RES4MED

Integration of renewable energy solutions in the Mediterranean electricity markets

RES4MED (Renewable Energy Solutions for the Mediterranean) is a non-profit association of 24 international leaders among utilities, industries, agencies, technical service providers, consultancy and academia, with the mission to support the deployment of renewable energy, both large scale and distributed energy, of energy efficiency solutions and facilitate their integration in the local and regional markets, to satisfy local energy needs.
RES4MED, as integrated platform for public-private dialogue on renewable energy issues in the Mediterranean, aims at building a dialogue with regional institutions, local governments and Regulatory bodies by providing a practical outcome oriented approach.
To achieve this mission, RES4MED has built a wide and solid network with the main Institutions, Association, Agencies and Research Centers, among which the Union for the Mediterranean (UfM), the Arab Cooperation on Renewables and Grids, the Regional Center for Renewable Energy and Energy Efficiency (RCREEE), the Association of Mediterranean Energy Regulators (MEDREG), the Association of Mediterranean Transmission System Operators (MEDTSO), the International Renewable Energy Agency (IRENA), Institut de Recherche en Energie Solaire et Energies Nouvelles (IRESEN), Société d'Investissements Energetiques (SIE), Agence Nationale pour le Développement des Energies Renouvelables et de l'Efficacité Energétique (ADEREE), and many others.
With all these partners, RES4MED started relevant partnerships and joint initiatives aimed at cooperating in specific fields in the Mediterranean Countries. This engagement activity is part of the RES4MED operating model set up for achieving the Association's objectives, based on the public-private partnership model.

About this journal

This journal has been published on the occasion of the second edition of the Advanced Training Course (ATC), organized by RES4MED, in partnership with Enel Foundation, in cooperation with the Politecnico di Milano and under the patronage of the Union for the Mediterranean. The aim of the course is to build an international network of experts, sharing the knowledge of RES4MED members and partners with a selected group of high profile middle managers and experts, representing the whole range of players in the Mediterranean renewable energy sectors. Thus, this publication intends to gather the knowledge made available during the course, alongside the main themes of the integration of renewable energies within Mediterranean electricity markets. The journal is divided into four sections: **"Technology"**, **"Innovation"**, **"Investment, Finance and Analysis"** and **"Transmission and Regulation"**. We would like to thank all the contributors, for the variety and high quality of articles we received.

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Enel Foundation

Energy for Knowledge

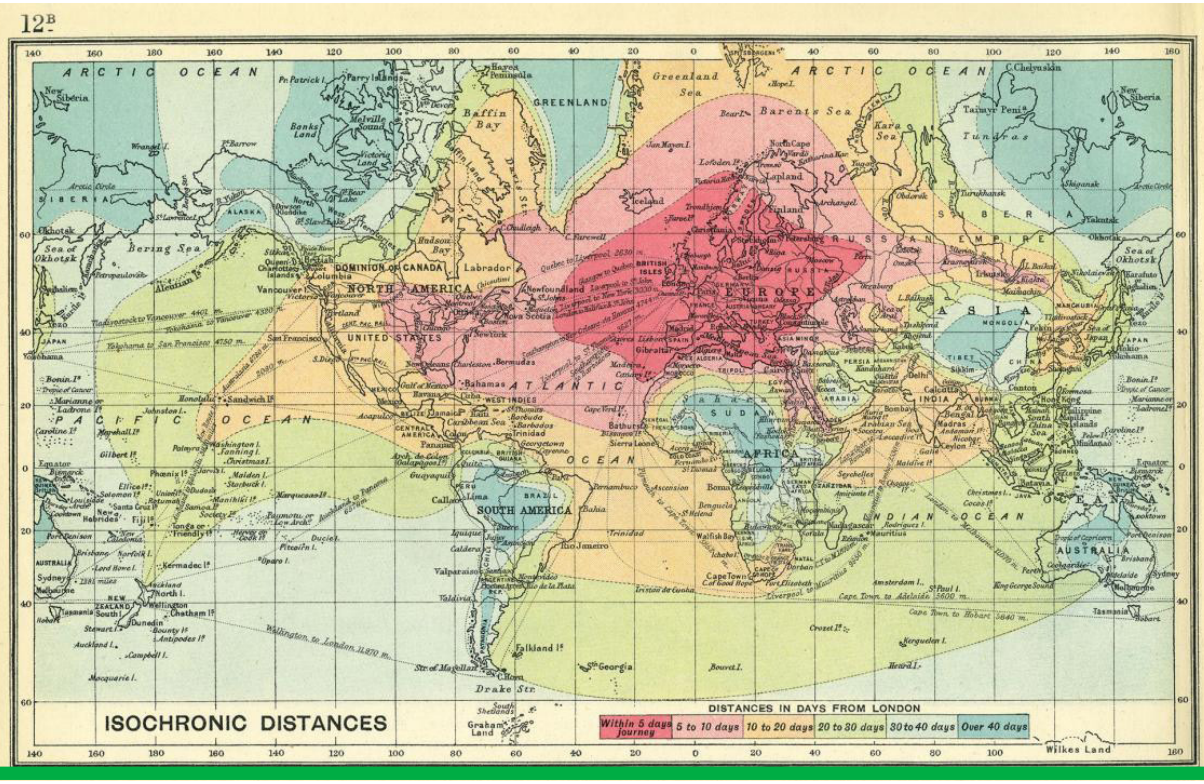
The role of capacity building for renewable energy integration

Carlo Papa, Director of Enel Foundation

In 1914, When J.B. Bartholomew, cartographer Royal to King George V, published "An atlas of economic geography" - most probably the first isochronic map of the last century based on the needs and requirements of a single community vs the rest of the World - he could hardly image a gathering of bright individuals like the one we had in Milan last November and the rapidness, openness and genuineness of interactions this group had and will have in the coming months.

A group that can overcome geographical barriers and bridges cultural difference traveling the World in less than 24 Hours and "navigating" the Net in less that few seconds. A group that demonstrates how important is a multiflags capacity building platform, like the one we put in place in cooperation with RES4MED and the Politecnico di Milano, indeed a key element to create a Sustainable future for all. A platform open to all thanks to which we can learn from each other, comparing countries strategies and policies while avoiding the errors of the past to build the future of renewable energy, a lively platform that can support each and every members of our group in his/her professional life.

You'll find in this volume the first piece - all the information and notions we went through during the course - of a wider puzzle we desire to build together integrating renewable energies in the Mediterranean electricity markets.



RENEWABLE ENERGY SOLUTIONS
FOR THE MEDITERRANEAN

Renewable energy integration in the Mediterranean electricity markets

Roberto Vigotti, Secretary General of RES4MED

Renewable energies represent a key resource for the countries of both shore of the Mediterranean, as they provide multiple solutions: from the economy and political stability to the energy transition, from industrialization to job creation and finally to full access to energy. Even though the cost of innovative technologies like solar PV and wind are drastically decreasing, there are still several challenges to be faced for their full deployment and to create a friendly framework for investment. Last but of key importance is also the full integration of many renewable energy generation in the Mediterranean electricity systems, due to their variability and intermittency.

Renewables can meet the energy needs of many Southern Mediterranean countries whose demand is constantly increasing, following the growth of population, and which the current generation systems often cannot adequately sustain, both from the economic and environmental side. They are the key element for the energy transition both for the fossil importing countries who can diversify their energy mix and reduce their energy bill and for those who are exporters of fossils and many of them still significantly dependent on fossil fuels for power generation: for them the so called "opportunity cost" suggests to deploy renewables, selling abroad their fossil fuels and prolonging the duration of their reserve.

The moment is also particularly timely. Climate diplomacy is increasingly important, and renewables can provide solutions to the COP21 in Paris, representing with energy efficiency the top solutions to decarbonise the global economy.

The priority for Southern Countries is to attract investments, in order to have the necessary power facilities built in time. The long term vision remains a fully integrated EU-Med energy market and a sequence of priorities has been identified, ranging from renewable energy generation for internal use to electricity trade between SEMCs neighbouring countries and, later, corridors between Europe and North Africa, enabling energy exchanges in both directions.

To deploy renewable energies in an integrated way it is fundamental to take into consideration all the stakeholders: from public institutions and ministries, to regulators, electric utilities, technology providers, universities, agencies and research centres. Local governments in the Mediterranean must have the role of setting targets, developing strategies and implementing tools to address the main barriers. Foreign investors can act as an enabler in this process. Local businesses and institutions should be actively involved in the whole process, while sharing experience and expertise among countries can be a fundamental catalyst for the full development of renewable energies in the Mediterranean. Capacity building has then a key role in this process, not only by exchanging experience but also in the creation of a true Mediterranean network of experts.

In this regard, RES4MED contributes to build Mediterranean sustainable energy partnerships with a "bottom up" approach able to propose solutions customized to local contexts. Training and Capacity Building are for us a priority, since new skills and competencies are locally required.

The objective of RES4MED's capacity development program dedicated to the Mediterranean region is to strengthen the capacity of the key stakeholders and decision makers to develop effectively renewable energy programs, fostering Public Private Partnerships (PPP) to facilitate investments in renewable energy power plants and related infrastructures.

Successful capacity development leads to an increase in the level of transparency in decision making and stakeholder inclusion, generating an effective dialogue and an enabling environment for local value chain and jobs creation.

POLITECNICO
MILANO 1863

Human Capital as powerful enabler for Renewable Energy penetration in the MENA region: capacity building, scientific research and international cooperation

Prof. Fabio Inzoli, Head of Department of Energy - Politecnico di Milano
Prof. Emanuela Colombo, Rector's Delegate to Cooperation and Development- Politecnico di Milano

MENA countries are endowed with significant energy resources but, currently, the local energy system, not reliable in terms of quantity, quality and security of the supply, is hardly in the position to sustain the needed equitable economic growth, coupled with environmental preservation and an inclusive society.

While sustainable development is acquiring higher relevance in the international community, the path in the MENA region is still long specially on the energy sector, since both primary and electric energy mixes still rely on oil and gas, while renewable energies (REs) penetration is still very low.

Over the last decade, great attention has been given to the establishment of appropriate policies and regulatory reforms and to the promotion of additional public investment and new financial instruments. The goal was to facilitate foreign investment into national markets and to promote deeper engagement of the private sector in the framework of new Public Policy partnerships. Within this enabling environment, great attention has been given to the economy, finance, policy and regulation. However, other cross cutting and interrelated elements are now being considered as more and more essential.

An innovative approach should be then contemplated, based on local capacity building, promoted by institutional capacity and sustained by international cooperation.
Capacity building is needed because renewable energies technologies require specific skills at local level to design or redesign, produce, market, install, operate, maintain, manage, plan operations and run businesses. Technical and managerial skills are crucial while, at the same time, a facilitator attitude, together with communication and learning skills, is essential for coordinating negotiations, promoting public participation and building consensus within the local community and with public and private stakeholders. Furthermore, education is needed at different levels, from vocational training to higher education, in order to build the required work force.
Once achieved, capacity building for individuals or groups of people acts as leverage for other benefits. Institutional building is then easier to obtain: policies and strategies can be better assessed, local acceptance is straightforward and regional technical reliance as a measure of sustainability and response to technical problems is prompter.
Moreover, in the framework of renewable energies, there are several opportunities to strengthen the capacity for promoting scientific research. Effective research requires substantial financial resources, highly trained and motivated scientists, as well as international cooperation and partnerships for carrying on state-of-the-art strategic joint projects.
In this scenario, international cooperation is essential to facilitate the innovation that is needed for REs penetration, specifically when established between the national energy institutions and coordinated with national and international private sector players, civil society organizations and academia, learning from previous experiences and pursuing the necessary process of adaptation to different economic, environmental, social and cultural frameworks.
Capacity building, institutional building, scientific research and international cooperation rely all on human capital, which should be therefore considered an asset in our global economy. Working on human capital as a crucial "natural and renewable" resource, and to empower local capacity as a consequent action, is one way to promote and scale-up renewable energy projects and policies within the regional energy systems.

