ai Nguyen. Politecnico di Milano, Energy Department Doctoral Programme in Electrical Engineering, XXIX-Cycle.

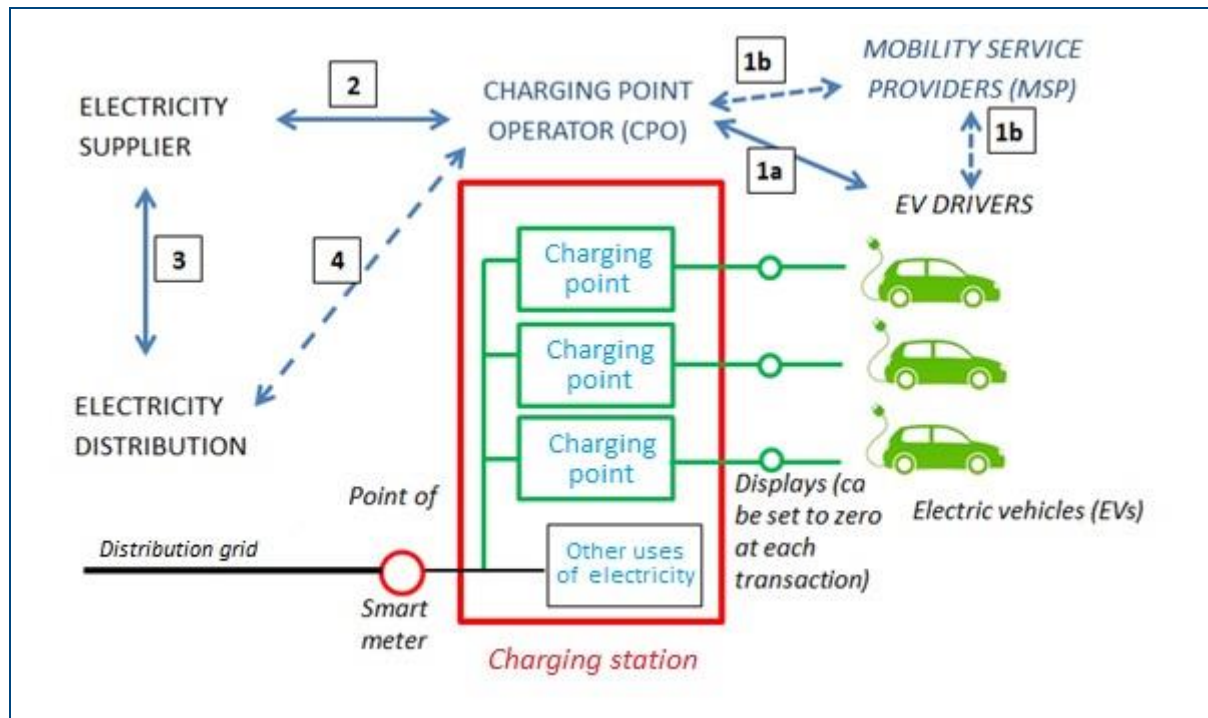
15 The 23rd International Conference on Electricity Distribution, EDP Distribuição's Inovgrid: First Electrical Energy Storage Project, Lyon, 15-18 June 2015. http://cired.net/publications/cired2015/papers/CIRED2015_0244_final.pdf

growing curiosity in the minds of energy companies and developers, which may have positive repercussions in the future for new projects based on energy storage technology.¹⁶

1.7 Electric vehicles

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. The main advantage is the high efficiency in power conversion through its proposition system of electric motor. Recently there has been massive research and development work reported in both academic and industry. Commercial vehicles are also available. Many countries have provided incentive to users through lower tax or tax exemption, free parking and free charging facilities.

The Italian Regulatory Authority for Energy, Networks and Environment (ARERA) in 2010 launched a first public consultation on EV charging infrastructures. The consultation illustrated the Authority's guidelines for pilot projects testing the business models for recharge of EV in areas open to the public and analyzes the transitional regulation for start-up solutions. Italian legislative decree n. 257/2016 states that DSOs are no longer admitted to own and operate EV recharge infrastructure. Prices charged by the operators of recharging points, are not at all regulated and should be in line with the AFI Directive article 4¹⁷ "...prices charged by the operators of recharging points accessible to the public are reasonable, easily and clearly comparable, transparent and non-discriminatory". EV charges are not only expressed in euro/kWh, but often are related to power/speed of the recharge, time of use, mapping of charging point (CP), booking of CP. The different prices set by the CP providers allows them to manage the CP occupancy.



16 CMS Guide to Energy Storage: Portugal. <https://www.lexology.com/library/detail.aspx?g=56107785-12f9-40f2-9acd-13326f279e26>

17 Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of Alternative Fuels Infrastructure (AFI): <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0094>

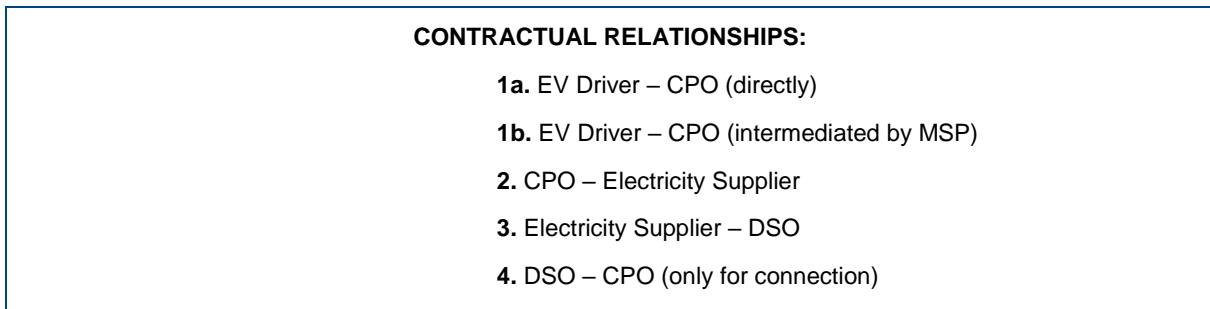


Figure 6. Contractual relationships in Italy

Following the Turkey case, the increase of the widespread use of EV during the last decade has drawn the attention to the charging station of EV. Therefore, Turkey has begun to study a proper regulation for establishing the necessary infrastructure in terms of charging the EV. Currently, the estimated number of electric vehicles in Turkey is about 1.000 and it is expected that the number will increase in the upcoming years. However, there are approximately 500 EV charging stations around the country-urbanized area. These charging stations are mostly concentrated in places such as shopping malls, public housing projects and parking areas. Currently, there are five different brands of charging stations in operation and it is estimated that the number will increase even more as the industry grows. The operating companies in this sector install and operate charging stations without any special permission at the moment. In other words, the approval of the distribution company is not required for the project of the installation of the charging stations. The operators that provide this service do not have a special authority or license. Beside the above regulations with the goal of increasing the number of electric vehicle charging stations, the “Procedures and Principles of Electric Vehicle Charging Station” has been opened to public opinion and industry evaluations. There are studies in progress on the draft, which is expected to be completed soon.

1.8 Distribution system operator (DSO) regulatory oversight

Most of the developments regarding smart grids involve distribution system operators. DSOs are responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems. They also have to ensure the long-term ability of the system to meet reasonable demands for the distribution of electricity (or gas).¹⁸ In the electricity sector, distribution means the transport of electricity on high-voltage, medium-voltage and low-voltage distribution systems with a view to its delivery to consumers but, in competitive markets, it does not include supply (retailer).¹⁹

DSOs play a critical role in the development of Smart Grids. The transition towards more distributed energy resources that have a high production volatility²⁰ require operators to adapt rapidly and, in particular, be able to keep supply security and power quality. Smart technologies can actually provide solutions notably for dealing with flexibility but their implementation is often challenging and has to build upon a strong involvement of distributors in innovation processes.

¹⁸ That definition is provided for by art. 2 n. 6 Dir 2007/72/EC concerning electricity and by art. 2 (6) Dir 2007/73/EC concerning gas.

¹⁹ According to art. 2 (5) Dir, 2007/72/EC.

²⁰ Cossent, R., Gómez, T., Frías, P. (2009). Towards a future with large penetration of distributed generation: Is the current regulation of electricity distribution ready? Regulatory recommendations under a European perspective, Energy Policy, Issue 3, 1145-1155.

Developing smart grids indeed includes several complementary technologies and procedures; there is a clear benefit in providing DSOs with a regulatory oversight covering all these different aspects. Among the challenges, a particular attention should be given to cross influences between decisions of TSOs and DSOs. Furthermore, in terms of efficiency, redundant decisions should be avoided, as much as possible, preventing consumers or retailers providing similar flexibility services at the same time. Thus, TSOs and DSOs should come up with clear definitions of hierarchical procedures and grid management plans adapted to one another and to the market.²¹

DSOs also play a key role in the deployment of smart meters. In competitive markets, they should be neutral towards commercial activities. Their role should be limited to providing means of collecting the required data allowing for identifying energy efficiency potential, ensuring a level playing field for competition²² and, thus, allow for the development of innovative services by energy suppliers.

The rollout of smart meters is conducted mostly by DSOs, which include purchase, installation, operation and maintenance. Therefore, in most cases, smart meters are owned by DSOs. Many DSOs believe that they should play a market facilitator role 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.²³ Thus, DSOs role is critical as an integrator of the distributed resources and managing network information (big data).

In France, the missions of the Energy Regulatory Commission (CRE) include supporting the evolution of electricity networks towards smart grids, notably with the aim of facilitating the reduction of greenhouse gas emissions, controlling energy demand and increasing the share of renewable energy. The scope of CRE's intervention also includes smart metering and new usages of electricity like electric cars.

CRE's role is twofold, playing a coordination role on smart grids in France and providing DSOs with a financial support scheme towards innovation. In terms of coordination CRE's contribution has three main objectives: (i) to contribute to the reflection on the evolution of the institutional framework and governance; (ii) integrate the subject of Smart Grids into regulatory activities, in particular by working on financing conditions, functionalities and monitoring and support of experiments; (iii) communication and animation of the actors involved in Smart Grids development. CRE adopted several deliberations providing non-binding orientations to operators, in particular regarding grid management performance, data management or innovation. The idea is to arrange a move from experimental stages to the industrial deployment phases.

Following France case, there are 166 DSOs of various sizes, which are ERDF covering 95% of the territory with 35 million clients; 4 local DSO companies (Gérédis Deux-Sèvres, URM in Metz, SRD in Poitiers and Electricité de Strasbourg) supplying more than 100.000 clients; and 161 small local DSOs. CRE determines the third party access tariff (called "tarif d'utilisation des réseaux publics de distribution d'électricité", TURPE).

²¹ Battle, C. and M. Rivier (2012). Redefining the new role and procedures of power network operators for an efficient exploitation of demand side response, IIT working paper, submitted to Energy Policy, December.

²² EC (2013). EG3 First Year Report: Options on handling Smart Grids Data, Expert Group 3 – Regulatory Recommendations for Smart Grids Deployment, Smart Grid Task Force, January.

²³ EDSO (2012). The role of the DSO in the Electricity market – from a Smart Grid perspective.

In France, the regulation of distribution networks is based on a cost-plus logic associated with an incentive regulation of operating expenses. The underlying principle is the application of uniform tariffs in France for the use of networks, which therefore requires a pooling of the coverage of charges. As far as smart grids are concerned, CRE has introduced a specific device to ensure that the network operators have the necessary resources to meet the costs of research and development as well as deployment of smart grids while encouraging them to use these resources effectively. CRE determines a trajectory for the R&D expenditures, discounted by the possible subsidies. The support to R&D and smart grid programs assume they would allow a reduction of investments, therefore capital costs, but at the cost of a (lower) increase in operating expenses. This could be the case for flexibility mechanisms such as peak shaving services or storage. As a result, the approach to OPEX regulation has been softened to avoid penalizing DSOs in case they increase OPEX while reducing CAPEX.

In the case of Israel, the organization of the electricity system remains centralized, thus significantly different than the one implemented in EU countries for instance. The electricity system operator IEC^(B) operates, as a single combined, coordinated system that engages in the supply of electricity to consumers, from the stage of generation of the electricity to its transmission, distribution, supply and trade. In addition, the company engages in the establishment of infrastructures that are required for the operations that have been set forth above and operates as the administrator of the electricity system. The operations of the company in distribution field includes the transfer of electricity from substations to consumers via high voltage lines and low voltage lines and the supply and sale of electricity to consumers. In the short term, IEC^(B) does not anticipate material technological changes that may affect the activity field. However, in the medium and long term, it is examining operations in the “smart metering” and energy storage fields.²⁴

²⁴ As of December 31, 2017.

2. Consumer Awareness

In the current developments towards smarter solutions and environmental friendly choices, consumers are supposed to play an increasingly important role. Actually, the new technologies can allow consumers to better adapt their behavior to the situation and constraints of energy systems, both in short and long term. In the short term, reducing peaks of demand provides a direct benefit by strengthening the security of the system and quality of supply. In the longer term, opting for technologies that are sober or adapted to local constraints can reduce the need for network or generation investments. However, such outcomes require an active behavior of consumers, which has to rely on a proper level of information and incentives. In other words, improving consumers' awareness of the individual and collective benefits is crucial for getting all the added value of smart technologies.

In this respect, the characteristics of smart grids can support informed consumer participation in markets (when the overall market design make it possible), and intelligent and informed use of energy. In other words, consumers are given a more participative and active role and they are provided with better information. It is mutually beneficial for producers and consumers since it increases the energy efficiency. Moreover, consumers' participation in systems functioning is even exacerbated when they become producers via self-generation of distributed generation. Such developments can, on the one hand, provide solutions but also create problems due to the instability provoked by power injection in distribution grids. Smart grid technologies are aimed at making distribution networks management more dynamic and, thus, supporting an efficient deployment of generation at the consumer level.

More generally, in competitive markets especially, the development of smart grids supports the transition from consumers to prosumers via an improved consumer awareness. Nevertheless, decentralized options and individual behaviors, to be efficient, require a certain level of coordination. In other words, it should be ensured, as much as possible that consumers make coherent choices, technological options can undoubtedly provide a high benefit in this respect. For example, as far as demand side management is concerned, aggregators and retailers are fundamental. They can indeed organize a coordinated reaction of consumers according to the state of the system, assuming that specific signals are sent.

Following the Egypt case, electricity law allows private production of electricity for self-generation and third party sales. In total, self-generation corresponds to 187 billion kWh and the consumer awareness among the prosumers are steadily increasing.

In the case of 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 the wrong use of it by spreading energy awareness among consumers and informing them of the impact of the misuse of electricity and its negative impact on their consumption.

Furthermore, the Joint Research Center (JRC) of the European Commission (EC) is currently mapping the smart grids of Europe and it has done a research about the relationship among the consumer awareness and the smart grids. The findings of this research highlight the widespread need to increase the awareness of consumers, to understand their reactions and the drivers of their behavior in order to increase the efficiency and expansion of the smart

grids.²⁵

Due to the inertia of energy systems (and especially the fact that electric devices are often in place for several years) most smart grid projects underline the need to involve consumers at the early stages of project development. At the same time, consumers should keep some freedom to choose their level of involvement and data privacy and protection have to be ensured. As a complement, communication is crucial since it is imperative to ensure that consumers have trust in and understanding of the complete smart grid process and receive clear tangible benefits. Some experiments have indeed highlighted some strong opposition from certain users, notably regarding smart meters deployment, due to perceived risks upon privacy. To differing extents, consumers will be able to reap numerous potential benefits i.e. energy savings, the reduction of 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.

²⁵ https://ac.els-cdn.com/S0301421513003637/1-s2.0-S0301421513003637-main.pdf?_tid=3b9b5638-ab55-489c-9660-63969bac50d3&acdnat=1535547870_609554582ac28b4f41662c3652237390

3. Conclusions

The implementation of SG 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 the reliability of the network by easing peak demands and improving energy efficiency.

In long-term, the implementation of the SG will likely require ongoing changes to the market rules and will significantly increase operational complexity. Accompanying the implementation of the SG, it is also expected a significant increase in the volume of data that will need to be gathered and analyzed, which will require more sophisticated solutions than those presently in use. New software programs and algorithms will be needed for energy balancing and control functions. Operators will require a new breed of visualization tools to aid situational awareness and improve decision-making and response time. System planners will need “Smart-Grid-aware” tools that extract efficiencies from existing infrastructure when new “smart devices” are used.²⁶

However, EU visions about SG roles remain relatively vague. The primary driver of this is the lack of clear standards for interoperability at a national level and “Mediterranean ring” level. This significant challenge must be addressed in order to actualize the SG vision and bring the promised benefits to fruition within the Mediterranean countries. In short, clear standards are absolutely necessary if the vision of a smarter grid is actually going to be attained. On the other hand, the EU RES Directive will boost definitely the SG with distributed generation, prosumers, and communities of energy and the electrification of transport (EV).

For instance, smart meters’ deployment arises several benefits such as reducing reading costs, network losses and electricity fraud (Montenegro case implied a reduction in network losses from 21% to 15% after a 72% deployment), but also regulators should be careful in deployment 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 Egypt 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 had the potential to deliver job creation, economic growth and electricity cost reductions for thousands of residential, commercial and industrial consumers, like the Cyprus case. Virtual net metering is another promotion scheme implemented in Greece that allow 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

²⁶ <http://www.netl.doe.gov/moderngrid/docs/MGI%20Vision%20Summary.pdf>

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. Additionally, 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 Greece case of rooftop PV illustrates.

Storage is an interesting option to fully extract the renewable potential, mainly in the solar and wind cases. It is remarkable the Jordan pilot project for 30 MW storage that is being open to developers this year, in order to achieve a wider demand coverage through renewable energy and thus, reduce their energy imports and 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 Electric Vehicle, charging points regulation seems critical, as in both case studies public consultations regarding charging infrastructures are being conducted. Regulatory issues should include business model ensuring competition, network tariffs without discrimination, connection procedures, and the integration of EV recharge in power system transformation. In the Italian case EV charges are not only expressed in euro/kWh, but often are related to power/speed of the recharge, time of use, mapping and booking of the connection point (CP). The different prices set by the CP providers allows them to manage the CP occupancy. In Turkey, more than 500 charging stations are installed, and regulation for procedures and principles of Electric Vehicle Charging Station has been opened to public opinion and industry evaluations.

The shared cases also illustrate different approaches for DSO regulation depending on the country 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, establish a fully integrated company (generation, transmission, distribution and retail). Finally, it should be stressed the relevance of data management an increasingly important topic for SG and DSO regulation.

4. Annex 1 – National case studies

4.1 Montenegro / smart metering

The Energy law of Montenegro defines that the Distribution System Operator shall establish the Smart Meter System until January 1, 2022. In order to implement this obligation, this operator is to equip at least 85% of consumers with smart meters by January 1, 2019.

Through the approval of investment plans, the Agency has approved the investments for the implementation of the project for the installation of new, modern meters with remote reading (smart meters). For the first phase of the project (2012 - 2015) the Agency approved the installation of 175.000 meters, while 80.000 meters were approved for the installation in the second phase (2015 - 2016). At the moment, the third phase (2016 - 2018) is being implemented. This phase approves the installation of another 45.000 meters.

Closing with 31.12.2017, out of the total number of 376.735 meters, the total of 275.150 new meters was installed, i.e. the coverage of smart meters amounted to 73,04%. When replacing old meters, the meters were moved to the property border, which, in addition to the reconstruction of the network, led to a reduction in possibilities for unauthorized use of electricity.

New meters have the ability for remote communication, thus achieving more efficient and accurate reading, a higher degree and more reliable disconnection of irregular consumers, and therefore a higher collection which largely exceeds 100% of the project (due to collection of outstanding claims). In addition, the automatic meter reading reduced the costs of reading because the need for manual reading decreased. During the implementation of this project, consumer databases were edited, and the monitoring of the losses by transformers was enabled.

The effects of the installation of new meters are also reflected in the reduction of distribution losses, as the total losses in the distribution network amounted to 14,96% in 2017, and are lower than losses in 2016, when they amounted to 15,62%. Losses in the previous period were also significantly higher, for example in 2012, when the project for the installation of new meters started, the losses amounted to 20,84%.

4.2 Egypt / demand side management

Demand side management	Electricity law 87/2015 set an obligation on the distribution companies to make DSM studies for consumers free of charge. EgyptERA has to review these studies by law. Work on this issue was started since 2016. DisCos calculate load factors and draw load curves for consumers.
Hourly metering	Hourly metering is not generalized but applied in some cases but most of load curves is drawn upon monthly base (kwh/month) while the duration is regularly one year.
Information of prices in advance	Prices announced every year before being applied by one or two cycles, while Time of Use tariff is applied on industrial sector.

Voluntary management of consumption	Most of the consumers who received DSM studies from DisCos applied the introduced solutions.
Automatic control of consumption	Different techniques of automatic control are applied. Either the microcontroller based AC systems or SCADA systems connected to loads. AC for lighting loads is widely disseminated in Egypt.
Participation on ancillary services (aggregator)	Egyptian Electricity Transmission Company EETC is the TSO who implement the scheduling mechanisms through their huge control system, dispatch is done half automatically by TSO, EEHC and DisCos, while EgyptERA set regulations and calculates the annual price for power factor and reactive power compensations.

Table 2. Egyptian demand side management

4.3 Spain / demand side management

4.3.1 Relevant Spanish regulation

The Spanish electricity wholesale market began working on 1 January 1998. The retail market was fully liberalized on 1 July 2003. Since then, all consumers have been able to choose their supplier. There is legal and functional unbundling in distribution activity and ownership unbundling for the transmission grid. After 2009, distribution unbundling was fully applied and thus distributors stopped their supply activity in favor of free suppliers. All consumer must pay the correspondent regulated access tariff plus the price of the energy in the wholesale market plus a commercial margin. Nevertheless, last resort suppliers and a last resort tariff were created for small consumers (below 10 kW), which can choose either free or regulated market. Since the 1 January 2014, the last resort regulated tariff was replaced by the PVPC system. Under the new system, the energy price paid by consumers is the price resulting in the day-ahead spot market and the ancillary services cost during the billing period (as opposed to the previous system based on specific long-term hedging products).

In absence of smart meter, a standard hourly demand profile is used in order to compute the energy cost to be paid by consumers. In addition, consumers have to pay the applicable access tariffs and other charges, such as the margin of the reference supplier. Since October 2015, consumers equipped with smart meters are billed based on metered hourly consumption and hourly prices.

Full smart meters deployment should be implemented in 1 January 2019. We are in the last year of implementation of the smart meters plan 2008-2018 for 27 million of consumers. Now, proximally 95% of them have a smart meter.

4.3.2 Market indicators

The wholesale market is characterized by a developed and liquid spot market with multiple participants and a moderate and stable concentration in the period 2013-2015 (always around C3 = 64%, CEER data).

The retail market has been historically more concentrated: industrial and SME segments increasing C3 slightly from 67% in 2014 to 70% in December 2016. On the other hand, domestic segment decreases C3 from 88,2% in 2014 to 85,5% in 2016 (CNMC data).

This is somehow reflected in the escalation of suppliers making offers in all the consumer segments (CNMC). Additionally, the retail market shows moderately high switching rates of 11-12% during the 2012-2016 period.

Some of these new offers are referenced to PVPC prices plus a constant margin for the retailer, independently of the client's consumption, so the consumer faces hourly prices and the retailer main purpose is to reduce consumer's bill.

4.3.3 Potential savings estimations

The mature wholesale market, the high number of new entrants and new offers, and the smart meter deployment together with default dynamic prices (PVPC) are factors that could set the grounds for the development of Demand Side Management.

A very simplified exercise was conducted in order to estimate the level of consumers' potential savings in case of shifting partially their demand. The following assumptions were considered (using 2017 hourly spot prices data):

- Percentage (%) of Shifted demand. Percentage of daily demand shifted from the most expensive hours to the cheapest ones during the period taken (a day or every day for a week). For a conservative estimation 25% was taken, and 50% as a proxy of a high shifting capacity (and probably with participation of batteries for storing cheap energy).
- Shifting period for the consumption: within 1 day²⁷.
- Demand/year: three levels of demand were taken based in the mean consumption of the access tariffs 2.0 DHA, 2.1A and 2.1 DHA. These access tariffs are mainly domestic and SME consumers, which higher demand and with time discrimination²⁸ have more incentives/potential to shift their demand (it comprehends around 2,8M supply points and an aggregated demand of more than 17.500 GWh equivalent to 7,5% of Spanish demand).

The potential savings linked to pure consumption from PVPC were aggregated in three different levels for the three access tariffs:

- A conservative estimation, with 25% daily demand allocated from the most expensive hours to the cheapest ones every day.
- A more optimistic, with a 50% of the daily demand allocated from the most expensive hours to the cheapest ones every day.

	Shifting period / Access tariff	Demand/year (MWh)	% Shifted	Potential savings (€/year)
Conservative	1 day / 2.0 DHA	17,0	25	135
	1 day / 2.1 A	8,5	25	66
	1 day / 2.1 DHA	5,0	25	39
Optimistic	1 day / 2.0 DHA	17,0	50	270
	1 day / 2.1A	8,5	50	131

²⁷ A more realistic approach would be systematic savings during periods even greater than a day exploiting the prices differences when a minimum difference threshold is met.

²⁸ In the 2.0 DHA and 2.1 DHA cases.

	1 day / 2.1 DHA	5,0	50	77
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Table 3. Conservative and optimistic estimations of potential savings

Potential savings²⁹ range from 39-77 €/year for a domestic consumer with a 5.000 kWh/year consumption, with a typical annual bill of around 800-1.000 €. Meanwhile for access tariffs with higher consumptions and more related to big households and SMEs the estimated savings vary between 66-270 €/year, with bills that could range from 1.500-3.000 €.

Additionally, by this potential savings linked to pure consumption, the Spanish regulation already gives incentives through the access tariff to modulate consumption during certain periods. Therefore, two or three discrimination periods are established that imply a reduction in the access tariff depending on which period is the consumption. For a typical Spanish household it could suppose at least 60 €/year savings³⁰, about 5-6% electricity bill. However as shifting capacity to non-peak hours increase savings could be up to 150€, about a 15%³¹. For higher levels of consumption and of capacity (8,5 MWh and 17,0 MWh) the benefits are consequently higher reaching to 300 €/year and 450 €/year considering that only one third of consumption allocated in peak hours (optimistic potential).

Summing up both potential savings:

Estimated savings shifting demand + discrimination tariff		
Demand level (MWh)	Conservative potential (€)	Optimistic potential (€)
17,0	385	720
8,5	216	431
5,0	89	217

Table 4. Estimated savings shifting demand and discrimination tariff

The mature wholesale market, wide offers options in the retail market with several players and dynamic tariffs along with smart meters set the ground for DSM. Pure savings from market prices are still modest for domestic consumers with higher consumptions and SMEs in low voltage (2,8M supply points). However, in combination with the discrimination access tariffs that allow additional savings, the current paradigm could imply significant potential savings for consumers with enough flexibility for shifting their demand. This could explain the constant increase of consumers in the discrimination tariff 2.0 DHA (P<10 kW) since 2013:

End period	Million supply points in 2.0 DHA (discrimination tariff with P<10 kW)
2012	1,06
2013	1,08
2014	1,24
2015	1,47

29 Taking into account also the taxes costs and the loss coefficient pass on consumers.

30 <https://blog.cnmc.es/2017/02/02/como-ahorrar-en-la-factura-de-luz/>

31 Estimated through CNMC comparison tool, only one third of consumption allocated in peak hours. <https://comparadorofertasenergia.cnmc.es/comparador/index.cfm?js=1&e=N>

2016	1,95
2017	2,74

Table 5. Number of supply points in the discrimination tariff

4.3.4 Egypt / self-generation

Self-generation	187,0 Bn kWh which covers all the consumption of Egypt
Net self-consumption	179,1 Bn kWh
Net metering (energy)	171,2 Bn kWh

Table 6. Self-generation and net self-consumption

4.4 Cyprus / overall summary

In Cyprus, electricity from renewable sources is promoted through subsidy combined with a net metering scheme. Additionally, there is a transitional “feed-in” tariff scheme in place. Access of electricity from renewable energy sources to the grid shall be granted according to the principle of non-discrimination. With regard to the use of the grid, renewable energy shall be given priority. Grid development is a matter of central planning (Transmission Network Development Plan 2017-2026 by the Cypriot TSO). There is number of policies aiming at promoting the development, installation and use of RES installations.