Clearly, this is only one way; not the fastest, but probably among the more sustainable to create a long lasting, autonomous and equitable development, leading to mutual benefits at the local and the global level.

Technology

MENARES
MENA Renewables & Sustainability

Social dimensions of large scale CSP power plants in the MENA region

MENA countries are endowed with abundant solar resources that go, in many regions, beyond the 1,800 kWh/m2/ year value, which constitutes the technical threshold to implement economically viable solar CSP power plants.

By their nature, solar CSP power plants have potential impacts on the surrounding environments (they needslarge surface, water for their operation, and are intensive investments projects). Within the framework of a research project carried out between June 2013 and March 2015, and which addressed the social dimensions of large scale CSP project in MENA region, the following impacts were identified to have potential positive contribution to socio-economic development:

1. Contribution to human development: promotion of education and training, as well as the opportunity to train workers on the job.
2. Contribution to socio-economic development: creation of jobs (skilled and unskilled, and direct and indirect); creation of business opportunities for SMEs through demand rise on engineering services, components (mainly local extensive technology components), services such as housing, car rents, catering and many others.
3. Contribution to sustainable development through the supply of secure and clean electricity that could power manufacturing units and productive sectors and will limit GHGs emissions.
4. Raising awareness about the feasibility of solar technologies for variety of applications in industry, agriculture, tourisms and residential sectors.
5. Creation of an image of marque of green region, cities and many others.
6. Creation of new physical infrastructure.
7. Integration of marginal areas in the national socio-economic

development.
8. Industry development, technology and knowledge transfer.

Whereas, the following impacts were identified as potential negative effects:

1. Creation of intensive capital projects in marginal areas might lead the creation of unrealistic expectations.
2. Competition over jobs and opportunities due to the huge demand on development.
3. Pressure on water resources.
4. Pressure on social services (education centers, health center, recreation centers, rent and others) due to the arrival of immigrants workers.

In order to maximize the benefits of large scale CSP projects and limit their potential negative effects, the following recommendations are proposed:

1. Effective expectation management and efficient communication regarding to project impacts.
2. Adoption of dry cooling in case the CSP project would use huge amounts to water volumes from already scarce resources areas.
3. Transparent and fair recruitment processes.
4. Accompanying social projects to respond to the new demand for social services and inflation control.
5. Fair distribution of benefits among adjacent communities, and fair and transparent approach in purchasing land.

N.B.: the research project was led by Wuppertal Institute and German Watch, in which MENARES contributed as Moroccan Local Partner.

Hydro Generation: Italgen hydropower plants

Italcementi Group has been generating energy from hydraulic sources since the 1910s.

Today Italgen, Italcementi electric spin off dealing with the international market of the renewable energy sector since 2001, owns 14 hydroelectric power plants, mainly located in northern Italy (especially in Lombardy, Veneto and Piedmont).

Plants are of two types:

- run-of-river (exploiting the stream flow directly)
- dam (using a reservoir placed upstream of the power plant from which the required water flow is channelled)

Hydropower plants are a valuable asset for Italgen. They contribute to the production and distribution of "sustainable" energy.

Focus on Vaprio D'Adda hydropower plant

The plant was built in the 1940s. The preliminary project, executed in 1945, provided the localization of the power plant building where the current intake is now placed (Concesa, Trezzo sull'Adda municipality).
The 4.5 km long gallery should have been used as tailrace instead of conveying channel to the forebay. However, the project was not feasible and the current layout was considered the best solution.
The plant started working in April 1951 and was purchased by Italcementi in 1956.
The power plant scheme includes:

1. The sediment basin
2. The forebay
3. The engines room
4. The control room
5. The transformers substation
6. The tailrace
7. The emergency drain

Technical information

Plant scheme	Run-of-river
Region	Lombardy
Municipality	Vaprio d'Adda (MI)
River	Adda
Installed capacity	20,900 kW
Average Flow	91,900 l/s
Head	16.75 m
Turbines	2 Kaplan with vertical axis (Tosi)
Commissioning	1951
Italcementi Acquisition	1956

Asja is an Italian company leader in power generation from renewable sources and in reducing climate-altering gas emissions.

Since 1995 Asja realized and managed 46 landfill biogas power generation plant, installed at municipal solid waste (MSW) landfill sites. In 2014 produced 375,000 MWh of green energy by 26 biogas plants in operation avoiding the emission of 1,580,000 tons of CO2 and the use of 610,000 oil barrels.
A landfill biogas plant is a power generation plant, able to exploit biogas naturally produced by anaerobic degradation of municipal solid waste previously disposed in sanitary landfill.
The capture of biogas avoids the release into the athmosphere of its most harmful component: methane (CH4), that is 21 times more polluting than carbon dioxide (CO2).

Asja can offer two different business cooperation options in landfill gas sector:

1. the awarding of a royalty to its business partner as a compensation for being given a license to use biogas. If this option is chosen, Asja will finance, build and directly operate the plant.
2. A full business opportunity management service package. When this option is chosen, the partner in business only provides the funds needed for the investment while Asja provides its know-how and takes care of the following: feasibility study; engineer-procure-construct - EPC - and design; licence/permit issuance process; plant operation and maintenance - O&M; energy and CERs sale; participation in public tenders.

Asja can handle CERs validation and sale (for both UNFCCC and Gold Standard CERs).

The Pianezza Biogas Plant

The biogas plant on the site of Pianezza landfill is composed of 4 different sections and 5 power generation units, for an overall installed power of 4,661 kWe.
Each engine is connected to a suction and treatment section, a general manifold, a series of well heads and a gas grid. Biogas is extracted through a network of vertical wells distributed on the landfill surface. Then, it is purified in each section in three different stages: firstly, separation of water vapor; secondly, cooling and condensate separation; thirdly, separation of solid particles.
The resulting biogas, now purified, is sent to the internal combustion engines for electric energy generation.
Exhaust gas treatment by regenerative thermal oxidation then reduces the amount of pollutants emitted into the atmosphere. In case of ordinary or extraordinary maintenance of the cogeneration unit, the biogas extracted is combusted in a high temperature torch.
The electricity thus produced, after being transformed into medium voltage via a LV/MV transformer, is introduced into the distribution network.
The annual electricity production of the Pianezza landfill biogas plant is 38.029 MWh, enough to satisfy the energy needs of 14,500 households.

The Pianezza biogas plant

Electricity from non-conventional sources: recovery of waste energy from gas expansion in urban natural gas networks

Natural gas is transported through a high pressure network (in a range from 12 to 70 bar) while its distribution to end users is done at low pressure (in a range from 0,04 to 5 bar).

The reduction from the high pressure of the transportation network to the pressure of the distribution network is done in let down stations through a pilot-controlled pressure regulator in which the mechanical energy of the gas is thermally dissipated for the Joule-Thomson effect.
IREN, in this sector, is studying an alternative solution to recover this waste energy and to produce electricity.
The installation of an expansion turbine in place of a pressure regulator – that can be kept as redundancy – allows the recovery of that energy otherwise lost: the mechanical pressure energy of the natural gas is transformed in kinetic energy and afterward in electrical energy through a generator. The use of a radial expansion turbine allows a wide working range and the efficiency is high even at lower loads.

In most applications, the components (piping and valves) cannot operate at a too low temperature (one problem could be the condensation) and therefore natural gas must be preheated before the expansion. The level of preheating is set to have at the exit a temperature between 5 and 15 °C. The thermal energy that is needed to preheat natural gas is then recovered and transformed in electrical energy.
The available potential energy may be calculated considering the enthalpy difference between the inlet and the outlet of the turbine, multiplied by the mass flow rate. The main contribution is given by the mass flow rate.

Typical installations are in the let down stations in towns, where is possible to recover from 160 to 3,000 kW.

IREN has built a demonstrator in the main let down station of Genoa City and has studied an integration to feed the surrounding district (a fire brigade station, a natural gas fueling station for private and public vehicles and a public school). This demonstrator is part of the Celsius project, financed by the European Union and aims to:

- provide electrical supply.
- Store mechanical energy through high pressure gas accumulation.
- Use of return water of the DH network for intercooling process.

The demonstrator has an electric power of 550 kW and allows a saving of 2800 MWh and of 450 tons of CO2 per year.

The Wind Tunnel at the Politecnico di Milano

The Wind Tunnel Facility at Politecnico di Milano Campus Bovisa, fully described at: http://www.windtunnel.polimi.it/, was designed to provide the highest technological standards for a wide range of applications.

The Facility location in the academic environment of POLIMI denotes a strong commitment to the scientific approach, so that being both a purely research tool and a modern instrument for high-technology industrial applications offering advantageous reciprocal synergies. Another characteristic of the Facility is the special closed-circuit configuration, arranged in a vertical layout with two test rooms in the loop.

Boundary layer test section: features

Size: 14m wide, 4m high and more than 30m long. Maximum wind speed 15 m/s, turbulence intensity ≈1%, turning table 13m diameter, allowance for earth wind boundary layer simulation with passive and active turbulence generators and for twisted flow.
Allowance for Wind Engineering scaled model testing with negligible blockage effects even with large scale models. High rise building and long span bridges are the typical applications with forced motion and free oscillations section model testing procedures provided as a standard. Full bridge aeroelastic model testing easily provided by the allowance of 14m wide test section and 13m diameter turning table. The technology of fully controlled scaled model Wind Turbine testing is available with a typical size of 2m diameter of the aeroelastic Horizontal Axis Wind Turbine model.

High-speed test section: features

Size 4m wide, 4m high, 6m long. Maximum wind speed 55 m/s, turbulence intensity ≈0.15%, turning table 2m diameter, allowance for closed / open (free jet) section operations. The higher speed test section, typically used for aerospace applications, is used also for dynamic stall test of wind turbine blades.

Innovation

airlight energy

The greenest, simplest and most sustainable CSP technology

"Flexibility through simplicity is the motto that drives our innovation" – states Lino Cardarelli, CEO of Airlight Energy Group.

By accumulating solar power by our tested CSP system and storing the heat into gravel, our technology provides a sustainable and green energy source even when the sun is not shining. And this predictability is nowadays a key asset, confronting the other partners of the sustainable energy portfolio - namely wind turbines and photovoltaics - which however cannot provide suitable storage capabilities, i.e. dispatchability.

We developed a simple, cheap and reliable technology to provide heat and electricity supply to energy-intensive industries and large utilities, by completely re-inventing all components of CSP plants to make their operations easier, more cost-effective and sustainable. The "greenest technology" means that we overcome some of the negative aspects of CSP systems, as for example the use of potentially non-ecological heat collecting media such as high-temperature oil or molten salts. In our case we simply use air as a medium, heated up to about 600 degrees, for a clean energy production cycle.