In order to promote the installation of PV systems from consumers, thus becoming 'prosumers', producers and consumers of renewable energy, the Cypriot Authorities had put in force two distributed RES incentive support schemes, published by the Ministry of Energy, Commerce, Industry and Tourism (MECIT), one based on net-metering and one based on self-consumption. In 2018, a net-billing scheme was also introduced with the aim of replacing the previous self-consumption scheme. Currently, the following schemes are in force:

- Subsidy: The “Support Scheme for PV and Biomass/Biogas 2017³²” scheme, aims at supporting the purchase and installation of PV up to 3kW for vulnerable social groups that will operate under a net-metering scheme.
- Net-metering: The “Support Scheme for PV and Biomass/ Biogas 2017” scheme introduced the net-metering system in Cyprus. The scheme was renewed and published on 25 June 2018 (“Support Scheme for PV and Biomass/Biogas 2018³³”) and involves PV systems up to 10kW connected to the grid by net-metering for all consumers. Total Available Capacity: 20MW.
- Net-billing: The “Support Scheme for PV and Biomass/ Biogas 2018” scheme introduced

³²[http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/B3F78CDCA3517FF1C225811A0034C8EE/\\$file/%CE%A3%CE%A7%CE%95%CE%94%CE%99%CE%9F%202017.pdf](http://www.mcit.gov.cy/mcit/EnergySe.nsf/All/B3F78CDCA3517FF1C225811A0034C8EE/$file/%CE%A3%CE%A7%CE%95%CE%94%CE%99%CE%9F%202017.pdf)

³³[http://www.mcit.gov.cy/mcit/energyse.nsf/All/9BDC1EE5AA2223CAC22582B700274F54/\\$file/%CE%A3%CE%A7%CE%95%CE%94%CE%99%CE%9F%20%CE%93%CE%99%CE%91%20%CE%A0%CE%91%CE%A1%CE%91%CE%93%CE%A9%CE%93%CE%97%20%CE%97%CE%9B%CE%95%CE%9A%CE%A4%CE%A1%CE%99%CE%9A%CE%97%CE%A3%20%CE%95%CE%9D%CE%95%CE%A1%CE%93%CE%95%CE%99%CE%91%CE%A3%20%CE%93%CE%99%CE%91%20%CE%99%CE%94%CE%99%CE%91%20%CE%9A%CE%91%CE%A4%CE%91%CE%9D%CE%91%CE%9B%CE%A9%CE%A3%CE%97%20NET-METERING%20NET%20BILLING.pdf](http://www.mcit.gov.cy/mcit/energyse.nsf/All/9BDC1EE5AA2223CAC22582B700274F54/$file/%CE%A3%CE%A7%CE%95%CE%94%CE%99%CE%9F%20%CE%93%CE%99%CE%91%20%CE%A0%CE%91%CE%A1%CE%91%CE%93%CE%A9%CE%93%CE%97%20%CE%97%CE%9B%CE%95%CE%9A%CE%A4%CE%A1%CE%99%CE%9A%CE%97%CE%A3%20%CE%95%CE%9D%CE%95%CE%A1%CE%93%CE%95%CE%99%CE%91%CE%A3%20%CE%93%CE%99%CE%91%20%CE%99%CE%94%CE%99%CE%91%20%CE%9A%CE%91%CE%A4%CE%91%CE%9D%CE%91%CE%9B%CE%A9%CE%A3%CE%97%20NET-METERING%20NET%20BILLING.pdf)

the net-billing system in Cyprus. It involves PV systems and biomass/biogas self-generation systems, from 10kW up to 10MW per electricity bill, installed in commercial and industrial plants. Total Available Capacity: 80 MW.

- Self-generation: “Self-generation” for the purposes of the Scheme is defined as the generation of electricity from power plants located in lawfully constructed premises located within the same block and/or adjacent to the premises of the commercial or industrial consumer. Energy is not injected into the grid but is used at all times for the sole purpose of own consumption and not for economic exploitation through network use. It is also possible to install a direct line to the premises in accordance with the provisions of the electricity legislation. In any case, the cost of the direct line will be borne by the applicant.
- Autonomous: This scheme refers to autonomous PV systems not connected to the grid.
- Feed-in tariff: (For legal persons and private entities- SSRES 2017): “Support Scheme for RES electricity production by plants that will be finally integrated in the competitive electricity market” introduces a transitional scheme, where RES plants can connect to the grid and receive an “RES price”. However, these RES plants will enter the competitive electricity market 12 months after the initiation of its operation.

4.4.1 Subsidy – PV in households with net metering – “Support scheme for PV and biomass/biogas 2017” scheme

Under the “Support Scheme for PV and Biomass/Biogas 2017” Scheme, grants relating to the purchase and installation of PV up to 3kW are allocated. Eligible are all-natural persons whose selection will be based on income and social criteria. Successful applicants can consequently operate under a net-metering scheme. The scheme will close when the maximum capacity (1.2 MW) is covered.

- Eligible technologies: PV installations are eligible.

Solar energy	PV systems up to 5,2kW (aggregate installed capacity 1,2MW)
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Table 7. PV systems for vulnerable consumer’s households (with subsidy)

- Amount: The grant amounts to € 900 per installed kW and will be paid to the approved applicants one-off, with a maximum amount of two thousand seven hundred euros (€ 2,700) per installation and per beneficiary. Even in the case where the applicant chooses to install a system beyond 3kW, the total amount of the subsidy will not exceed two thousand seven hundred euros (€ 2,700).
- Addressees:
 - Entitled party: All-natural persons belonging to vulnerable social groups (Ministerial Decree 289/2015). In addition, recipients of the family allowance for single parents, with a family income less than €39,000 are also eligible.
 - Obligated party: The obligated party is the state, represented by a committee of the MECIT (Administrative Committee of the Special Fund for RES and Energy Efficiency) as well as the Electricity Authority of Cyprus (EAC).

4.4.2 Net-Metering (for all consumers)

Cyprus introduces for the first time a net-metering scheme in 2013 and since then net metering scheme is still open to the public. Certain improvements to the scheme were made from time to time. The net-metering scheme in Cyprus applies to natural and legal persons producing

electricity from PV plants. Since 2017, Biomass/ Biogas plants are also eligible.

This category concerns investments by natural or legal persons for the installation of PV systems up to 10kW connected to the distribution network to cover their own needs by the application of the net metering system. PV systems can be installed in accordance with the instructions of the appropriate authorities:

- On the ceiling of legally built premises or on the ground within the same block where the legal premises are located.
- In a land where a drilling or construction of a shaft is authorized by the competent department (concerns only farmers).

The cost of installing the PV system, including the cost of purchasing and installing the electricity meter, is entirely borne by the beneficiaries.

- Eligible technologies: PV and Biomass/ Biogas installations are eligible.

Solar energy	<p>For households: PV up to 10kW (aggregate installed capacity 5MW)</p> <p>For non-domestic consumers: PV up to 10kW (aggregate installed capacity 15MW). In this category, 3MW are reserved for agricultural companies and fisheries and 4MW for public educational institutions such as public schools and kindergartens</p>
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Table 8. Solar energy for households and non-domestic consumers using net-metering

- Amount: The electricity offsetting will be carried out once every two months or each month for each calendar year by EAC or by any other electricity supplier to which the consumer has contracted. Any surplus will be transferred in the next two months or next month while any deficits will be invoiced. The final account (measurement of February - March) of the calendar year will be the final settlement. Electricity surplus cannot be carried over from one calendar year to the next.
- Addressees:
 - Entitled party: Entitled are natural persons and public administration entities as well as legal entities (fisheries and agricultural companies are included).
 - Obligated party: The obligated party is the state, represented by the EAC.

4.4.3 Net-billing (for commercial and industrial consumers)

This category refers to installations of RES systems that are being installed in commercial or industrial premises (i.e. commercial, industrial units, public buildings, camps, schools, agricultural and livestock units, fishing enterprises) for the purpose of generating electricity for their own use.

RES systems can be installed on the roof of legally built premises or on the ground within the same piece and / or adjacent pieces with the premises, they will serve.

Main requirement is that for the installed systems the maximum installed capacity of the system cannot be above 80% of the maximum consumption of the user, as recorded in the previous year, unless there is a storage system installed or an export limitation control scheme. Moreover, the expected annual energy production by the RES system should not exceed the annual energy consumption of the applicant.

- Eligible technologies: PV and Biomass/Biogas installations are eligible.

Solar energy	For industrial/commercial units and public administration buildings: net-billing PV systems between 10kW - 10MW, aggregate installed capacity 40MW, 3 out of which fall under the Ministry of Agriculture Scheme 2014-2020).
Biogas/biomass	For industrial/commercial units and public administration buildings: net-billing biomass/biogas systems between 10kW - 10MW, aggregate installed capacity 40MW, 3 out of which fall under the Ministry of Agriculture Scheme 2014-2020).

Table 9. Solar energy and biomass/biogas for industrial consumers using net-billing

In addition, in August 2018 the net-billing scheme was extended to High Efficiency Combined Heat and Power (HECHP) units for self-consumption. This scheme also applies to commercial/industrial and public administration consumer categories for the installation of HECHP systems with the prime goal of covering their own consumption. The installed capacity of each net-billing HECHP system can be up to 5 MW. The aggregate installed capacity for 2018-2019 for the HECHP systems is estimated to be 20 MW. Furthermore, the installed capacity of the systems should be adapted to the consumption profile of the consumer.

- Amount: All consumers who will install a net-billing system will pay their supplier the applicable charges determined by CERA. For both net-billing schemes a bidirectional meter with two registers is installed, that measures separately:
 - the absorbed electricity (net consumption) and
 - the surplus of electricity injected into the grid (net generation)

The meter should have telemetering and data recording capabilities. If a bidirectional meter is not technically feasible, two meters can be installed to record the above data.

Measurements are taken every twenty (20) minutes and the electricity netting is carried out for every twenty-minute interval. This essentially constitutes a real-time net-billing scheme.

The billing period is one or two months (depending on the consumer category), where all twenty-minute intervals with net consumption are summed together and all twenty-minute intervals with net generation are also summed together. The difference with the self-consumption scheme is that with the net-billing scheme net generation and consumption are billed separately for each billing period. Currently the price that the energy from RES or HECHP is remunerated is calculated every month based on a methodology approved by CERA.

The price for buying electricity from RES or HECHP is the sum of a reference price, which is checked and recalculated if needed every year, and a fuel-price adjustment part, which is calculated every month. In the future, once the new market arrangements are operational, the price that the RES and HECHP generation is bought will be linked with the electricity wholesale price.

For both net-billing schemes and for each billing period the cost for the net-generation (credit for the prosumer) is calculated, along with the cost for the net consumption (debit for the prosumer). If the cost of the net consumption is higher than the cost for the net-generation then the prosumer is billed for the difference between these two. If the cost for the net-generation is higher than the net consumption, then the amount is credited in the next billing period.

In the last bill, within a period of twelve months, the final financial settlement is carried out. If

there is a remaining credit this is not transferred from one twelve-month period to the next and is deleted without being compensated. Therefore, incentive is given to the prosumers to dimension the generation installation to follow their consumption profile as closely as possible.

4.4.4 Self-generation PV and biomass/biogas systems for industrial/commercial units and public buildings

"Self-generation" for the purposes of the Scheme is defined as the generation of electricity from power plants located in lawfully constructed premises located within the same block and/or adjacent to the premises of the commercial or industrial consumer. Energy is not injected into the grid but is used at all times for the sole purpose of own consumption and not for economic exploitation through network use. It is also possible to install a direct line to the premises in accordance with the provisions of the electricity legislation. In any case, the cost of the direct line will be borne by the applicant.

- Eligible technologies: PV and Biomass/Biogas installations are eligible.

Solar energy	For industrial/commercial units and public administration buildings: self-generation PV between 10kW - 10MW (aggregate installed capacity 40 MW, 3 out of which falls under the Ministry of Agriculture Scheme 2014-2020).
Biogas/biomass	For industrial/commercial units and public administration buildings: self-generation biogas/biomass plants between 10kW - 10MW (aggregate installed capacity 40 MW, 3 out of which falls under the Ministry of Agriculture Scheme 2014-2020)

Table 10. Solar energy and biomass/biogas for industrial/commercial units and public administration buildings

4.4.5 Autonomous PV and biomass/biogas systems

For PV and biomass/biogas systems not connected to the grid there is no limit in the capacity of each system and there is no limit as well in the total installed capacity of the systems. All consumers are eligible.

- Eligible technologies: PV and Biomass/Biogas installations are eligible.

Solar energy	For all consumers: self-generation PV (aggregate installed capacity – without limitation).
Biogas/biomass	For all consumers: self-generation PV (aggregate installed capacity – without limitation).

Table 11. Solar energy and biomass/biogas for industrial/commercial units and public administration buildings

Autonomous PV and biomass/biogas systems can be installed in legally constructed premises located within the same block and / or adjacent blocks with the premises they will serve.

Interested parties can, if they wish, install storage equipment by submitting together with the application all the information provided by the manufacturer, the safety measures, as well as the contribution of the storage equipment to the entire system.

4.4.6 Feed-in-tariff

“Support Scheme for RES electricity production by plants that will be finally integrated in the competitive electricity market” introduces a transitional scheme, where RES plants can connect to the grid and receive a “RES price”. However, these RES plants will enter the competitive electricity market 12 months after the initiation of its operation. This is not a clear “feed-in-tariff”, as its main purpose is to ease the easier introduction of new RES to the new competitive electricity market.

- Eligible Technologies: Wind energy, solar energy, biomass and wave energy are eligible.

Wind energy	Eligible
Solar energy	PV and CSP are eligible
Biomass	Eligible

Table 12. Eligible technologies

4.4.7 Installed RES capacity in Cyprus

Figure 7 below presents the annual RES installed capacity (kW).

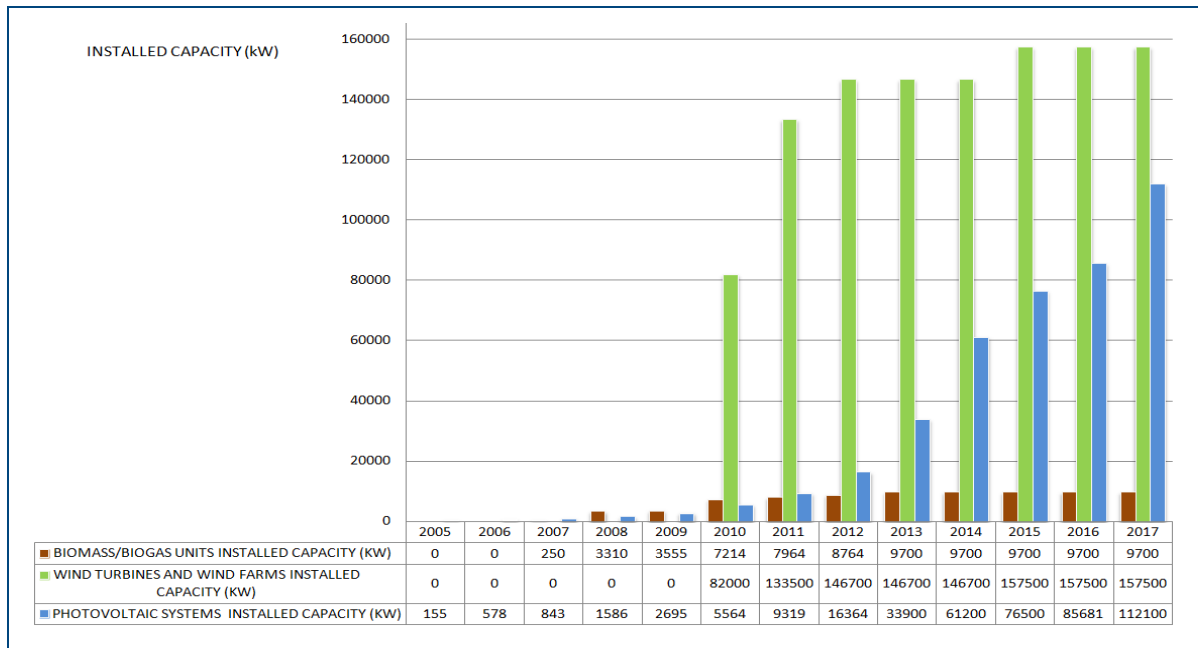


Figure 7. Annual RES installed capacity (kW)

Figure 8 below presents the number of the installed Net-Metering Systems and the installed capacity of those systems for the period 2013-2017.

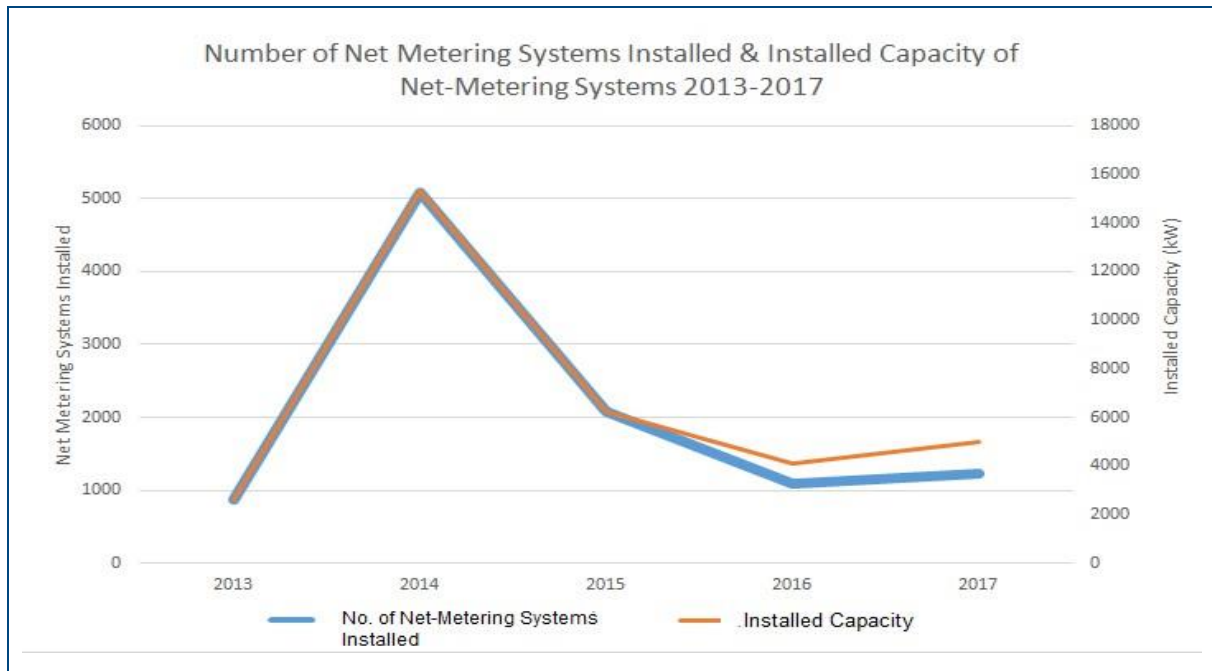


Figure 8. Number of the installed net metering systems and installed capacity of net metering systems for the period 2013-2017

Figure 9 below presents the installed capacity of self-generation systems, both for PV and biomass for the year 2017.

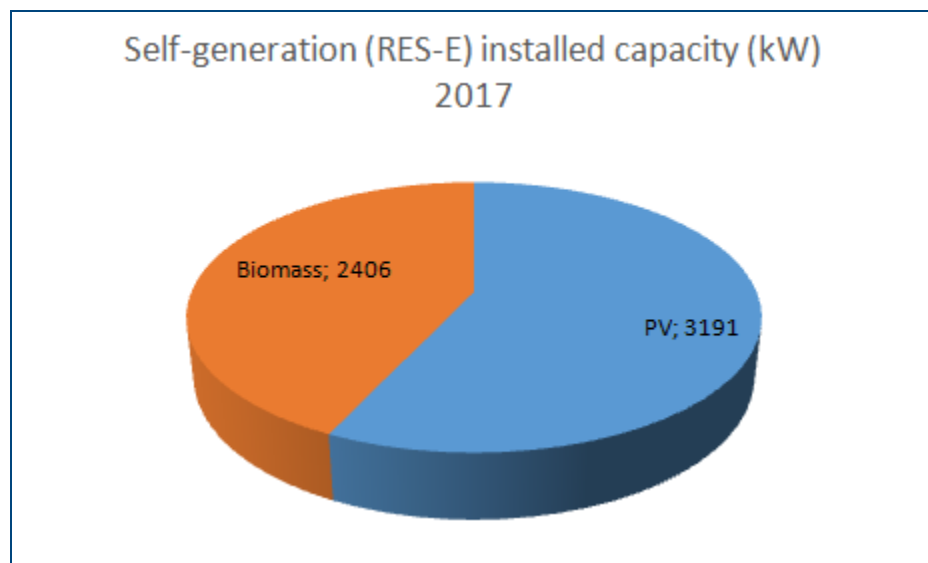


Figure 9. Self-generation (RES-E) installed capacity 2017

4.5 Greece / distributed generation

4.5.1 RES existing framework over distributed generation

▪ Introduction

Currently in Greece, the distributed generation policies are linked only to the installation of PV plants. There are two methodologies in place, one which is the first implemented in 2009 that has with the separate remuneration of the energy produced by the PV plant to do and the other

where netting of the consumed energy by the connection point and the produced energy by the PV plant is carried out. The former was very successful in the beginning where the energy produced was remunerated at high prices based on Feed-in-Tariffs (FiT) and the latter is becoming more attractive in the last 2 years. Detailed analysis is provided below.

▪ **Program: “PV plants on rooftops”**

By virtue of the Ministerial Decree No. 12323/ΓΓ’175/04.06.2009 (National Gazette No 1079 B’) a special program for the installation of the PV plants on rooftops was implemented. According to this, the production of a PV plant with a maximum capacity up to 10kWp located on house or SME rooftops is to be remunerated based on FiT mechanism for a period of 25 years. The above income was designed to be exempted from taxation and according to the initial plans; the program will be active until 31.12.2019.

More specifically, the FiT was predefined in the Ministerial Decree in question and was connected with the date of the connection of the PV plant to the grid. In general, due to the sharp decrease of the CAPEX of the PV equipment, the Ministry of Energy and Environment decided to reset the prices in order to avoid overcompensation of the PV producers. The final FiT pricing as a function of the connection date as it has been reviewed by L. 4254/2014 and the Ministerial Decree ΥΑΠΕ/Φ1/1289/9012/30.04.2013 is presented in the table below:

Connection Date of the PV plant	FiT (€/MWh)
2009	550
2010	550
2011 1 st -2 nd quarter	550
2011 3 rd - 4 th quarter	470
2012 1 st quarter	415
2012 2 nd quarter	385
2012 3 rd quarter	340
2012 4 th quarter	295
2013 Jan	270
2013 Feb – 2014 Jan	125
2014 Feb - 2015 Jan	120
2015 Feb – 2016 Jan	115
2016 Feb – 2017 Jan	110
2017 Feb – 2017 July	105
2017 Aug – 2018 Jan	100
2018 Feb – 2018 Jul	95
2018 Aug – 2019 Jan	90
2019 Feb – 2019 Jul	85
2019 Aug – 2019 Dec	80

Table 13. FiT of PV plants on rooftops as a function of the connection date

As it is physical, the development of this application was extremely swift in the beginning (years 2009 – 2012), but following the reset of the FiTs which took place mainly in years 2013 and 2014 and b) the inauguration of the net metering scheme which seems to be more positive for the investors, the program has come to a standstill situation. The above fact is depicted in the following graph, where the evolution of the PV Rooftop Installations in the context of the program in question is depicted as a function of time. Actually, the installed capacity since 2013 has not changed.

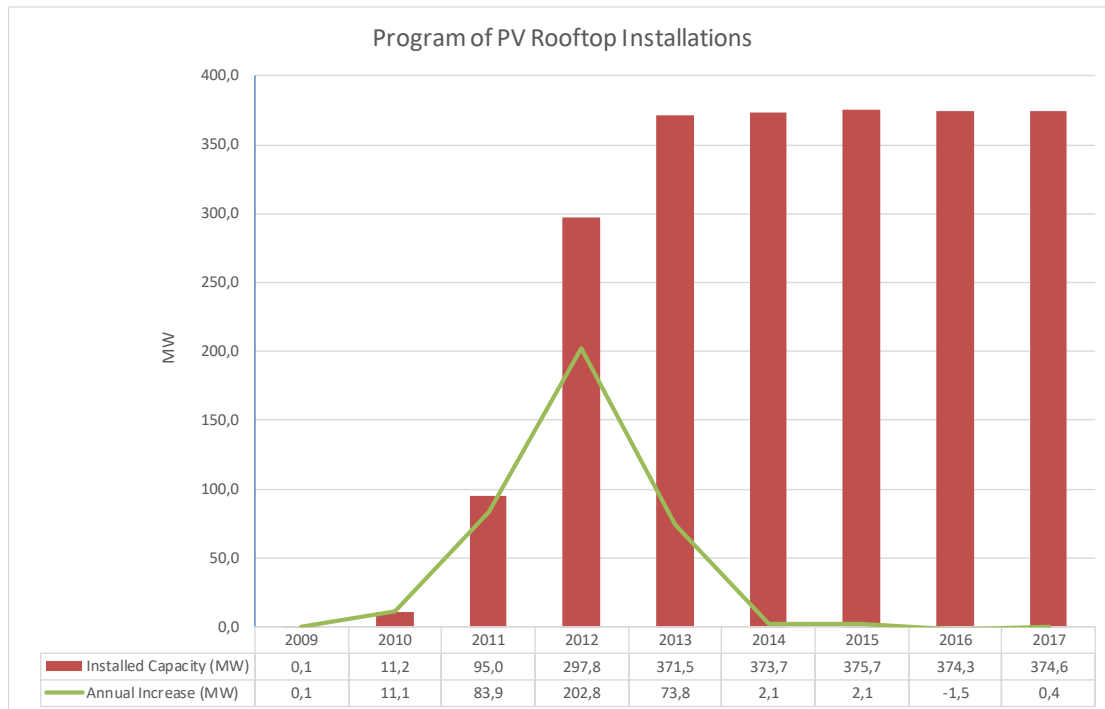


Figure 10. Development of PV plants on rooftops in the period 2009-2017 (Source: HEDNO)

- **Program: “Energy net metering”**

According to the national legal framework (L.4414 / 2016, article 13, National gazette 149 A’), “Energy net metering” is considered the offsetting of the electricity produced by the RES station or High Efficiency CHP (Hereinafter “HECHP”) self-producer with the electricity consumed at a self-producer’s facility located in the same or adjacent plot as the RES station. Precondition is that both the RES station and the self-producer’s facility are connected through the same point to the grid and especially for the RES production; an additional separate internal meter is installed.

Moreover, “Virtual energy net metering” (set forth by virtue of L.4513 / 2018, Article 23, National gazette 9 A’) is the offsetting of electricity produced by RES stations or HECHP self-producers, with the total electricity consumed in self-producers’ facilities, of which at least one is not in the same or adjacent location as the RES station. If it is, it is powered by a different electrical connection. Especially and focusing on the Energy Communities (EC), it is set forth in the aforementioned law that the offsetting of the electricity produced by the RES station or HECHP belonging to EC is carried out with the total electricity consumed in installations of members of EC and vulnerable consumers or citizens living below the poverty thresholds within the Region where the EC is located and operating. Moreover, the virtual energy net metering is an application that can be implemented by public entities, which are pursuing public or other public interest purposes of general or local scope and also agricultural SPVs.