We completed our long-standing development activities with a full-scale pilot plant, built next to a large cement factory in Ait-Baha, Morocco. It provides solar energy to heat conversion to a pre-existing ORC turbine. This is the tangible result of eight years of research and development work motivated by the goal of creating a groundbreaking implementation of the technology. We invested in field testing, scouting of

suppliers and interaction with major industrial partners and independent research agencies. This year the Ait-Baha plant entered the commissioning phase and will reach full performance by next year. The commissioning and operation results in a relatively harsh environment will constitute the best business card of our technology.

"The idea is to cleverly put together simple and widely known materials such as concrete and PVC foils to create the support structures and major components of the plant" – says Andrea Pedretti, CTO at Airlight Energy.

In order to build our project pipeline for the coming years, we are primarily targeting energy intensive industries, such as cement, mining industry, refineries, and even existing traditional power plants. By combining our air-based heat receiver with its existing process, the customer will be able to save a considerable amount of the operating cost associated to fossil fuels such as coal, natural gas, petcoke or heavy fuel oil. In addition, with an estimated lifetime of 60 years, our plants could represent the backbone of an industry's energy portfolio.

Among all the countries in the sunbelt, the MENA area is certainly crucial, with a focus on Morocco, Algeria, Egypt, Jordan, Saudi Arabia.

An eye of regard was put to the social impact of our technology: thanks to the use of concrete to build the CSP mechanical structure instead of steel beams, training of country work-force, we can make sure that up to 60% of the project value remains local. Moreover, we designed the collectors so that they can recover up to 90% of the water we use to wash the plant and collect rainwater, adding more environmental value to local communities.

The heat-storage system, well integrated with the energy production and distribution cycle by an intelligent automatic control system, is also simple and reliable and based on cheap components that can easily be sourced locally.

Last but not least, our CSP is not harmful to birds and other animals, since the hot components near the mirror focus are encased into light and transparent plastic foils.
In conclusion, we believe that years of financial, intellectual and technical investments successfully yielded a brand new product, which does not simply constitute an incremental improvement, but likely a phase transition in the current CSP technology: a product designed to be effective and competitive over the next decades.

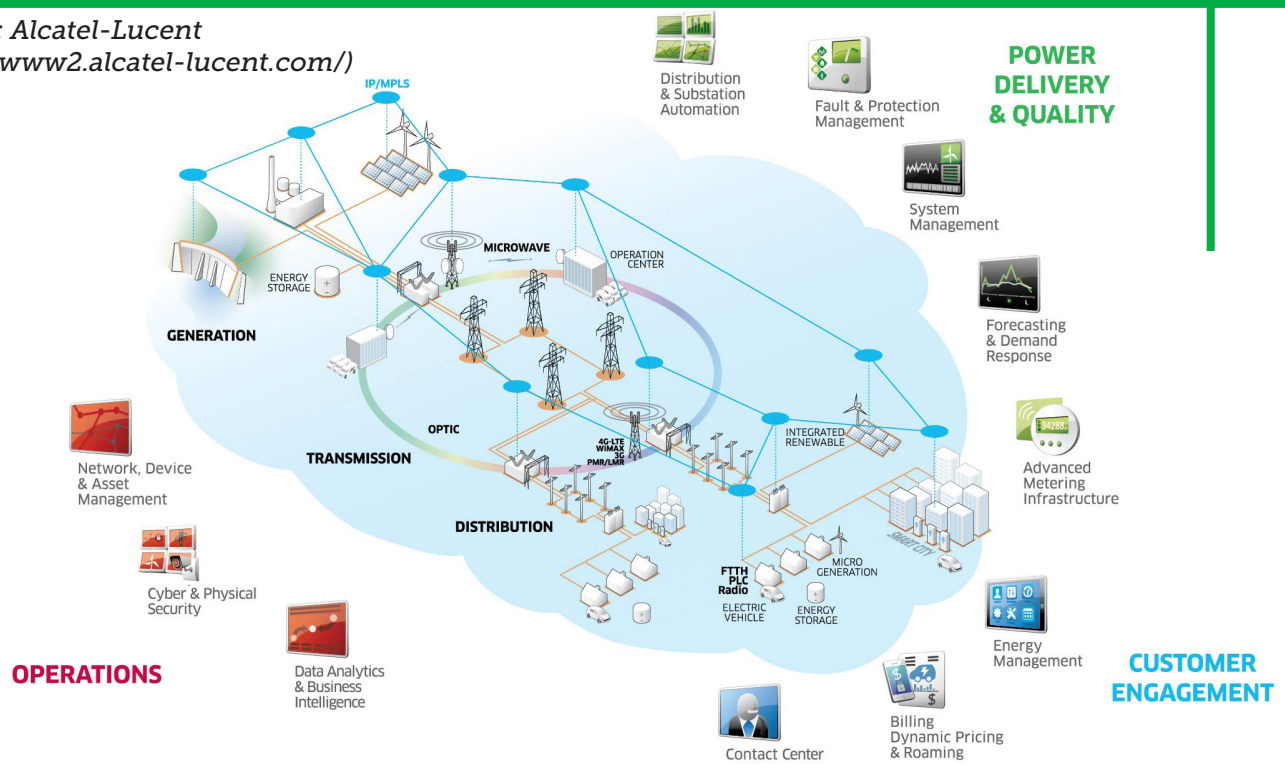
The intense use of communication technology in the energy sector plays a key role in the transformation of the energy scenario, in order to achieve goals to which the EU and the national institutions and stakeholders aim.

On the one hand, smart grid management, smart energy services, demand side management and integration of distributed generation can be supported by the information and communication technology. On the other hand, studies and research within the telecommunication industry can reduce ICT equipment and infrastructure energy consumption and enhance efficiency.
In the last years, the traditional energy grid paradigm has changed, and the increase of renewable solutions and distributed generations have played a major role in this transformation. Energy grids – originally designed to carry power from a few central generators to a large number of customers – rely their operation on the exchange of data controlled by the ICT systems. Hence, the introduction of ICT leads to the new Smart Grids concept development, thanks to the implementation of:

- connectivity between (and within) the electric utility and third party entities, either as vendors, consumers, or regulatory bodies.
- Communication over a variety of devices of the Energy grid through the different wired and wireless available technologies.

In this scenario, it is clear the importance of the ICT research to implement communication networks with suitable Quality of Service (in terms of latency, delivery, etc.), harmonize the technological solutions (to facilitate interoperability), individuate the best strategy for spectrum management and assure security and data protection to the information exchanged.

Source: Alcatel-Lucent (http://www2.alcatel-lucent.com/)

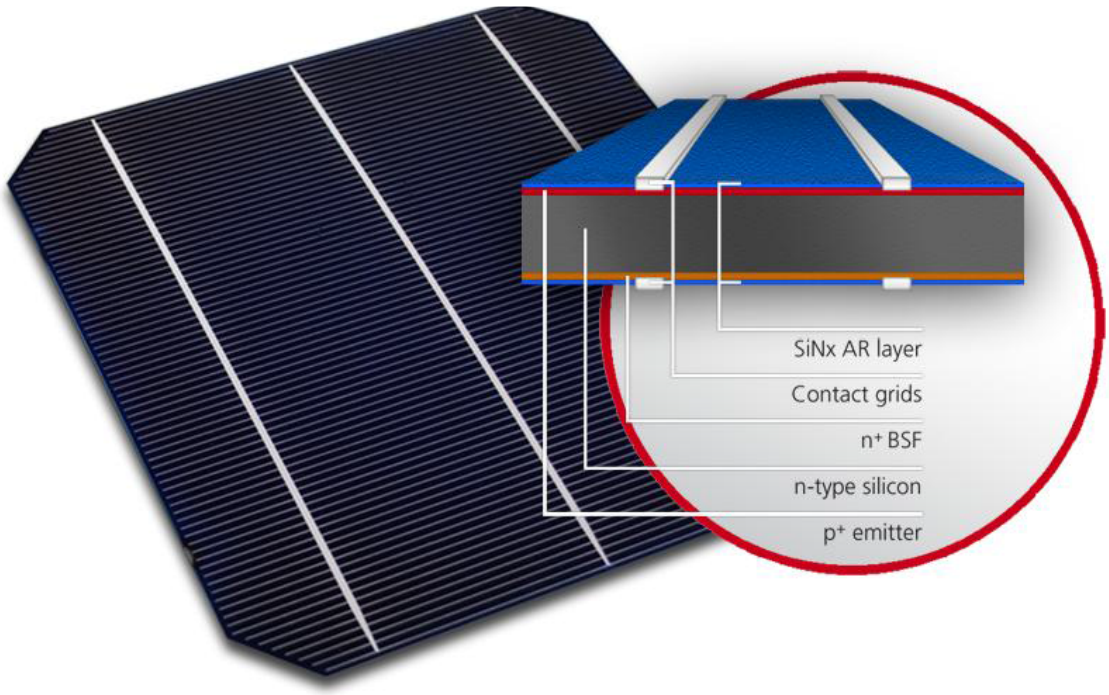


Recently we have seen a regular improvement in cell and module performance globally.

Currently, the standard p-type silicon technology (so called: BSF - aluminium back surface field), represents a very large share (>90%) of the world massive production, with solar cell efficiencies of more than 19%. This progress is mainly due to the development of advanced metallization processes, which allows the creation of a lightly doped emitter and a reduced shadowing over the front side of the cell. For many solar cell producers, the so called: "Passivated Emitter Rear Cell" (PERC) concept, represents a natural evolution of a standard technology. Such cells are already in production on a large scale in Asia, with a cell efficiency around 20%. The next step to the PERC technologyis represented by the PERT technology (Passivated Emitter Rear Totally diffused) – shown in Figure 1 – which have one interesting particularity: it can be "bifacial". The big step forward is due to the benefit that such cells can receive thanks to the "Albedo effect"(which is the reflectivity measure of a surface) and the gain in yield can be impressive (e.g. a bifacial gain of 20% is corresponding to an equivalent cell efficiency of more than 22%).

The PERT cell technology has also the advantage of being more globally compatible with the existing standard production lines, with very few additional manufacturing tools required in order to upgrade the standard machineries. The PERT cell architecture is composed by two diffused layers, namely p+ for the emitter and n+ for

Figure 1:BiSoN technology: n-type PERT cell



Source: ISC Konstaz, 2015

the BSF on each surface. Finally, the anti-reflection dielectric coatings (SiN) and symmetrical contacting grids are deposited on both sides. The PERT cell is commonly developed on n-type Cz substrates to avoid the LID effect (absence of the boron–oxygen complex).

Experts in the field are confident that cells efficiencies over 22% can be easily achieved since 2015 on and more producers of PERT solar cells technology are expected to come in the next years. Today MegaCell, with its BiSoN solar cells technology (developed jointly with ISC Research Centre of Konstanz - Germany) is one of the leading worldwide companies which are investing massively in the installation of high-efficiency bifacial solar cell capacity because of its benefits and potentiality.