Topology of the metering devices in “net metering” applications

- Basis of all the calculations the amount:

$$E \text{ (energy extracted)} = \Pi \text{ (Energy Produced)} - A \text{ (Energy Consumed)}$$

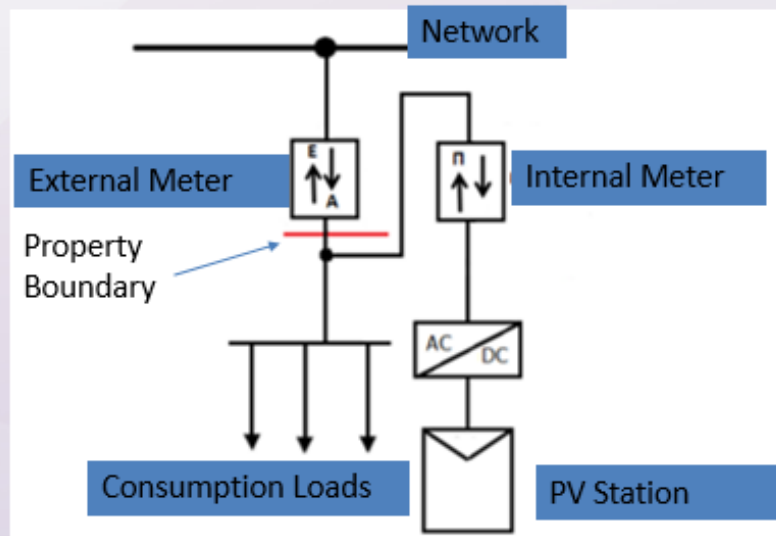


Figure 11. Topology of net metering scheme

▪ Existing legal and regulatory framework

The main predictions of the existing framework are as follows:

- The application is implemented for PV stations only.
- For virtual energy net metering, only the offsetting of the production of a multi-consumption station of the same natural or legal person is allowed (1 station/PV plant to n consumptions of the same entity).
- Capacity Restrictions:
 - Station installed capacity up to 20kW or 50% of the agreed consumer's power Exception: 100% public entities which are pursuing public or other public interest purposes of general or local scope
 - Non Interconnected Islands: 10kW (Crete: 20kW) or 50% of the agreed consumer's power
 - Exception: 100% public entities which are pursuing public or other public interest purposes of general or local scope
 - Maximum power limit: 500kW for the Interconnected Network, 300kW for Crete, 100kW for other NII and 1000kW for Energy Communities
- Energy Net Metering or Virtual Energy Net Metering contracts have 25-year duration.
- Clearing of energy surpluses every three years (in favor of the Special RES Account).
- Specific provisions regarding the amount of energy to be taken into account when calculating the regulated Tariffs (RES Levy, Public Services Obligations and Network Tariffs)
- Surpluses of energy (energy covering the internal needs and exported to the grid) are not entitled to additional remuneration with the exception of public entities where the surplus of energy up to 20% of the produced energy is entitled to additional remuneration based on the specific RES technology reimbursement.

It can be said that for the time being the institutional framework is rigorous, allowing only the installation of photovoltaic stations and taking into account the technical constraints and risks for both the safety of the Network and self-producers and other consumers.

As it is mentioned above, virtual energy net metering is only allowed for specific consumer cases, since in these cases it should be taken into account that 100% of the energy produced is injected into the grid (0% simultaneity, accounting for net metering of energy produced and consumed). Therefore, combined with the short duration of implementation, especially the implementation of virtual energy net metering systems is still relatively limited, showing nevertheless a significant increase in the last two years (2016 and 2017) as it is presented below. In addition, the interest regarding virtual net metering schemes is very low with only two units in operation currently.

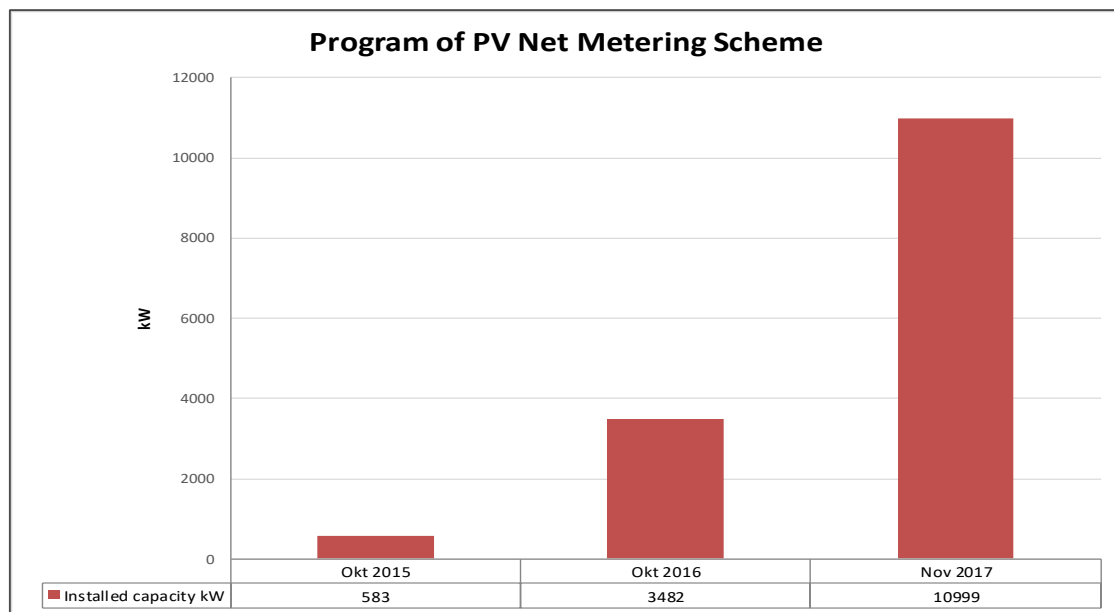


Figure 12. Development of PV net metering applications in the period 2015-2017 (Source: HEDNO)

Last but not least, Energy Communities (by virtue of L.4513 / 2018) are allowed to install RES and HECHP stations as well as hybrid stations up to 1MW to meet the energy needs of their members and vulnerable consumers or citizens living below the poverty thresholds by implementing virtual energy net metering.

▪ **Modification of the institutional framework**

At present, there is a Working Group organized by the Ministry of Energy and Environment active working on the amendment/improvement of the Net Metering Schemes, having the following main tasks:

- More renewable non-photovoltaic technologies (small wind turbines, biomass / biogas / bio-liquids, small hydropower) as well as HECHP to be included in the scheme.
- Combination of two (2) RES technologies at the same application.
- Practical Implementation of virtual energy net metering by EC and issue of all relevant documentation (connection agreements, purchase agreements etc.) to meet the energy needs of their members, with the possibility of integrating vulnerable consumers or even those living below the poverty standards.
- Ability to calculate the energy produced in Medium Voltage to Low Voltage consumptions by taking into account network losses factors approved by RAE.

- In energy net metering, battery storage (only for the needs of the installation, with a ban on energy exchange with the Grid).

4.6 Cyprus / distributed generation

Cyprus has significant potential for distributed generation (DG) development especially from the sun and in less extent from wind. These non-depletable sources of energy are domestically abundant and have less impact on the environment than conventional sources. They can provide a reliable source of energy at a stable price.

Sunshine is abundant in Cyprus during the whole year, with an average sunshine duration of 11,5 hours per day in summer and 5,5 hours in winter. Figure 14 indicates an average global solar irradiation resource of 2.000 kWh/m² on an optimally tilted PV module.

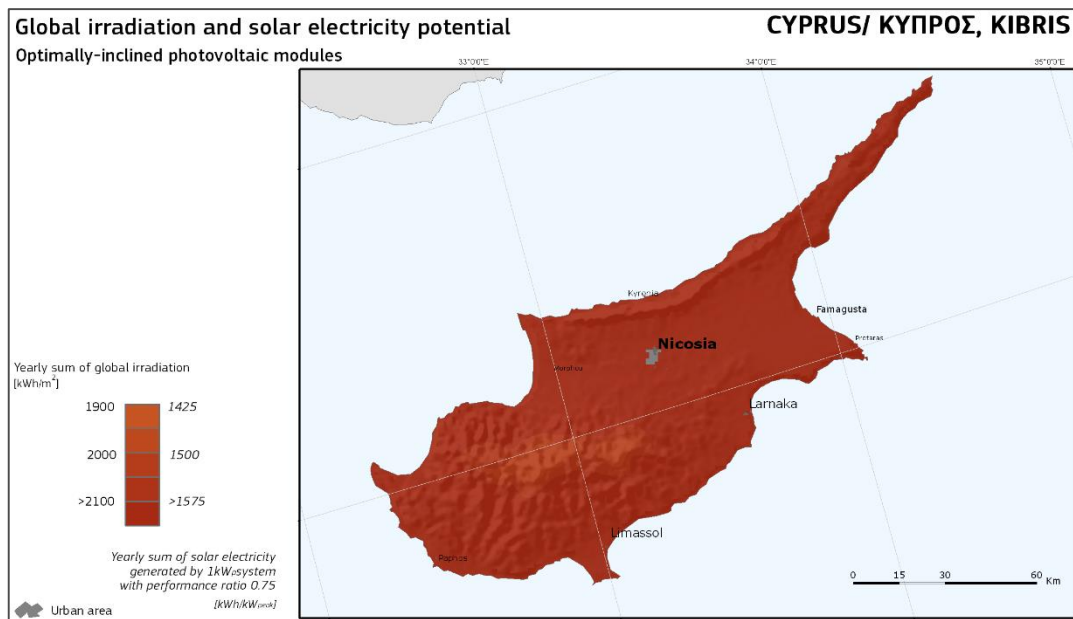


Figure 13. Solar resource map of Cyprus³⁴

The wind energy potential is generally limited in the Eastern Mediterranean where surface winds are usually of light or moderate strength. However, over the island of Cyprus winds are quite variable in strength, due to a complex orography and local heating effects. Differences of temperature between sea and land, which are built up daily in summer, cause significant sea and land breezes. Figure 15 indicates that most of the country has an average wind speed (at 10 m above ground level) below 5 m/s. In a few places, however, much higher wind potentials (up to 8 m/s) are available.

³⁴ <http://re.jrc.ec.europa.eu/pvgis/>

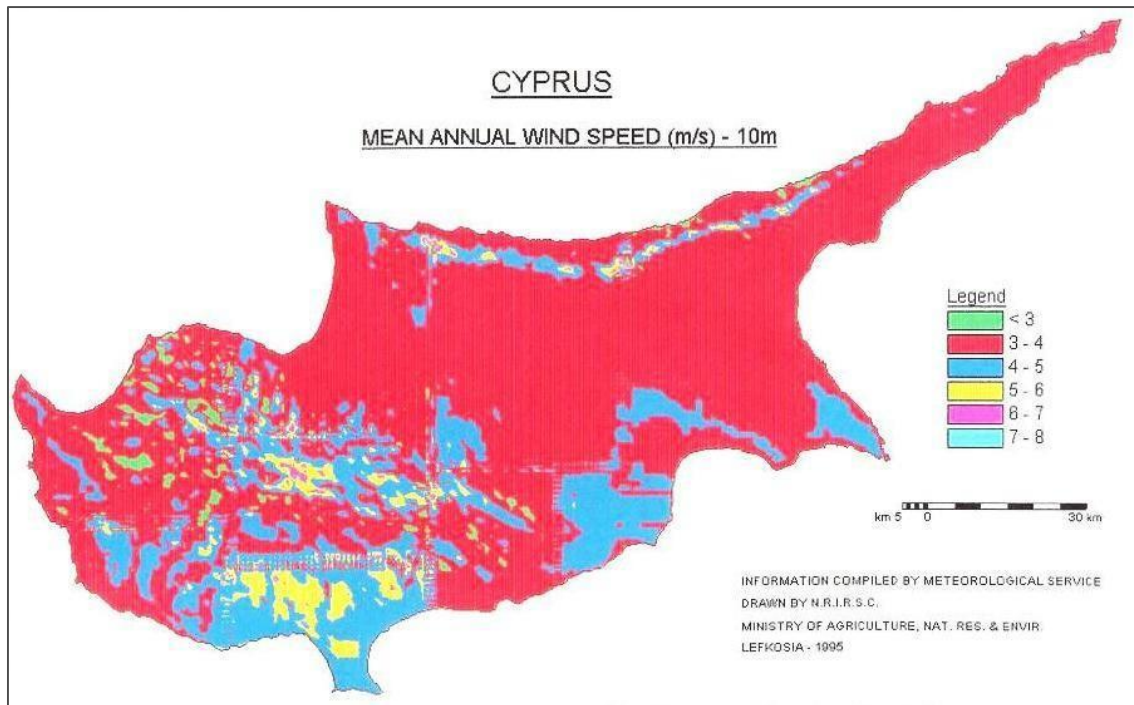


Figure 14. Wind resource map of Cyprus (Source: Ministry of Agriculture)

The last decade DG technologies are rapidly developing in Cyprus, taking into account the policy that is being followed by the Government and the regulatory measures that were taken by the Regulator in order to promote RES-E and increase RES penetration in the energy mix of the island.

Renewable energy offers a way for Cyprus to reduce both the cost and the environmental impact of generating electricity. In the wake of the recent economic recession, turning to renewables can help to reduce fuel imports, strengthen the trade balance and create local jobs. The success of solar water heaters, for example, can be replicated for solar photovoltaic.

As an EU member state, Cyprus must comply with a national renewable energy target currently set at 13% of gross final energy consumption from renewable energy by 2020. The renewable energy share for the power sector has been set at 16% by 2020 in the first National Renewable Energy Action Plan (NREAP) (Ministry of Energy, Commerce, Industry and Tourism, 2010). In addition, Cyprus has aspirational renewable energy targets that extend beyond 2020, aiming for 25,29% the renewable energy by 2030. The renewable energy share for the island was 8,35% in 2017 and has been following an increasing trend in recent years. This roadmap shows that not only can Cyprus meet its EU and national renewable energy targets but that renewable energy generation provides a least-cost option that can greatly exceed the renewable energy targets while reducing generation cost. As a result, it is likely that renewable energy targets could be revised in the next review of the NREAP.

The Figure 16 below gives the RES penetration levels for year 2017. The average RES penetration reached 8,35 % of the Total Generation in Cyprus for 2017.

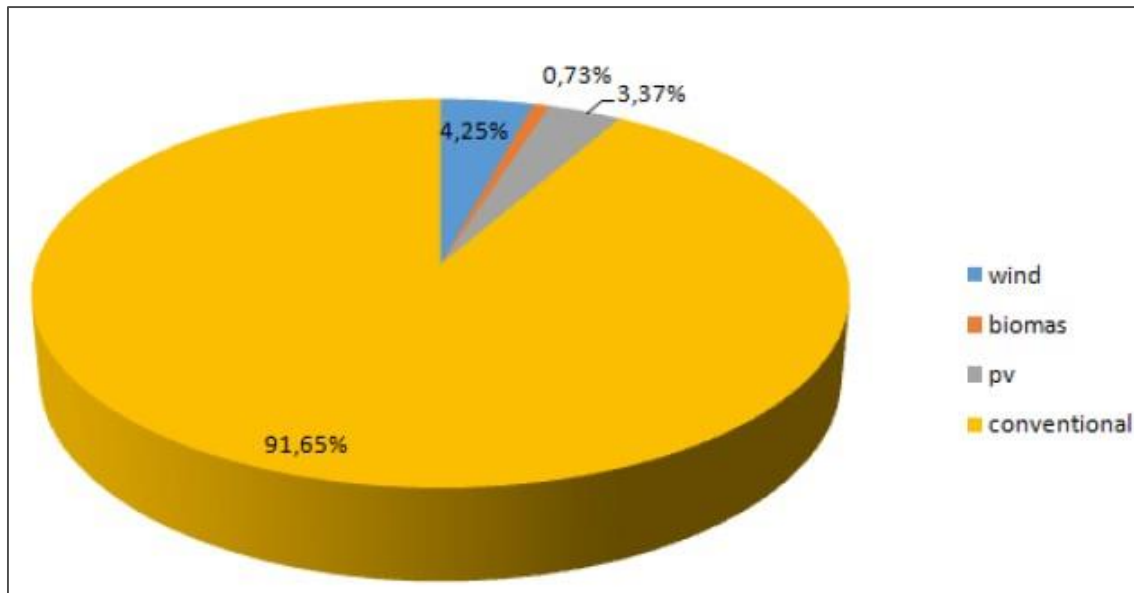


Figure 15. RES penetration levels for the year 2017

Since 2006, several measures for the promotion of RES-E have been taken.

At the initial stage, it was clear that energy market alone could not deliver the desired level of renewables in the country, meaning that national support schemes were needed to overcome this market failure and spur increased investment in renewable energy. Of course, these public interventions were carefully designed in order to avoid distortion of the functioning of the energy market as well as avoid leading to higher costs for households and businesses. Therefore, at the beginning grant schemes were implemented by the government providing grants on the capital cost of the investment and on a later stage a feed in tariff scheme was implemented for RES-E technologies. These actions lead to the development of distributed generation technologies especially for domestic use (small-scale electricity generation) as well as commercial use (PV and wind parks and biomass systems).

Towards the development of RES-E and especially DG and taking into account EU trends and policies very important steps were taken on which CERA has substantial contribution. These steps were the implementation of Net Metering and Self-production schemes after a CERA decision in 2013, whereby our country is a pioneer in this field at a European level. Taking into account the evolution of the Schemes, the very positive response of the public, especially, it can be said that the whole effort has been crowned with success, resulting in the creation of numerous jobs, the growth of the economy and reducing the cost of electricity for thousands of residential, commercial and industrial consumers.

Currently, the schemes are under review by CERA and the Ministry in order to pave the way for further RES penetration in the market and further development of DG. The new plans include a net billing scheme and the continuation of net metering.

Figure 17 below presents the number of the installed Net-Metering Systems and the installed capacity of those systems for the period 2013-2017.

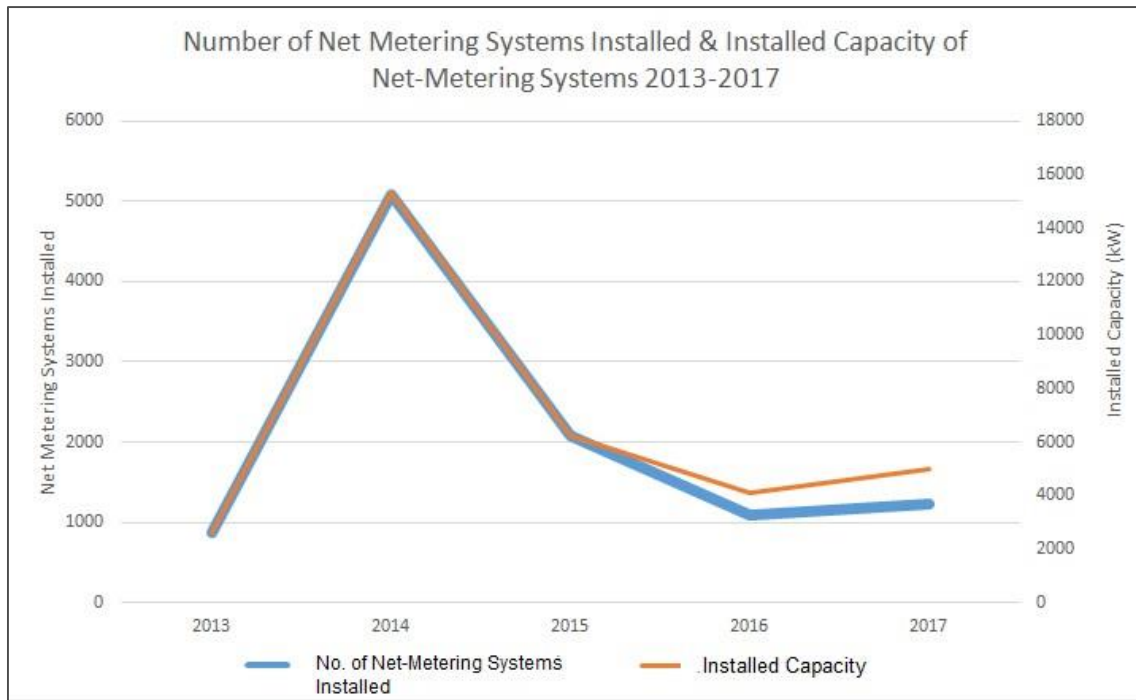


Figure 16. Number of the installed Net-Metering Systems and Installed capacity of Net Metering systems for the period 2013-2017

Figure 18 below presents the annual RES installed capacity (kW).

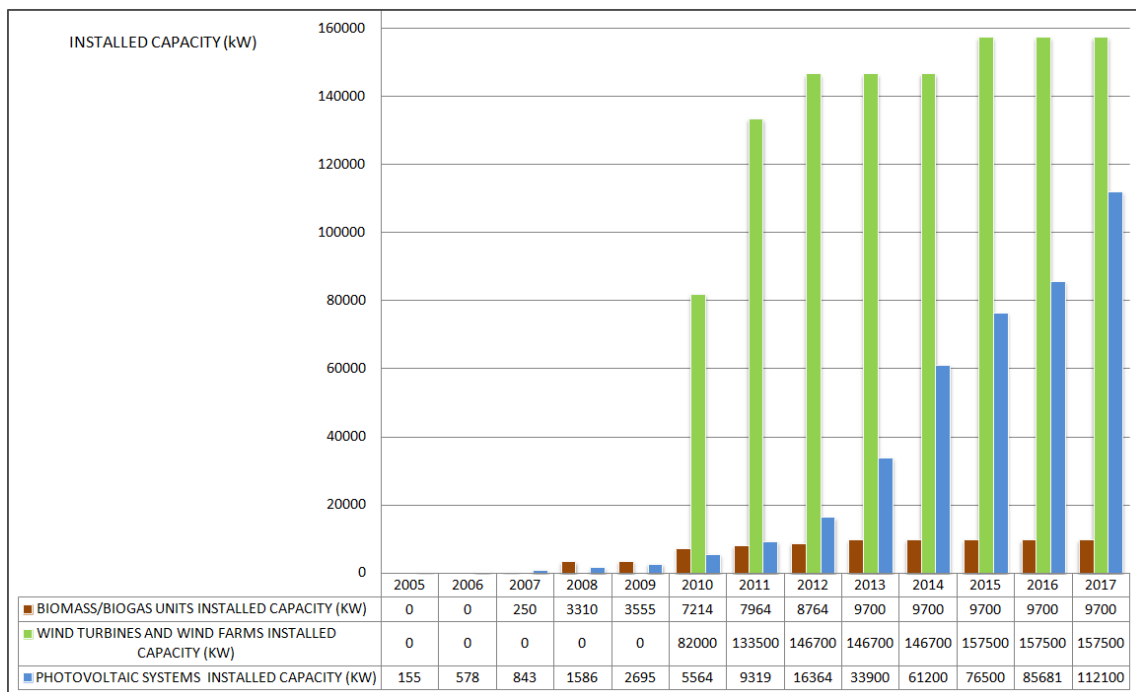


Figure 17. Annual RES installed capacity (kW)

4.7 Jordan / storage

The Hashemite Kingdom of Jordan is an energy importing country, which increases the ratio of imported energy to GDP and leads to a great pressure on the balance of payments and the constant need for foreign currencies to finance the purchase of the Kingdom's energy needs. This requires searching for alternative sources of traditional energy. The most important alternative sources available in the Kingdom. As the strategies are flexible enough to keep abreast of developments and events, the renewable energy strategy has been modified to target 20% of the total energy mix in 2020, a strategy to develop ways to exploit diverse renewable sources of energy including solar, wind, geothermal, geothermal, hydropower and other natural resources to contribute to increasing the proportion of renewable energy from the total energy mix, which would reduce the oil bill and diversify energy sources and protect the environment for sustainable development.

The Hashemite Kingdom of Jordan is clearly rich in renewable sources of energy especially solar energy, with the potential of rising average direct solar radiation. Kingdom of the so-called countries of the solar belt, the areas between the latitudes 25 North and 25 South, has been shown by various scientific studies that the number of days when the sun rises to the Kingdom of 316 days a year and an average of 8 hours per day, is one of the best sources of renewable energy to generate electricity in the Kingdom. Many regions in the Kingdom are characterized by wind speeds ranging from 7-8.5 m/s, which is an appropriate speed for building plants that use wind energy to generate electricity.

The adoption of renewable energy has become a global feature and scope for international cooperation and exchange of experiences in this field. In order to secure the legislative environment of institutions concerned with the renewable energy sector, several laws, regulations and instructions have been issued in the Hashemite Kingdom of Jordan. The first is the Renewable Energy & Energy Conservation Law No. 13 of 2012 to regulate all renewable energy sources and to encourage reliance on renewable energy sources to generate electricity, encourage investment and competition in the sector, and encourage inputs of production, processing and any equipment that help to conserve energy in general. Many of the regulations and instructions provided for in this Act to achieve these objectives. The Ministry of Energy and Mineral Resources, in cooperation with specialized technical bodies and centers, shall work on plans to improve the sector and optimize its utilization, through coordination with the wholesale licensee, tender or solicitation on competitive grounds for the development of one or more of the sites listed in the approved land list In accordance with the provisions of the Renewable Energy Law and the rationalization of energy for the purposes of generating electricity. The renewable energy sector in the Kingdom is regulated and monitored by the Energy and Minerals Regulatory Authority by specifying the different responsibilities of the licensees and granting them the necessary licenses under the laws, regulations and regulations in force for practicing the various activities based on the balance between the interests of consumers and licensees, investors and any other related parties.

In the past years, there has been a remarkable growth in the increase in dependence on renewable energy through the completion of several projects in addition to the signing of a number of energy purchase agreements that pave the way for future projects in the field of renewable energy. The Kingdom also witnessed a remarkable growth in the use of solar energy to cover the private consumption of homes and houses of worship as well as the entry of these systems on the commercial, hotel and industrial sector through the systems of net measurement and transit.

The Hashemite Kingdom of Jordan, represented by the Ministry of Energy and Mineral Resources and in partnership with the Energy and Minerals Regulatory Authority, seeks to reduce the waste of electricity and the wrong use of it by spreading energy awareness among citizens and informing them of the impact of the misuse of electricity and its negative impact on their consumption.

The Hashemite Kingdom of Jordan is pressing ahead with its first electricity storage project to bolster its expansion in solar and wind generation.

The Middle Eastern kingdom expects to sign a contract for a 30 MW battery in the third quarter. The project, which was tendered last year, will help ensure the country has green electricity day and night. The list includes a number of local and international companies including Philadelphia Solar and Kawar Group, and companies and coalitions from Lebanon, the UAE, Bahrain, Cyprus, Saudi Arabia, Spain, Germany, Italy, the Netherlands and Japan, as well as qualified contractors such as Tesla, Toshiba, ABB and others.

The ministry opened the door in August to developers interested in entering into projects of storing electricity produced from renewable energy projects, with the aim of establishing an electricity storage station in the Ma'an Development Area No. 1 with a capacity of at least 30 MW, production rate of solar and wind power projects.

The ministry said at the time that the qualified applicants would sign a memorandum of understanding with the ministry in order to prepare the necessary studies and prepare a presentation commensurate with the requirements of the project and provide the necessary information to the ministry so that the ministry can evaluate the offers of applicants.

The total capacity of renewable energy projects contracted by about 1.350 MW constitutes about 34% of the total energy currently generated in the Kingdom, which is about 4.000 MW.

The National Electricity Company expects the capacity of renewable energy to reach the electrical system in 2020 to 2.000 MW, currently accounting for 15% of the total capacity of the electrical system and about 400 MW, including 200 MW of solar energy and 200 MW of wind power.

Jordan aims to meet its target of securing 10% of energy from renewable sources by 2020. With costs of producing power from sun and wind falling, the challenge now is how much Jordan can expand in terms of renewables, making sure that the system continues to be reliable and available, so here comes the issue of storage.

Development banks are helping finance this program. The European Bank for Reconstruction and Development recently lent \$70 million to Alcazar Energy Ltd., a Dubai-based developer, for an 86 MW wind farm in Jordan. ACWA Power International of Saudi Arabia is also planning renewables projects in the country.

Until now, the project in its first steps (tenders soon will give the ministry the project offer) and soon the national electricity company will limit the exact location, which would be in the northern of Jordan.