Additionally to the higher energy output of the bifacial solar modules, there are also inherent advantages compared with standard monofacial solar modules. Usually, the bifacial modules are available as a glass-glass substrate or, in certain cases, with a transparent backsheet substrate. In particular, this last one have typically a certain water permeability, allowing water to penetrate into the backsheet and enter the interior of the solar module laminate. Glass-to Glass type, on the other hand, will totally prevent a possible water penetration into the module interior over the large area of the solar module backside, which will avoid any degrading effects over time, such as oxidation or delamination. Another advantage of the glass–glass modules is their greater flexibility, notably when using thin 2mm glass, as well as their mechanical robustness as a result of the solar cells being positioned in the neutral mechanical plane of the material sandwich. Since the mechanical stability is significantly increased for glass–glass modules, compared with glass–backsheet modules, the frameless applications become the preferred mounting design. This favours direct applications in building-integrated photovoltaic systems (BIPV) and reduces system costs. Frameless designs may also minimize the risk of potential-induced degradation (PID) in systems with a high operating voltage, as the driving force for PID is the potential between the grounded frame and the cells.

Defining and achieving flexibility in the energy system

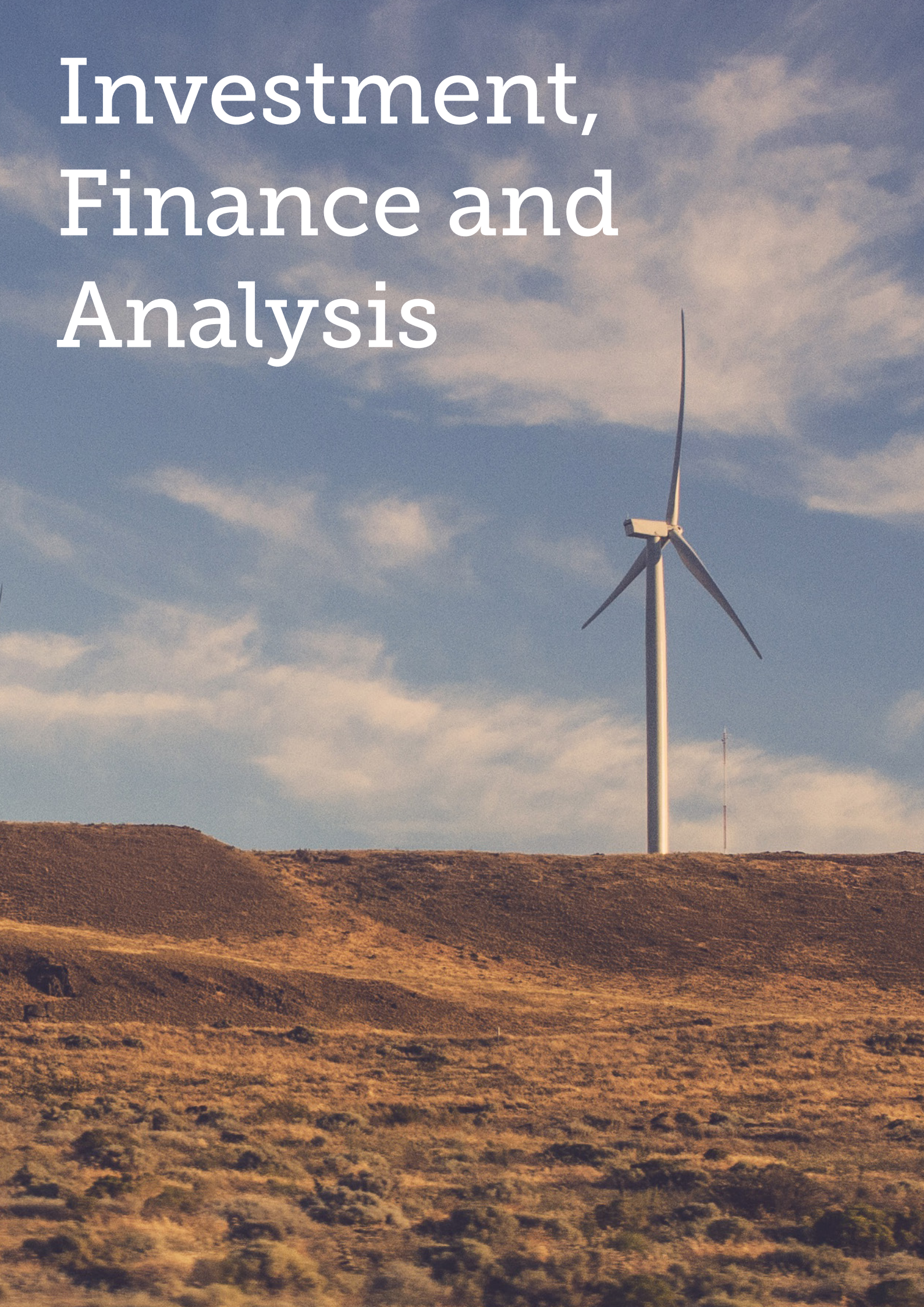
Flexibility is the ability of a power system to maintain continuous service despite of rapid and large swings in supply or demand.

Traditionally, flexibility was provided in power systems almost entirely by controlling the supply side. In systems with increasing shares of variable renewable energy sources (VRES), additional flexibility is needed to maintain system reliability as the variations in supply and demand grow to levels far beyond what is seen today. VRES reduce the flexibility resources in the system by displacing traditional supply side flexibility providers while simultaneously increasing the need for flexibility due to their inherent stochastic nature. This creates a "flexibility gap" that will need to be covered by new flexibility options.

A transformation of power system planning and operation is needed. The question of having sufficient resources to meet demand is changed to having sufficient flexibility resources to balance net demand forecast errors and fluctuations. By increasing VRES penetration levels, the impacts to more long-term timeframes become more stringent. This affects the choice of suitable flexibility options: in shorter timeframes, response times are of more importance; in longer timeframes, the ability to offer large storage content and long shifting periods would be of more importance.

The present lesson considers the different flexibility options that are best suited to different operational timeframes. In fact, the variety of options show that there are several possible solutions to consider in each timeframe. As expected, the main mature options are on the supply side; on the demand side, a key mature option is the large-scale industrial demand response, while pumped hydro is the main mature storage technology. Most of the new demand and storage options are small scale technologies.

Investment, Finance and Analysis



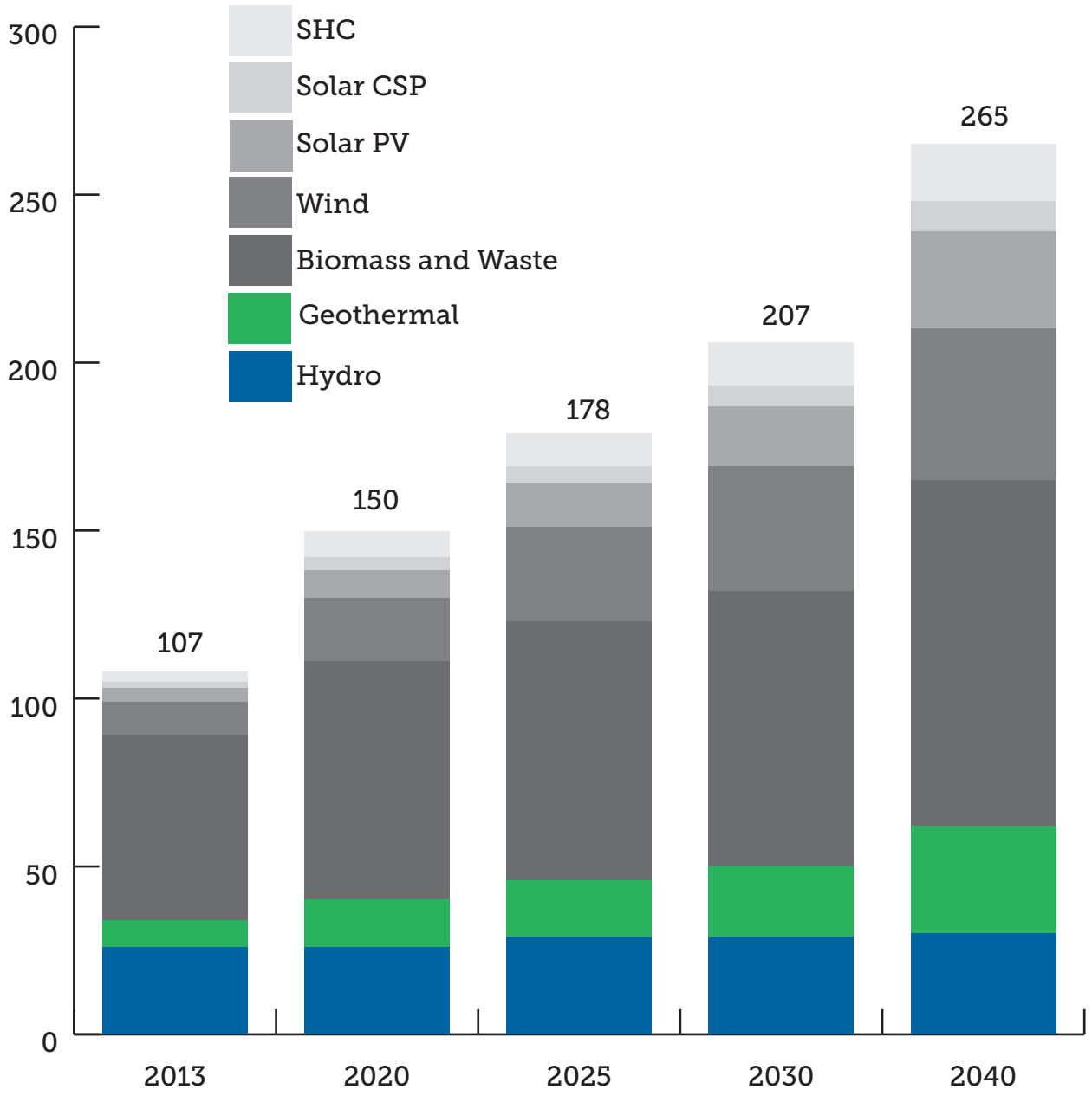
Renewable energy accounts for 11% of total primary energy supply (TPES) in the Mediterranean, or about 107 Mtoe.

Whereas the contribution from hydropower has remained more or less constant over the years (at some 20 Mtoe per year since 2000), non-hydro renewables have experienced significant progression, with a two times growth since 2000, to reach more than 80 Mtoe in 2013. In particular, wind and solar PV have been showing the highest average annual growth rates since 2000, at 23% and 29% respectively. However, the geographical distribution across the Mediterranean is unbalanced, with North countries accounting for almost 80% of total renewable energy supply in the region. Traditionally the most exploited renewable energy sources have been biomass and hydro. Geothermal energy contributes in a few countries, mainly Italy and Turkey. In more recent years, wind and solar, both for electricity and heat production, have entered the energy mix.

In terms of electricity generation capacity, the amount of renewable technologies in the Mediterranean region has increased substantially, particularly over the last decade. It was 196 GW in 2013, about 13% of total renewable power capacity worldwide. Hydro and non-hydro renewables together were 34% of the cumulative power capacity in the Mediterranean region in 2013 and represented the second largest source of electricity after natural gas. With current trends, hydro and non-hydro renewable energy technologies are expected to dominate the Mediterranean energy mix by 2016, thus surpassing natural gas as the first electricity generation source in terms of installed capacity. In particular, non-hydro renewable electricity capacity net additions were well over 8 GW per year on average, over the past ten years. Until 2000, renewable power generation capacity was almost exclusively based on hydropower, with other renewables accounting for less than 1%. In the last decade a more diversified electricity generation mix has emerged, thanks to increased policy support, decreasing costs of technologies and relatively high social acceptance. As a result, in 2015 non-hydro renewable power capacity was higher than hydro capacity, at 106 GW.

According to the projections of the OME's Mediterranean Energy Perspectives, in the Proactive Scenario, renewable energy technologies would account for two-thirds of cumulative installed power capacity in the Mediterranean by 2040. This reflects the push towards renewable energy technologies put in place in the Mediterranean countries, with most countries having set renewable energy objectives to the 2020 – 2030 horizon and adapted their regulatory framework. Reaching the PS implies adding capacity of about 15 GW per year over the next 25 years, most of which by non-hydro technologies (14 GW). North Mediterranean countries are expected to add about 9 GW of new renewable capacity per year to reach a total of 396 GW by 2040 (thus more than doubling current RE power installed capacity). South and East Mediterranean countries will contribute more than 6 GW per year, to reach 181 GW by 2040, a five times growth in the PS compared to current levels. This would completely change the electricity market supply and demand structure in South and East Mediterranean countries.

Evolution of renewables-based primary energy demand in the proactive scenario, 2013-2040



Source: OME Database

Competitive deployment of PV and Wind: the importance of multi-year and multi-technology plans

Over the last two decades, the evolution of the renewable energy market has surpassed all expectations. This is mainly due to the acknowledgement of renewables as cost competitive energy sources, rapidly deployable with a modular nature allowing further expandability and opportunity to exploit economies of scale. Crucially, renewables also mitigate the exposure of power prices to the commodity market fluctuations.

Regarding the recent past, 2014 was a record year for the RE industry, when cumulative renewable capacity exceeded 1,800 GW (representing a 342 $bn investment channeled into the industry) spurred by the most mature technologies, i.e. wind and solar PV, whilst an increasing number of countries registered RE installed capacity higher than 100MW. The RES market's positive trend is expected to continue worldwide at a steady pace up to 2035, with developing countries contributing over 60% to the global growth in electricity production.

Middle East and North Africa (MENA) regional governments and national stakeholders are gradually embracing the renewable era but are faced with challenges about how to best stimulate the renewable energy market in their respective countries. One of the key factors invariably identified by investors is the need for a long-term plan and boosting investor confidence, a result that can be achieved through the establishment of government-backed multi-year and multi-technology renewable energy penetration (competitive or non-competitive) schemes.

As a research conducted by Ernst & Young shows, governments can address up to 75% of those barriers that are still hampering renewables in the MENA region.

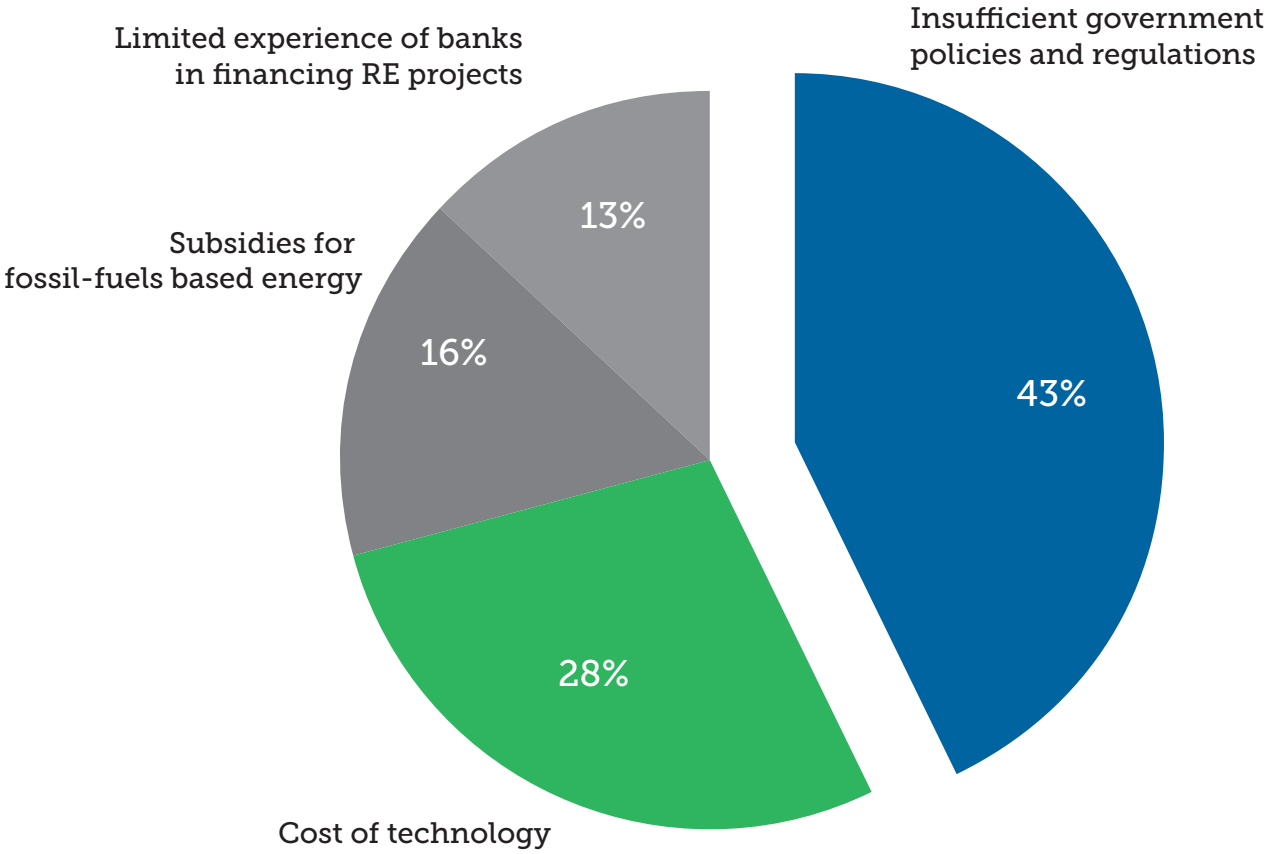
In this view, government-sponsored multi-year and multi-technology plans present advantages both for private investors and host countries. On the one hand, private investors benefit from the risk mitigation effects, a better definition of companies' growth plan, the reduction of permitting and tendering risks. On the operational side, this allows for the creation of easily transferrable skills and workforce. On the other hand, thanks to long-term planning, projects are easier to bank and developers take long positions in larger developments. Such a predictability is also beneficial for the development of local industries and the growth of sector-specific areas, thus diversifying the skill sets and eventually decreasing the national energy dependency.

Morocco is a good example of a state that adopted such an approach and is now playing a strategic role in Enel Green Power's growth strategy. As a matter of fact, the Moroccan government promoted a stable regulatory framework and set long-term targets for renewables, i.e. 42% electricity generation by 2020, of which 2GW Wind and 2GW Solar.

Similarly, Egypt features very high in Enel Green Power's MENA growth strategy, thanks to the Egyptian government strong backing of RE. Local authorities announced long-term targets for renewables, i.e. 20% electricity generation by 2020, of which 7,200 MW Wind and 1,320 MW Solar. Competitive bidding programs for IPPs were launched for both domestic and international investors, aiming at realizing large -scale projects with 20-25 years PPA with EETC. Furthermore, a FIT scheme was recently launched for small-medium projects (<50 MW) with 20/25 years PPA with EETC at fixed tariffs.

Following these examples, other MENA countries have kick-started ambitious programs to rely on RES to cover a substantial part of their growing electricity demand. Renewables in MENA are already a reality and Enel Green Power is keen and ready to participate in this new era.

Main barriers to the deployment of RE in MENA



Source: MENA Cleantech Survey Report, E&Y 2013

Sustainability and local value content in the Mediterranean

An interview with Italgen Managing Director Giuseppe De Beni

Local value content is a relevant issue related to the renewable energy projects in the MENA region. Sometimes, it is perceived as a sort of "burden". What is your experience in terms of socio-economic benefits and job creation in countries such as Egypt and Morocco?

As for Egypt, I'm used to mention an event occurred during our 1st Public Hearing in Hurghada. On that occasion, we met all the stakeholders involved (i.e. representatives from the major entities, meaning the Ministry of Environment, the Ministry of Electricity & Renewable Energy, the Governorate of the Red Sea, local communities, local universities and local banks).

We were ready to answer to very detailed engineering based questions. But, out of one hundred questions we got, eighty were related to the consumption of water in the area, specifically "once workers will be on site, where will they get water, to eat, to have a shower or whatever?" Such a question entailed, and keeps on doing, that a project must have a strong return on the environment. That is why, well in advance, we went through a comprehensive environmental and social impact assessment, taking care not only of birds, but also of local communities.
My answer, going back to the Public Hearing, was: "we are three kilometers from the Red Sea: we will take care of water through a desalinization process". Therefore, once our project will be up and running, one or two wind turbines will be dedicated to provide energy and water to small villages close to the site.

What is our lesson learned? To be both environmentally respectful and open minded, either in Egypt or in Morocco. Local Public Hearings can't be compared to European's. Beyond the commitment to the environment, stakeholders are mainly concerned with basic needs. Therefore, if FDIs are consistent with their projects and compliant with local needs, meaning reliable and able to offer practical help to local communities, that is perfect.
In short, I suggest to be very simple and aim to go straight to the point.

Cement plants are energy intensive and Italcementi Group is deeply concerned with sustainability on all its dimensions. The Group has declared a precise target, i.e. to reach 10% of its cement plants energy needs covered by RE within 2020. How relevant is the return on the environment in your decision-making processes?

The ambitious 10% target is very challenging, but we are on the track to reach it. The return on the environment is relevant indeed, and it includes the cooperation with local suppliers and the involvement with local universities, such as El Gouna Technische Universität, having capacity building in mind. Specifically, we have appointed an Egyptian company to perform civil works, and it quickly started employing international standards habits. This, in particular, for health and safety procedures, which are compulsory for any contractor working with Italcementi Group. It is just one of a series of fruitful win-win situations we are promoting.

In Egypt you are one of the major investors and Italcementi Group is among the most relevant players in the cement production. How would you sum up your several year experience in the country and your lessons

learned, either at Italcementi Group or Italgen level? How do you see Egypt's pace of progress towards a more sustainable energy system?

Yes, Italcementi Group, leader in the cement sector, is currently among the most relevant investors in Egypt. Its electric spin-off, Italgen, is strongly committed in the renewable energy field in the country. Our Phase I 120 MW wind farm project, located in Gulf El Zeit (Red Sea Governorate) is currently the most advanced. We accomplished all the necessary steps, obtained all the permits and started with the construction phase late 2014. So it is a positive sum up, a win-win situation, both for Egypt and ourselves.

In terms of delivery and lessons learned, we have been cooperating with all Ministries, local Entities and Authorities involved in order to pave the way and define a roadmap, at least in terms of framework, that other investors (either foreign or local) may follow in the near future. To this purpose, let me say without self-praise, that we helped institutions to establish a very outstanding framework, either technical or legal, to be applied to executive regulations.

Our additional lesson learned is that an investor has to cooperate with the relevant Authorities to jointly develop a new attitude vis-à-vis the private sector, which is somehow new to local Institutions.

Last, but not least, I would suggest Egyptian Authorities to speed up the implementation of the executive regulations we mentioned before. Too much time lost in bureaucracy may lead to miss the chance of a mutual (i.e. public-private) growth.

In 2014 Italgen began the construction of Gulf El Zeit Phase I, a 120 MW wind farm located in the Red Sea Governorate, which should be followed by a nearby additional 200 MW wind farm project (Phase II). It has been the first Foreign Direct Investor to pioneer the Renewable Energy sector attaining all the necessary permits from the Egyptian Government. Which are your recommendations to a foreign industrial player investing in the country?