4.8 Italy / electric vehicles

4.8.1 Electric vehicles (EV) background

The Italian Regulatory Authority for Energy, Networks and Environment (ARERA) in 2010 launched a first public consultation on Electric Vehicles recharge infrastructures. The

consultation illustrated the Authority's guidelines for pilot projects testing the business models for recharge of electric vehicles (EV) in areas open to the public and analyses the transitional regulation for start-up solutions. The document is part of a process initiated with the decision ARG/elt 136/10.

The consultation followed the decision ARG/elt 56/10 which established the methods and the connection tariff for the recharging of electric vehicles in the private sector (housing, condominium or company parking).

At that time, both legislative framework and technological solutions were not yet defined. Different business models were envisaged, but no one was still approved at legislative level.

In 2010, ARERA admitted not only independent service providers, but also electricity DSOs (Distribution System Operators) to carry out pilot projects; for DSOs two special requirements were set:

- Multivendor approach (freedom of electricity supplier at each transaction – extremely difficult to implement);
- Accounting separation.

In 2014, the European Commission with AFI Directive 2014/94/EC (Directive alternative fuel initiative) provides clear addresses in particular:

- EV recharging in public places should be a competitive activity;
- DSO must act on a non-discriminatory basis in respect of any EV recharge provider.

In Italy, the Directive has been implemented into the national system through the legislative decree n. 257/2016. Therefore, DSOs are no longer admitted to own and operate EV recharge infrastructure.

4.8.2 ARERA provisions – public recharging

ARERA in line with all the legislative provisions adopted in transposition of AFI directive, considers that:

- EV recharging in public places must not be a monopoly activity with fully regulated actors;
- Industrial players have business interest in optimizing charging points siting.

At the end of 2016, EU proposal for a recast of 2009/72/EC Directive (electricity directive) declared that DSO could be admitted only if particular conditions are fulfilled (under NRAs) approval.

The path followed by Italy in the last years is fully compliant with what is stated in the proposed recast of the electricity directive.

Concerning the tariff, a monomial network tariff for low voltage grid points dedicated to EV recharge has been introduced with decision ARG/elt/ 242/10 to foster the kick-start of EV recharge in public places.

Furthermore, ARERA Decision 654/2015 on tariff regulation confirmed for the period 2016-2019 a monomial tariff for LV-connected grid points dedicated to EV recharge, avoiding any special tariff for Charging Points (CP) installed in sites that have further electricity usages than EV recharges (e.g. large service stations, typically connected in MV, with pumps, lighting, car-washing, etc.).

Concerning the prices to apply, charged by the operators of recharging points, these are not at all regulated and should be in line with the AFI Directive article 4 “...prices charged by the operators of recharging points accessible to the public are reasonable, easily and clearly comparable, transparent and non-discriminatory”

EV charges are not only expressed in euro/kWh, but often are related to power/speed of the recharge, time of use, mapping of CP, booking of CP. The different prices set by the CP providers allows them to manage the CP occupancy.

To make easier to develop EV charging infrastructure in public places, ARERA introduced “derogation” from ordinary connection procedures:

- Electricity DSO is free to agree time-to-connection standards directly with CPOs (charging point operators) according to a plan for massive installation of EV charging infrastructure in public places, under the following conditions:
 - No discriminatory conditions towards different applicants;
 - Equal conditions throughout the served area.
- Possibility for CPOs to enter into bilateral agreement with DSOs through electricity suppliers (administrative simplifications)

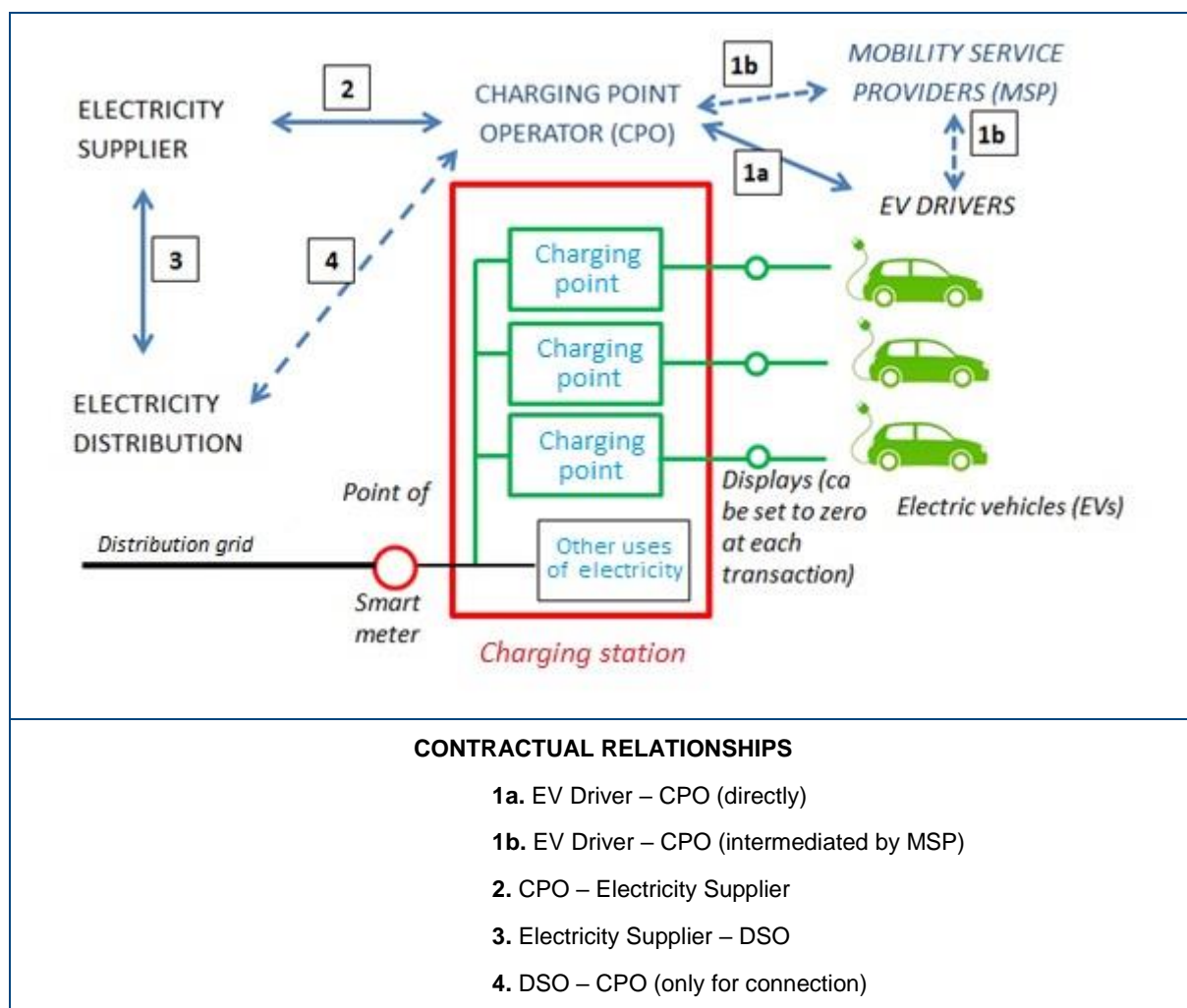


Figure 18. Contractual relationships

4.8.3 Next steps

E-mobility needs and will need connection to power grids and connectivity (car/driver/CPOs/MSPs). Regulatory issues will include business model ensuring competition, network tariffs without discrimination, connection procedures. ARERA attention will be focused on integration of EV recharge in power system transformation:

- Smart charging, V2G and V2H;
- Dispatching services (regulatory decision 300/2017: new trials for demand response may include CPs);
- Possible contribute to System Frequency regulation.

4.9 Turkey / electric vehicles

4.9.1 Charging stations for electrical vehicles

The increase widespread use of electric vehicles over the last decade has brought the main subjects of charging of electric vehicles. Thus, Turkey has begun to study on regulations for establishing the necessary infrastructure in terms of charging the vehicles. Currently, the estimated number of electric vehicles in our country is about 1.000. While there are two types of electric vehicle sales available in the market, it is expected that the number will increase in the following years. When we look at the number of charging stations, it is seen that there are approximately 500 charging stations.

These charging stations are mostly concentrated in places such as shopping malls, public housing projects, parking areas. Currently there are five charging stations in operation from different companies and it is estimated that the number will increase even more as the industry grows. The operating companies in the sector install and operate charging stations without permission at the moment; in other words, the approval of the distribution company is not required for the project of the installation of the charging stations. The operators that provide this service do not have a special authority or license.

When we look at the regulations that have been made up until now, two regulations come to the forefront. The first one is mentioned in the second paragraph of Article 5 of Electricity Market Distribution Regulation:

“In connection applications made by users; the electric project containing according to the qualifications of the application the number and power of motor and generating sets, the number and power of fast, medium and slow charging units to be installed for charging electric vehicles, technical specifications related to other installations and / or equipment such as lighting and heating installations and their protection systems is presented to the distribution company. The distribution company may also require additional information from the user in the framework of the proposed project.”

The second amendment mentioned in the article 40 of Planned Area Type Reconstruction Regulation on 8 September 2013. And so, the legal infrastructure for the installation of electric vehicle charging facilities was provided. With this amendment, it is foreseen that electric vehicle charging facilities can be made in parking lots, fuel stations or other suitable places for the charging of electric powered vehicles.

Beside the above regulations within the goal of increasing the number of electric vehicle charging stations, the “Procedures and Principles of Electric Vehicle Charging Station” has been opened to public opinion and industry evaluations until the end of the working day on 12

December 2017 by EMRA. There are studies in progress on the draft, which expected to be completed soon.

According to the draft:

- Companies wishing to set up a charging station should make application for the connection to the distribution companies located in the region. These companies will be able to serve all electric vehicle users without a prior contract.
- Such companies will be able to sell electricity for non-profit purposes and notify this to the distribution company.
- Charging stations must be installed and operated in accordance with current standards.
- Additionally, companies may receive additional service fees that are not subject to the regulation of EMRA except for the cost of electricity sales to consumers.
- Companies that have production and supply licenses can sell electricity through bilateral agreements and charging stations.
- Companies will notify the relevant distribution company in terms of all the closing down cases, transfer from one place to another and changing name related to charging stations.
- The charging station that is in private property (home or office) which does not conduct any commercial activity is not responsible of these procedures and guidelines.

The new Parking Regulation (by-law) prepared by the Ministry of Environment and Urbanism was published in the Official Gazette on 22/02/18. The obligation of reserving a parking area for each of three apartments was revised as reserving a parking area for each apartment. In addition to this, the municipalities were allowed to increase this number according to their requirements. Besides, with this regulation, at least one of every 50 parking spaces at the parking lots of the district and general car parks and shopping malls will be arranged in accordance with the electric vehicles (including charging units). The administrations could increase the number of electric car parking lots in case of necessity. The Parking Regulation will be in process on 01/06/2018.

4.10 France's strategy for the development of innovative technologies in power distribution

4.10.1 CRE's support to smart grids development

The missions of the Energy Regulatory Commission (CRE) include supporting the evolution of electricity networks towards smart grids. Its mission is, in particular, to ensure the proper functioning and development of electricity grids for the benefit of consumers and consistent with the objectives of the French energy policy, in particular the objectives of reducing greenhouse gas emissions, controlling energy demand and increasing the share of renewable energy production in final energy consumption.

CRE has been involved in smart grid development for many years, in particular because smart grid technologies can provide effective solutions to many of the issues France is confronted which include electricity supply to islands and isolated areas, territory planning or the development of decentralized generation. The new usages of electricity is also in the focus (like electric cars).

The CRE decided to play a coordination role on smart grids in France, it created an institutional think tank and runs a website dedicated to smart grids (www.smartgrids-cre.fr) in order to disseminate and promote works and experiments carried out in France. It also regularly

organizes forums, information meetings and debates. In 2013, CRE published a work program with three main objectives: (i) to contribute to the reflection on the evolution of the institutional framework and governance; (ii) integrate the subject of Smart Grids into regulatory activities, in particular by working on financing conditions, functionalities and monitoring and support of experiments; (iii) continue the work of communication and animation of the actors involved in Smart Grids development.

CRE published several deliberations providing non-binding orientations to operators. In the deliberation of June 12, 2014, CRE proposed 41 recommendations on the evolution of legal, technical and economic frameworks for the development of low-voltage smart grids, aiming to: (i) promote development of new services for users; (ii) increase the performance of public low-voltage electricity distribution networks; (iii) contribute to the overall performance of the electrical system. In its deliberation of 25 February 2015, CRE introduced the principle of roadmaps updated every year for network operators and formulated new recommendations related to data management, development of self-production or pooling of different energy networks. CRE published another deliberation on December 8, 2016, with the aim of enabling the most mature Smart Grids technologies to move from the experimental stage to the industrial deployment phase. It proposed additional recommendations to electricity and gas DSOs that concern, in particular, the publication and exploitation of consumption data, the pooling of different energy networks, the sharing of information on the relevance of Smart Grids technology solutions being deployed, as well as the stability of electrical system in island areas.

4.10.2 DSO regulation in relation with smart grids

In France, the regulation of distribution networks is based on a cost-plus logic associated with an incentive regulation of operating expenses. The underlying principle is the application of uniform tariffs in France for the use of networks, which therefore requires a pooling of the coverage of charges. Indeed, France has 166 Electricity Distribution System Operators (DSO) of very variable sizes. Enedis dominates with a coverage of 95% and 35 million customers, 4 distributors have more than 100,000 customers: Gérédis (Deux-Sèvres), URM (Metz), SRD (Poitiers) and Electricité de Strasbourg. There are also 161 small local distributors.

CRE determines the third party access tariff (called “tarif d’utilisation des réseaux publics de distribution d’électricité”, TURPE). This tariff is equalized, therefore the same for all the DSOs. Consumers can choose between 2 options, either directly contracting their access with the DSO or request their electricity supplier to be the counterpart of the DSO. In both cases, the charge is calculated based on an average distribution cost plus a management fee. Charges are determined according to the level of voltage on which consumers are connected.

As far as smart grids are concerned, CRE has introduced a specific device to ensure that the network operators have the necessary resources to meet the costs of research and development as well as deployment of smart grids. The principle is to give Enedis the necessary resources to carry out R&D projects, in encouraging them to use these resources effectively. CRE determines a trajectory for the R&D expenditures, discounted by the possible subsidies. If expenditures are below the initial targets, the gap is deducted from the total amount of money to be recovered from billing.