I would suggest FDIs to be "patient" and to start since the beginning with an outstanding methodology, in order to grant the project bankability. Just to give you an example, after identifying the site, it is advisable to set a reliable wind measurement campaign, a comprehensive environmental and social impact assessment, and a Public Hearing.

In addition, grid connection and network access contracts should be signed in order to fulfill the preliminary steps and proceed. Everything has to be done according to high international standards in order to ensure a smooth due diligence for the subsequent project financing.

Therefore, my basic recommendation is to apply an outstanding methodology to ensure bankability, essential "ingredients" to support RE investments without jeopardizing the project or putting it on hold.

It would be additionally advisable that the Government of Egypt may speed up the executive regulations and subsidies phase out on both electricity and fuel.

In early 2015 Italgen joined RES4MED. In which way being part of RES4MED's shareholders may represent an added value for Italgen?

RES4MED is a very good opportunity for RE industry and value chain. I wish it may capitalize the contributions coming from any single member and transform them in a unique product.

I additionally wish it may become a valuable spokesman for all its members towards institutions such as ONEE, NREA, EgyptERA. A solid and reputable image will certainly benefit all of us.

RES4MED has to become our fast track. Let me be a bit harsh. It is not a matter of signing agreements, it is a matter of what we will get from them, and what we can give.

As you know, I'm very focused. RES4MED has done a great job so far; it is now time to consolidate, to select few relevant priorities and pursue them. I wish to see top deliveries and accountability, hopefully in a short period. Inshallah!

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The role of EPC contractor in utility scale projects

Countries around the world continue to hungrily develop, pursue, and approve utility-scale solar PV projects, defined as upwards of 10-50 MWp in size (DC capacity).

European engineering, procurement and construction contractors have built more than half of the world's solar power stations, even though less than 30% of this global capacity is in Europe. Germany and Spain in particular are continuing to benefit from their earlier leadership in solar power deployment. Although their home markets have now shrunk to a trickle, the expertise their companies built up in the last decade still gives them a competitive advantage in world markets today.

Italy, because of the sudden cut of the incentive system before the consolidation of a sound industrial chain , has benefited only partially from the exponential growth of the solar sector.

Globally, a larger share of clean energy investment is going to distributed renewable energy projects, a field which is dominated by solar PV. While global asset finance for utility-scale renewable energy projects fell 4% year-over-year to $47.3 billion, investments in distributed generation increased 21% to $19 billion.

The engineering, procurement and construction (EPC) provider capacity of utility-scale solar power projects is essential to the success of the project. Tipically, this is because the EPC contractors companies offer a complete turnkey service from the location of suitable land and the management of all the legalities, to the supplying of equipment, construction, connection and the subsequent operation and maintenance of the project. The EPC provider assumes a wide variety of risks entering into a utility-scale solar power project's construction phase. These risks include labour disputes, delivery conflicts, safety compliance, weather

delays and environmental, technological, engineering and legal challenges. Early and proactive risk management by the EPC provider's project team translates to success in completion of construction and timely energisation, allowing the owner to meet revenue projections for energy output.

Under an EPC contract. the contractor will design the installation, procure the necessary materials, and complete construction, either through own labor or by subcontracting part of the work.
Financing an EPC contract typically requires the following elements:

- a fixed completion date.
- A fixed completion price.
- No or limited technology risk.
- Output guarantees.
- Liquidated damages for both delay and perfomance.
- Security from the contractor and/or its parent companies.
- Caps on liability. Ideally, there would be no caps on liability. However, given the nature ol EPC contracting and the risks to the contractors involved, there are almost always mps on liability.
- Restrictions on the ability of the contractor to claim extensions of time and additional costs.

EPC contracting has many advantages: one point of contact, "Hands off" approach, minimal staffing requirements, minimal legal risks.

The amount of risk involved in a utility-scale solar plant creates formidable construction challenges to navigate. A skilled project management team is essential for EPC providers and owners seeking to negotiate a project to timely completion and successful energisation.

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The role of Technical Advisor in project finance structure

The Technical Advisor ("TA") plays a key role supporting its clients during all steps of structured financing, ensuring cash-flow sustainability and keeping project risks under control.

In a RE project, the roles of the TA can be multiple but linked by a common "fil rouge": the safeguard of the investment. Different project stages correspond to different roles of the TA, which is called to assess the technical aspects which can influence the "bankability" of the project, through the so-called "Due Diligence" process.

Due-Diligence services set the basis of the project bankability.
The Private Investor (equity) or the Bank (debt) wants to be reasonably confident that technical/administrative elements are sound before the potential project acquisition or construction. A cautious and engineered approach foresees a preliminary Due Diligence (necessary before acquisition) and a later comprehensive Due Diligence procedure (essential before financing).
The foreseen standard checks include site suitability, permits, design quality, key components, energy yield estimations, contracts, business plan.
With reference to the business plan, the key element for bankability is DSCR (Debt Service Coverage Ratio), i.e. the indicator which tells the ability of the project to repay its debt to the Bank and better remunerate the investment to the Investor.

At a later stage, the TA supervises construction, commissioning and operation phases.
Milestones checks during construction and Acceptance Tests are crucial stages, as they often coincide with bank disbursements: their supervision by the TA is instrumental for the financing.
Finally, the operational phase can be supervised by the TA, which monitors the project's performance and O&M activities.
Another role of the TA is related to supplier qualifications.
When a project includes hardware supplied by little-known manufacturers (PV modules, inverters, wind turbines, LED lighting systems...), the TA assesses hardware quality, but also the capabilities of the producer. In fact, the Financer also wants to be sure about production practices, guarantees and post-sales services.
The TA visits production facilities, interviews key managers, gathers technical, financial, safety, quality documents and emits a "bankability report", which helps Financers support projects with confidence.

The Technical Advisor is your trusted Engineer: safeguard the success of your venture through its specialized technical skills.

In 2014, 130 GW of additional RES capacity were installed in the world. Renewable energies provided 20% of global final energy consumption in 2014.

Despite this huge growth, the sector is increasingly facing new and different challenges:

- Declining policy support and uncertainty in many European countries and USA.
- Electric grid-related and market constraints.
- Local opposition in some countries.
- Global subsidies for fossil fuels.
- Declining energy prices.
- Increasing competition.

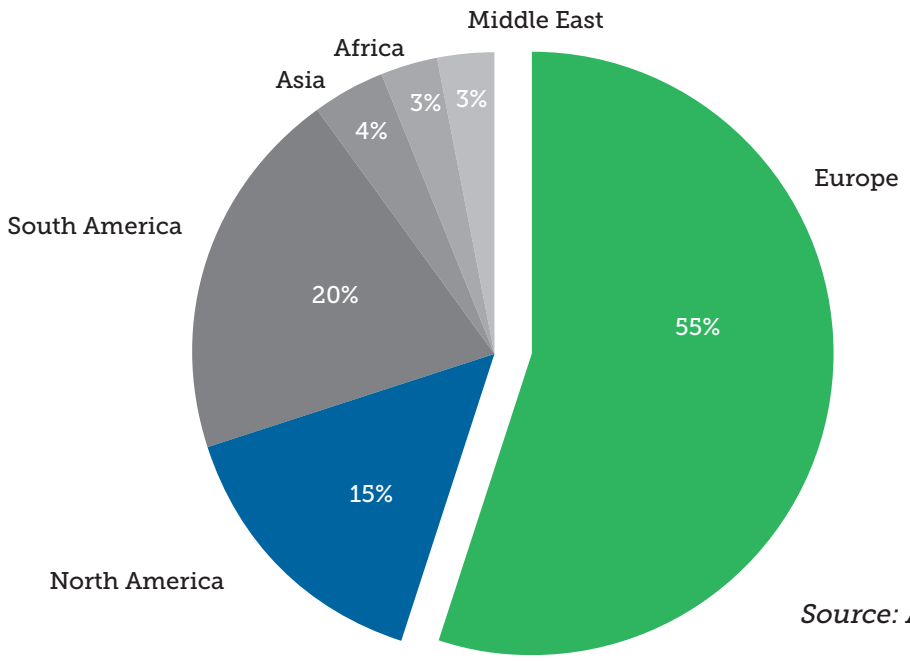
Many utilities reacted to these challenges with large M&A deals aiming to gain rapidly an important dimension and exploit economies of scale.

For 2014, the top 42 European gas and power companies implemented 70 RES deals, the 31% of the total deals concluded by them. Most deals involved Europe (55%) but around 45% included a series of acquisition in the Americas, Africa and Asia. Most of the deals outside Europe were in the Americas (25%), in particular US, Canada, Chile, Colombia, El Salvador, Mexico and Brazil. Wind represents the largest part of RES deals (47%), followed by PV (15%) and hydro (10%). The other technologies weight 28% of the deals in 2014.

On the other side we reviewed many divestments, as clean-tech assets are becoming more and more attrac¬tive for financial investors. The above mentioned dynamics show that the secondary market for renewables assets is gaining great interest among different typologies of investors globally.

To recap, in 2014 34% of the renewables deals were divestments, 20% partnerships, followed by acquisitions (19%), purchase agreements and joint ventures (11%).

Geographical focus of deals implemented by the 42 leading European Gas&Power Groups in RES



Source: AGICI, 2015

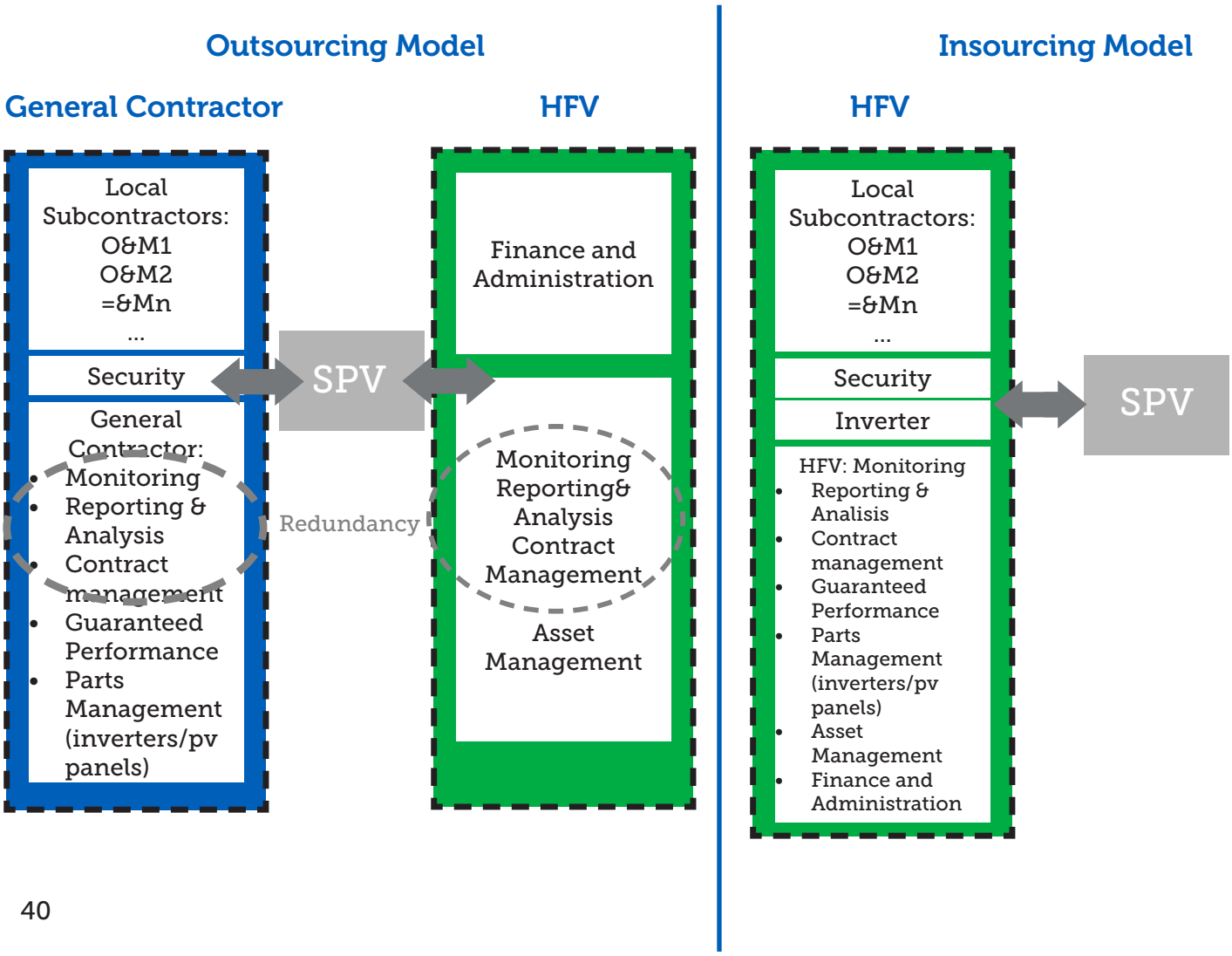
With the experience built by HFV in the photovoltaic sector, since its birth in 2009 to date, we are be able to define the key issues of a proper management of the plants, aiming to increase technical efficiency and cost effectiveness.

The main issues in the sector are synthetized as follows:

- technical and operations management boosting.
- Remote monitoring and management.
- Analysis and streamlining of operating costs.

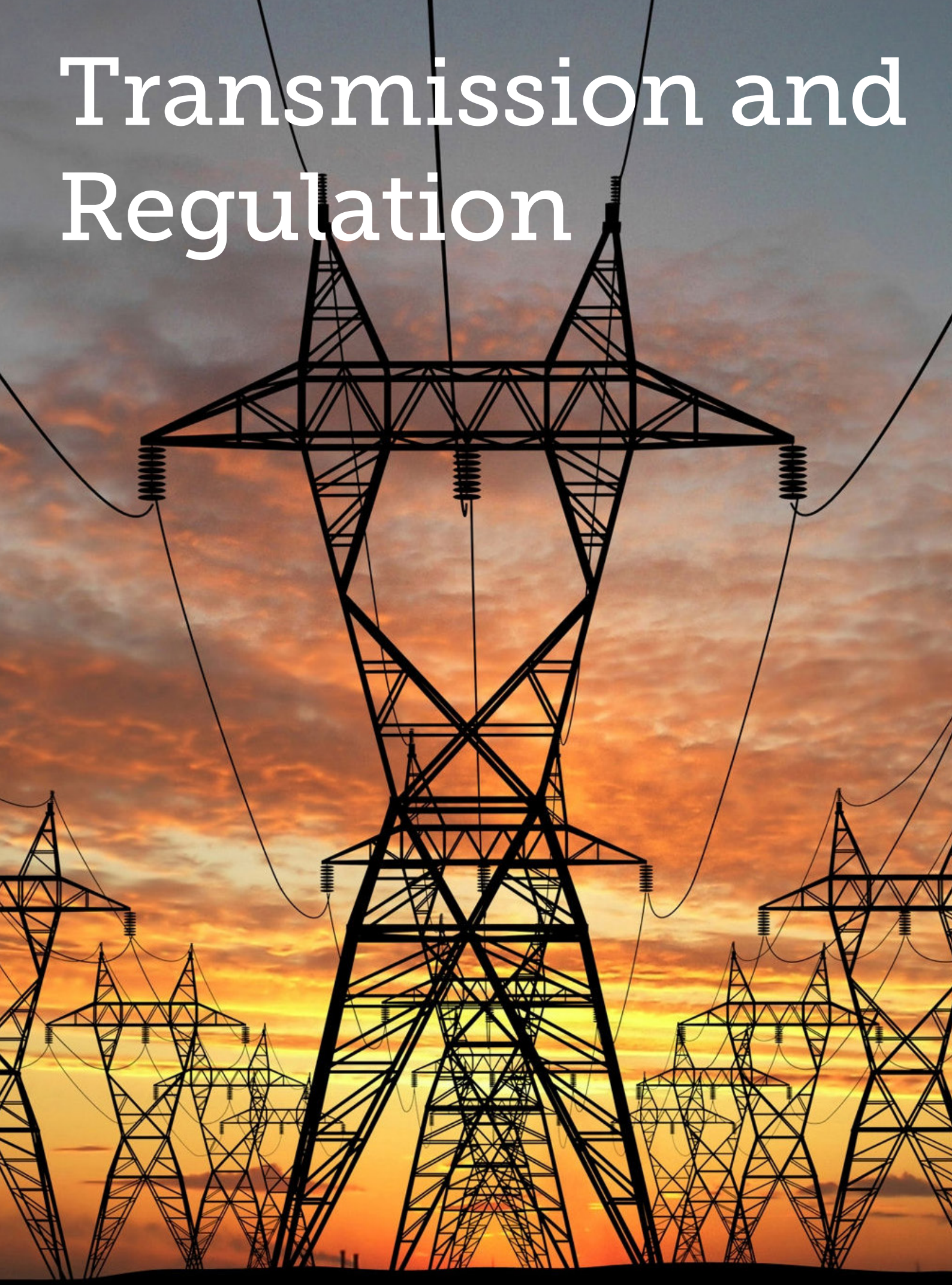
HFV has changed the plant management model in 2013, moving from the outsourcing model for field coordination (with General Contractor) to the insourcing model, in which the coordinating activity lies in the hands of the company owner of the assets (please refer to the graph below).
In this way the owner manages directly the electrical maintenance on site, the inverters, supplies PV panels, transformers and other electrical components, manages/outsources the security.

Considering the size of the plants portfolio and their territorial distribution,



the operating management is carried out thorough the support of a local and a central team.
The local team includes Plant Managers, engineers or technicians, who all take care of checking constantly all operating activities, and who are coordinated by the central management in order to grant a consistent approach and a constant alignment of activities.
The central team provides technical and engineering support, asset management, reporting and monitoring.
HFV is implementing another change in its managing model, from a contract for provision of services, to a contract for a service on call for breakdowns, which would have pre-set payment terms and response times.
This organization approach allows HFV to manage its annual production with plant availability close to 100%, and it brought to an improvement in the quality of work, in response times, and, most of all, a decrease in the recovery time.
Finally, the new managing model brought to a reduction in costs for over 30% with respect to the costs the company bore with the previous managing model.

Transmission and Regulation



In a context of strong investment needs in energy infrastructure and market reform in the Mediterranean region, one of the key objectives of the Association of Mediterranean Energy Regulators (MEDREG) is to advocate in favor of independent energy regulators. MEDREG works to act as a facilitator and ensure that all Mediterranean countries establish an independent national regulatory agency both for the electricity and gas sectors.

In order to provide the vision of Energy Regulators on the situation of Infrastructure investment in the Mediterranean region, MEDREG developed a report that maps current and projected interconnection infrastructures for electricity (and gas) and discussed the challenges to finance them properly in the absence of an harmonized regulatory framework. This report assesses the main barriers that represent an obstacle to efficiently using existing infrastructure and financing new projects. Below you can find 4 recommendations selected among those of the report.

1. Promote deeper harmonization of national regulatory frameworks

The absence of a regulatory level playing field between the Northern and Southern shore of the Mediterranean is particularly negative for investments, as different sets of rules exist in the various Mediterranean sub-regions. In particular, it should be noted that South-South dialogue and regulatory harmonization need strong improvements in order to build efficient cross-border interconnections. In the absence of a formal commitment among Mediterranean policy makers, all stakeholders from the EU and MENA region have to voluntarily engage now to establish deeper legal harmonization, most notably regulators and TSOs.

Also, during the last twenty years, Southern Mediterranean countries have elaborated different institutional schemes with the aim to promote the usage of Renewable Energy Sources (RES). However, incentive measures tend to be limited and only a few of these regulations foresee the use of feed-in tariffs as a means of support. Regulators should put in place a solid knowledge in order to transfer this value to final customers in particular concerning distributed generation.

2. Increase the use of existing interconnections in the Southern shore

In spite of the existence of several South-South Mediterranean interconnections, electricity trade among these countries has remained modest. Integrated resource planning is essential at the national as well as at the regional level to review, understand, and provide input to the planning decisions of the interconnection projects.

3. Evaluate the economic benefits of new cross-border infrastructure projects

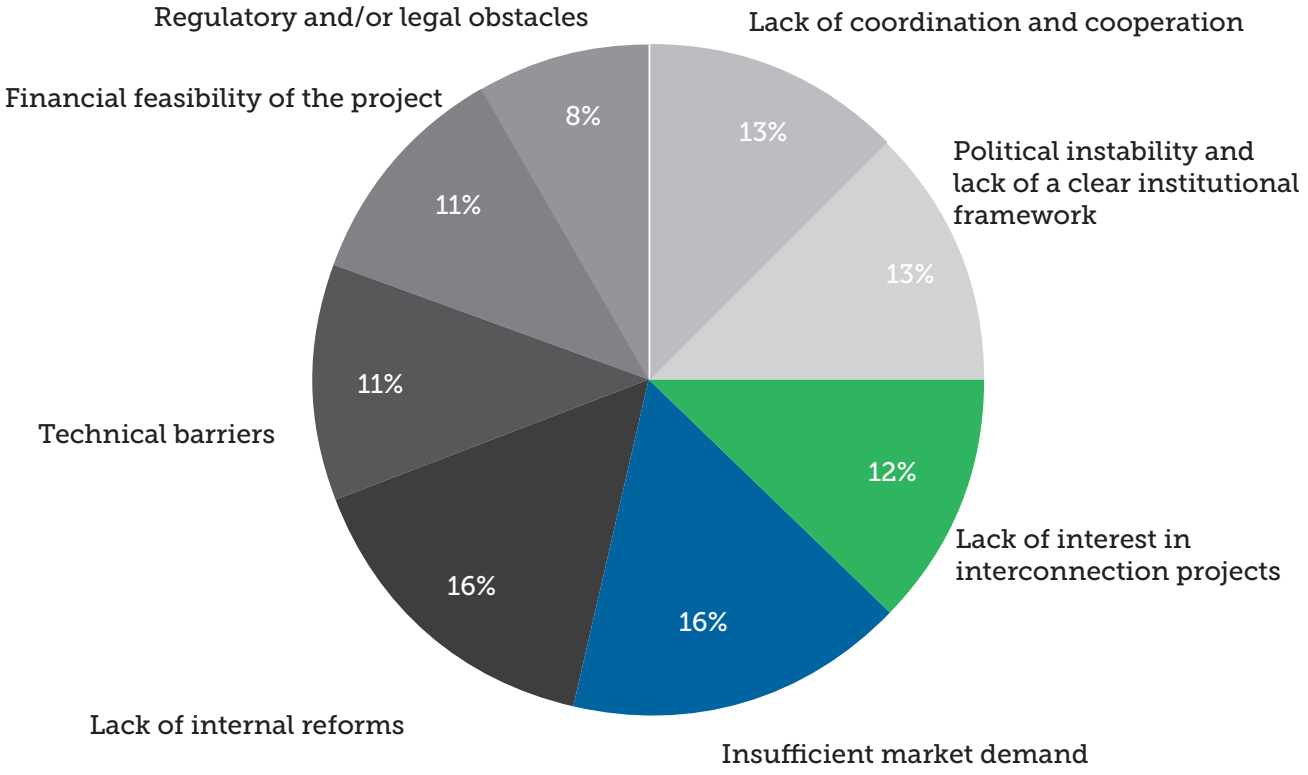
Developing sound methodologies for CBA will help improving the investment climate in the region. The economic assessment shall also take into account security of supply and social considerations. An effective way to ensure risk-adjusted returns to investors could also be through 'priority premiums', which compensate the additional risk and complexity of new projects.