The support to R&D and more specifically to smart grid programs assume they would allow a reduction of investments, therefore capital costs, but at the cost of a (lower) increase in operating expenses. This could be the case for flexibility mechanisms such as peak shaving services or storage. As a result, the approach to OPEX regulation has been softened to avoid

penalizing DSOs in case they increase OPEX while reducing CAPEX.

4.10.3 Smart grids experiments in France

CRE monitors the smart grid initiatives in France. It has either identified more than 150 pilot projects, under construction or already commissioned. The map below illustrates the number of projects spread over the French territory.

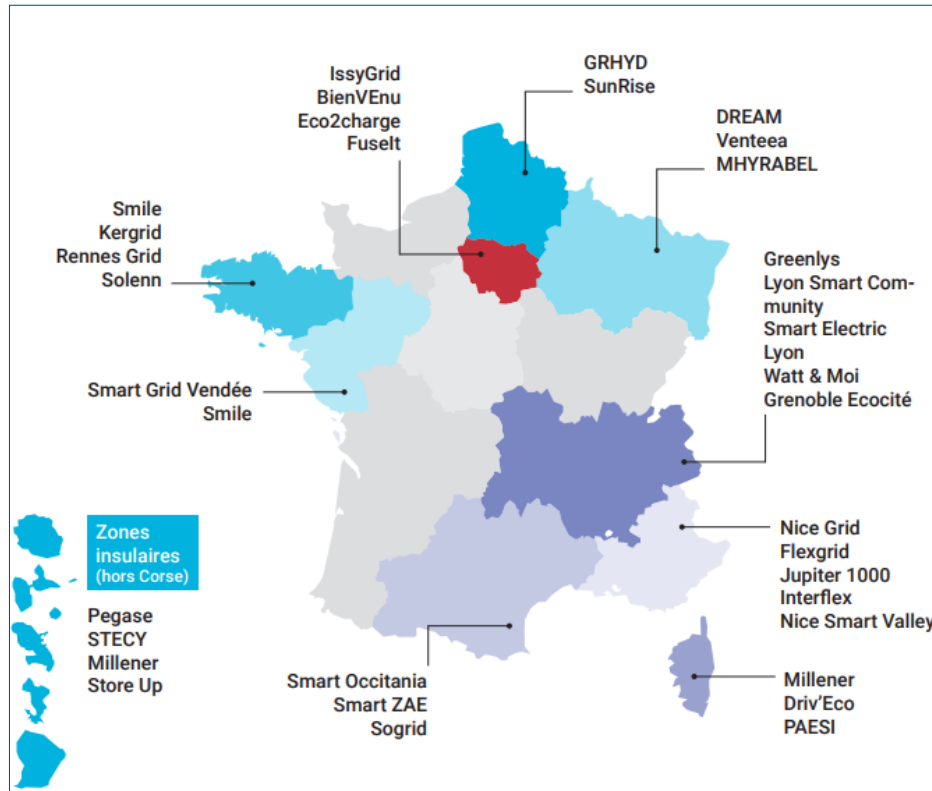


Figure 19. Smart Grids initiatives in France

As a successful example, it is worth to mention the Nice Grid project, which is supported by a consortium of 7 members including the DSO (Enedis) and the TSO (RTE). The objective is to develop an integrated approach, which includes demand side management, PV integration, test power storage and grid management. The idea is also to trigger new behaviors of participants and testing the capacity of energy autonomy at the level of a neighborhood.

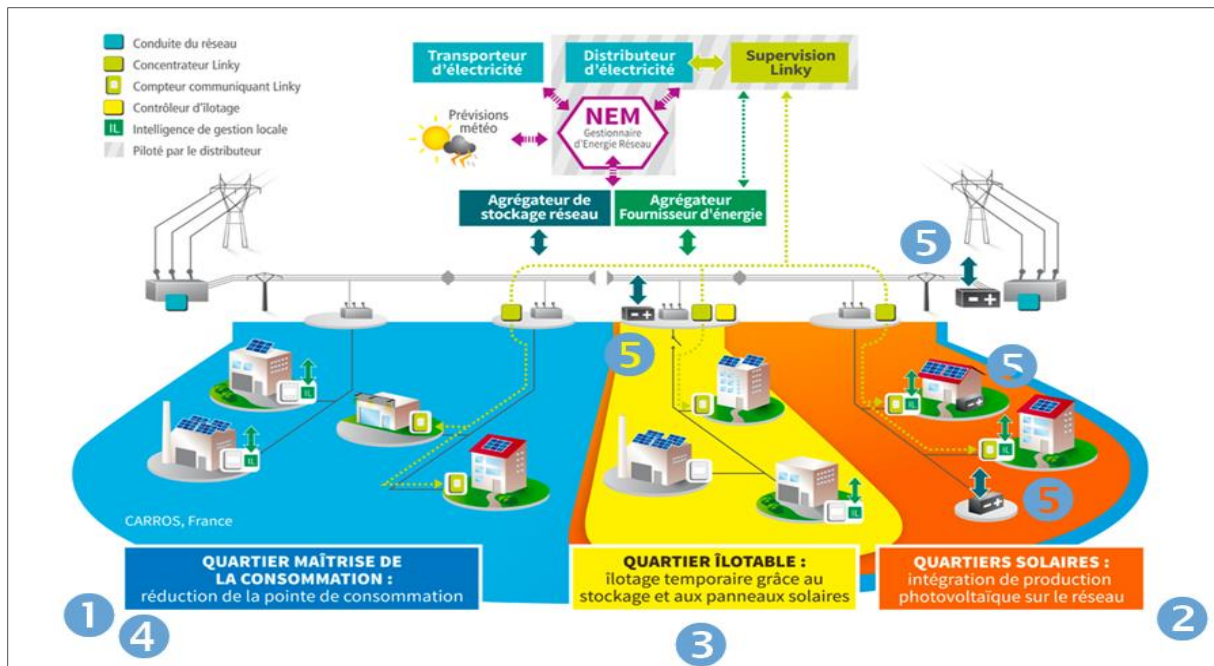


Figure 20. Nice Grid project diagram

4.10.4 Smart metering development in France

Smart metering deployment has also been an important development in France these past few years. Two programs have been implemented, for gas (Gazpar) and electricity (Linky). Smart meters are progressively installed all over the territory. The aim is to provide the information necessary for introducing more sophisticated technologies and, in particular, the improvement of demand side management. Two aspects can be mentioned: better inform consumers about their consumption and bill, and allow new technologies for demand switching in the perspective of aggregated demand reduction in case of tension on the system.

Smart metering development has led to new reflections on data management. The current technological revolution leads to a huge increase of the volume of data at all the levels of energy value chains. Regulation has to accompany this change allowing opportunities to happen while properly addressing risks. In this regard, the Regulator's objective is to turn data management into a tool serving the efficiency of energy systems. With this aim, CRE has carried out a study to investigate possible options for an efficient data management. Another important issue is represented by the governance and CRE's main concern is to ensure efficient collection, storage and use of data also helping to clarify the responsibilities by delineating public service and competitive activities.

4.11 Palestine / Self-Generation and Distributed generation

4.11.1 Self-Generation

▪ Net-Metering

A net-metering scheme is in place since 2015. Based on Council of Minister's decision number 04/77/17 of the year 2015, Palestinian electricity regulatory council PERC and Palestinian energy and natural resources authority PENRA in collaboration with the distribution companies (DISCOs) prepared the net metering regulations for RE systems (max capacity of 1000 kWp).

Net metering is done on a kWh basis. Imported and exported electricity are netted at the end of the month. If a surplus gets generated by the end of the month, 75% of the surplus kilowatt hours get remunerated as credit for customer at the end of the project's production year (1 April-31 March) so that the energy balance exported to the prosumer is rotated within only one year of production.

▪ Meters

The prosumer's current meter should be replaced with a bidirectional meter to measure the electricity consumption and the exported electricity to the distributor network. The prosumer will pay for the replacement. If the meter mentioned above is not available for any reason, another meter should be added to measure the exported electricity to the distributor network; in this case, the prosumer will have two meters and will have to pay for the extra meter. In case that the prosumer has a pre-paid meter; the distributor should replace it with a normal post-paid meter to be able to make the financial calculations. Prosumer will have to pay for the extra meter.

▪ Wheeling

Different location of the project and place of consumption with no contradiction to the terms of instructions, any prosumer within the Distributor's area of operation shall be entitled to set up a project for the production of renewable energy (max capacity of 1000 KWp) and connect it to the distributor's network. The place of consumption of electricity produced from this project could be in a different location than the place of production provided that both places are in the same distributor's area of operation.

In this case and based on Council of Minister's decision number 04/77/17 of the year 2015. The distributor will deduct 10% of the produced electricity as transmission fees.

The beneficiaries of this system have to comply with all other rules and instructions that regulated renewable energy projects that connected to the electricity network with Net – Metering system.

Description	Unit	2015	2016	2017	2018
Net Metering Installed Capacity	KWp	0	2,919	5,483	11,893
Net Metering Production	KWh	0	3,164,435	6,715,199	13,532,938

Table 14. Net Metering Installed Capacity and Production in Palestine

4.11.2 Distributed generation

▪ Feed-in Tariffs (FiT)

FiT scheme provides a long-term purchase guarantee of electricity from renewable sources at a pre-determined price. In 2012, a PV FiT scheme was introduced through the Palestinian Solar Initiative (PSI). This category concerns investment by households and small commercial businesses with eligible systems up to 5 kW connected with DISCO's networks and the scope is to install up to 5MWp at the end of 2020.

The tariff was set for three stages, the first one at 1.07 ILS/kWh, so higher than the electricity purchased from IEC which was at 0.4 ILS/kWh at that time (The Ministry of Finance MoF to cover the difference). Then the second FiT was reduced to 0.8 ILS/kWh. In 2015, the FiT scheme was re-introduced with a third stage tariff of 0.54 ILS/kWh. By 2018, about 400 out of 1000 envisaged systems with a total of 1124 kW were installed and connected to the grid.

- **Medium capacities projects**

A Mid capacities scheme is in place since 2018. Based on PENRA's chairman decision number (1) of the year 2018, PERC in collaboration with the DISCOs prepared the Mid capacities regulations and guidelines for RE mid capacities system (max capacity of 999 KWp).

This category concerns those who wish to invest in medium scale of PV plant, the system which is called "RE Station" could start from 5 KWp till the max of 999 KWp, this generation station should be owned by a private and independent company to sell DISCOs electricity in affordable prices.

5. Annex 2 – List of abbreviations

Term	Definition
ABB	ASEA Brown Boveri
AC	Alternative Current
AFI	Alternative Fuels Infrastructure
ARERA	Autorità di Regolazione per Energia Reti Ambiente (Authority for Energy, Networks & Environment)
Bn	Billion
C3	Combined market share of 3 largest electricity suppliers
CAPEX	Capital Expenditure
CEER	Council of European Energy Regulators
CERA	Cyprus Energy Regulatory Authority
CHP	Combined Heat & Power
CMS	Cameron McKenna Nabarro Olswang LLP
CNMC	Comision Nacional de los Mercados y de la Competencia
CO ₂	Carbon dioxide
CP	Charging Point
CPO	Charging Point Operator
CRE	Commission de Régulation de l'Énergie
DC	Direct Current
DER	Distributed Energy Resources
DG	Distributed Generation
DHA	Tarifa con Discriminación Horaria
DSM	Demand Side Management
DSO	Distribution System Operator
DisCos	Distribution Companies
EAC	Electricity Authority of Cyprus
EC	European Commission
EDP	Energias de Portugal
EDSO	European Distribution System Operators
EEHC	Egyptian Electricity Holding Company
EETC	Egyptian Electricity Transmission Company
EG3	Expert Group 3
EgyptERA	Egyptian Electric Utility & Consumer Protection Regulatory Agency
EMRA	Energy Market Regulatory Authority
EMRC	Energy & Minerals Regulatory Commission
ERDF	Électricité Réseau Distribution France (Enedis)
ERSE	Entidade Reguladora dos Serviços Energéticos (Energy Services Regulatory Authority)
ESS	Energy Storage System
EU	European Union
EV	Electric Vehicle
FiT	Feed-in Tariff

Term	Definition
GDP	Gross Domestic Product
GGP	Guidelines of Good Practice
GW	Gigawatt
HECHP	High Efficiency Combined Heat & Power
HEDNO	Hellenic Electricity Distribution Network Operator (locally known as DEDDIE)
IEA	International Energy Agency
IEC ^(A)	The International Electrotechnical Commission
IEC ^(B)	The Israel Electric Corporation
IEEE	The Institute of Electrical & Electronics Engineers
IIT	Instituto de Investigacion Tecnológica
IT	Information Technology
JRC	Joint Research Center
km	Kilometer
km ²	Square Kilometer
kW	Kilowatt
kWh	Kilowatt Hour
m	Meter
M	Million
m/s	Meter per Second
MEDREG	Mediterranean Energy Regulators
MSP	Mobility Service Providers
MW	Megawatt
MWh	Megawatt Hour
NREAP	National Renewable Energy Action Plan
PCI	Project of Common Interest
PHEV	Plug-in Hybrid Electric Vehicle
PUA	Public Utility Authority
PV	Photovoltaics
PVPC	Precio Voluntario para el Pequeño Consumidor (Voluntary Price for Small Consumer)
RAE	Regulatory Authority for Energy
REGAGEN	Regulatorna agencija za energetiku (Energy Regulatory Agency)
RES	Renewable Energy Sources
RES-E	Electricity from Renewable Energy Sources
RTE	Réseau de Transport d'Électricité
SCADA	Supervisory Control & Data Acquisition
SG	Smart Grid
SME	Small Medium Enterprise
SPV	Special Purpose Vehicle
TSO	Transmission System Operator
TURPE	Tarif d'Utilisation des Réseaux Publics de Distribution d'Électricité
UAE	United Arab Emirates

Term	Definition
US	United States
V2G	Vehicle-to-Grid
V2H	Vehicle-to-Home
WG	Working Group