4. Design a Ten-Year Network Development Plan for the Mediterranean region

The assessment of overall costs and benefits deriving from infrastructure investments (in particular new ones)

is a complex task and needs very careful consideration. In the medium term the improvement of the use of existing infrastructures and the definition of common rules regarding new ones. In the medium to long term, it could be beneficial for the region to develop a Mediterranean TYNDP based on a sound methodology developed by TSOs and assessed by regulators. Considering the European experience regarding the PCIs and following the example of the Energy Community, MEDREG could also consider a list of infrastructure projects that are of interest for the whole region. The selection process should be transparent and non-discriminatory.

Combined impact of barriers for electricity and gas



Source: Elaboration of MEDREG

The state of global fossil-fuel subsidies

In a world where CO2 emissions are sharply increasing and air pollution represents a dramatic threat to human health and environmental sustainability, it appears extremely urgent to change our energetic model and sustain the deployment of renewable energies against traditional fossil sources. Yet, globally fossil-fuels are still being heavily subsidised, especially in developing countries. According to IEA, in 2014 the global value of subsidies to fossil energy amounted to $490 billion, which represented around three and a half times the value of subsidies to renewable energies in the power sector ($135 billion in 2014).

By definition, an energy subsidy is "any government action directed primarily at the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers" (IEA, WEO 2014). Consumer subsidies arise when the price paid by consumers, that can be both firms and households, is below a benchmark price, which, when possible, is the quotation of the commodity on the international markets, while producer subsidies arise when prices received by suppliers are above this benchmark (IMF). Moreover, since efficient taxation of energy requires including all the externalities related to the use of energy, whenever negative externalities are not included in the price of fossil fuels, there is already an implicit subsidy to their consumption.
Critically, a subsidy creates a market distortion that leads to a misallocation of resources, which in turn results in a long-term economic cost. For example, subsidies can discourage investment in the energy sector, or crowd out growth-enhancing public spending, as many countries spend more on energy subsidies than on education or public health (IMF). Importantly, when fossil-fuel consumption is subsidised, renewable energies are less able to compete. Consequently, following the IEA, "the more a government subsidises fossil fuels, the more it has to subsidise renewables if it wants to keep a level playing field".

Italy does not represent an exception. Legambiente estimated in €17.5 billion the total value of direct and indirect energy subsidies to fossil-fuels in 2014. This is quite unexpected, given the little or none space this topic has in the Italian public debate. These subsidies take the form of grants and tax benefits, discounts on royalties or public funds distributed to fossil-based power generation plants, oil companies, energy-intensive industries and transport companies. They encourage excessive fossil-fuel consumption, aggravating pollution and the Italian energy dependence, considering that we spent around €44 billion in energy imports in 2014.

Globally, subsidies to fossil fuels decreased moderately in 2013, after growing marginally in 2012 and more sharply in 2011. In general, they are strongly correlated with oil prices (IEA, WEO 2014). Hence, thanks to their recent plunge, policy makers are facing a "make-or-break moment". Following Maria van der Hoeven, the former Executive Director of the IEA (International Energy Agency), "they have leeway to take actions that even a year ago would have been unthinkable, for example eliminating subsidies to fossil-fuels consumption, introducing carbon pricing or taxes, and financing clean energy research, development and deployment".

Italy has already significantly deployed renewable energies and the lessons learned could be helpful for countries with an high potential in clean energy growth, towards their path to sustainable development.

The RES contribution to cover energy needs in Italy has increased strongly over the last years, thanks, among other things, to the strategic targets set up by the EU Renewable Energy Directive (2009/28/EC), which requires Italy to increase renewable energy by up to 17% of gross final energy consumption by 2020.

Italy intends to go beyond the European Target (17%) contributing significantly to the reduction of GHG emissions and to the objective of energy security, while fostering a sustainable economic growth, also in the energy sector. For this reason, in March 2013, has been approved the new National Energy Strategy, which foresees by 2020 a RES share of 19-20% of gross final consumption, equal to an annual 23-24 Mtoe of final energy consumption. This will enable a reduction in emissions of up to 50 million tons of CO2.

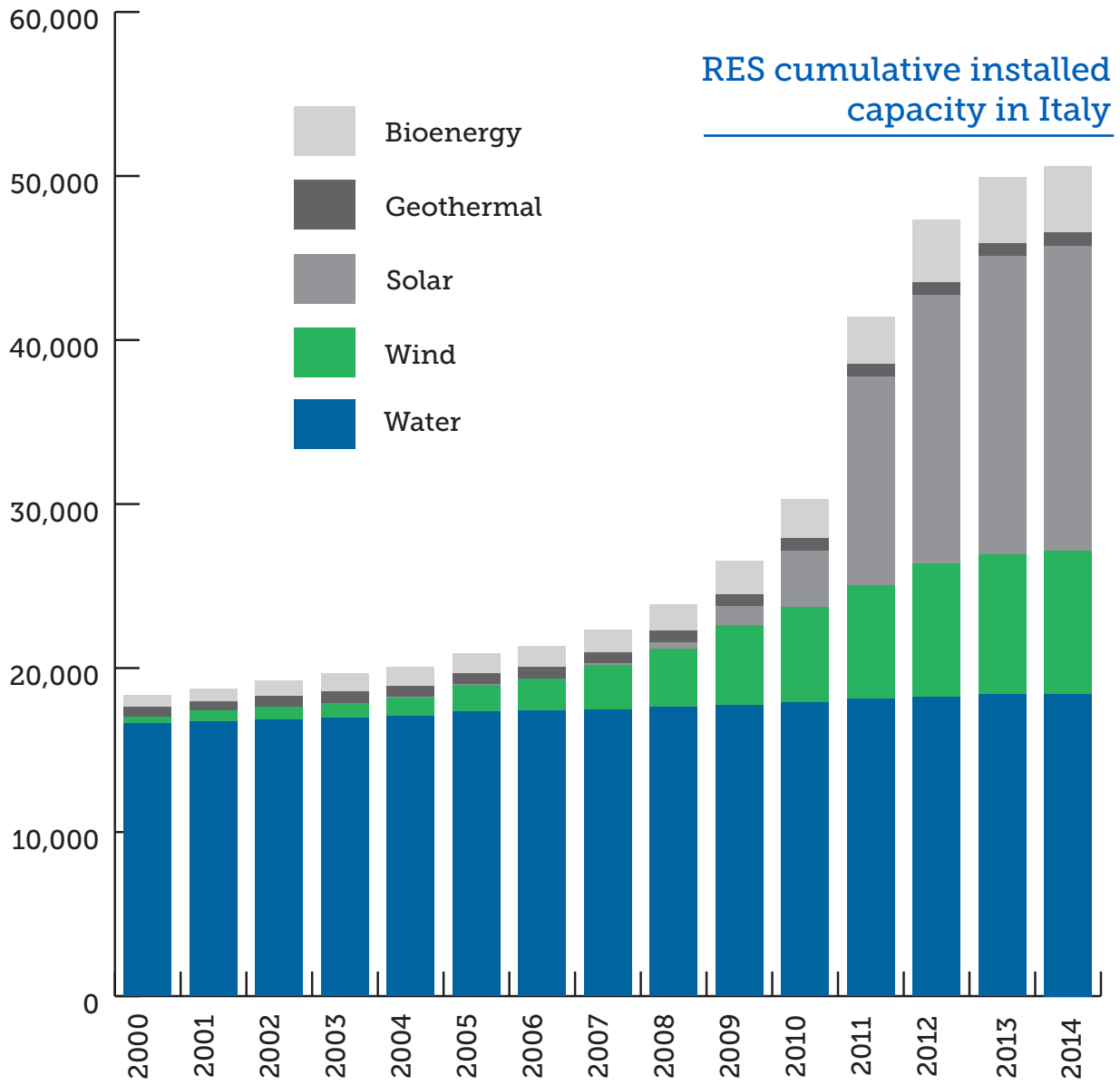
The production of renewable electricity has seen very strong development in recent years in Italy. With regard to the electricity sector, the "20-20-20" target has already been met in 2012, nearly 8 years ahead of time (27,6% of the gross final electricity consumptions in 2012 compared to the NREAP objective of 26,4% by 2020). This can be explained by the strong increase in installations that Italy faced in recent years, most notably photovoltaic: the installed PV capacity, in fact, reached a total capacity of more than 18 GW in 2014.

This growth has been possible because Italy has developed policies that have strongly favored RES development by supporting significantly the demand side. Italy, in fact, has a considerable history of promoting renewable energy sources with different support instruments, starting in 1992. However, this has led also to adverse effects, like the impact on Italian consumers' energy bills and the impact on electricity grid.
This tendency to direct support policies to the demand side in order to encourage the deployment of renewable energy has affected many countries that in recent years are becoming more concerned about the real cost related to the economic support given to renewable energies.

In Italy, for example, we have faced this kind of issue and starting from 2011 the Government introduced a total annual spending limit on the economic support addressed to PV installations, equal to 6,7 billion for the period 2011-2016, with the provision that in case the limit is reached before 2016 there would be no further supporting scheme available for PV installations. As a matter of fact, the limit was reached in 2013 and starting from July 2013 there is no more supporting scheme for PV installations.
Moreover, it should be also considered that sometimes direct support policies to the demand side have not sufficiently promoted the domestic industries and the research and development sector.
Therefore it is now necessary for many countries to foster also the supply side, by directing expenditures towards the most high value technologies and sectors, taking into account local potential and developing in particular technologies with higher returns in terms of environmental benefits and economic value creation such as GDP growth and employment.
To face those new challenges, a broad approach is required in assessing the effects of renewable

energy deployment in order to review policies in an increasingly competitive and global market. The impacts of renewables' growth should be analyzed in a comprehensive way by taking into account not only the results on energy markets, tariffs and infrastructures, but also the influence on learning curves of technologies, net economic effects in terms of investments, value added and jobs, balance of trade, environmental and social impacts, interaction with other policies.

In conclusion a comprehensive monitoring activity along with market design can provide effective feedback on strategic priorities, targets and instruments and can also help industries in internationalizing their businesses; within this framework the technologies' costs are a key factor for the definition, the monitoring and the updating of targets, instruments and policies provided for the RES development.

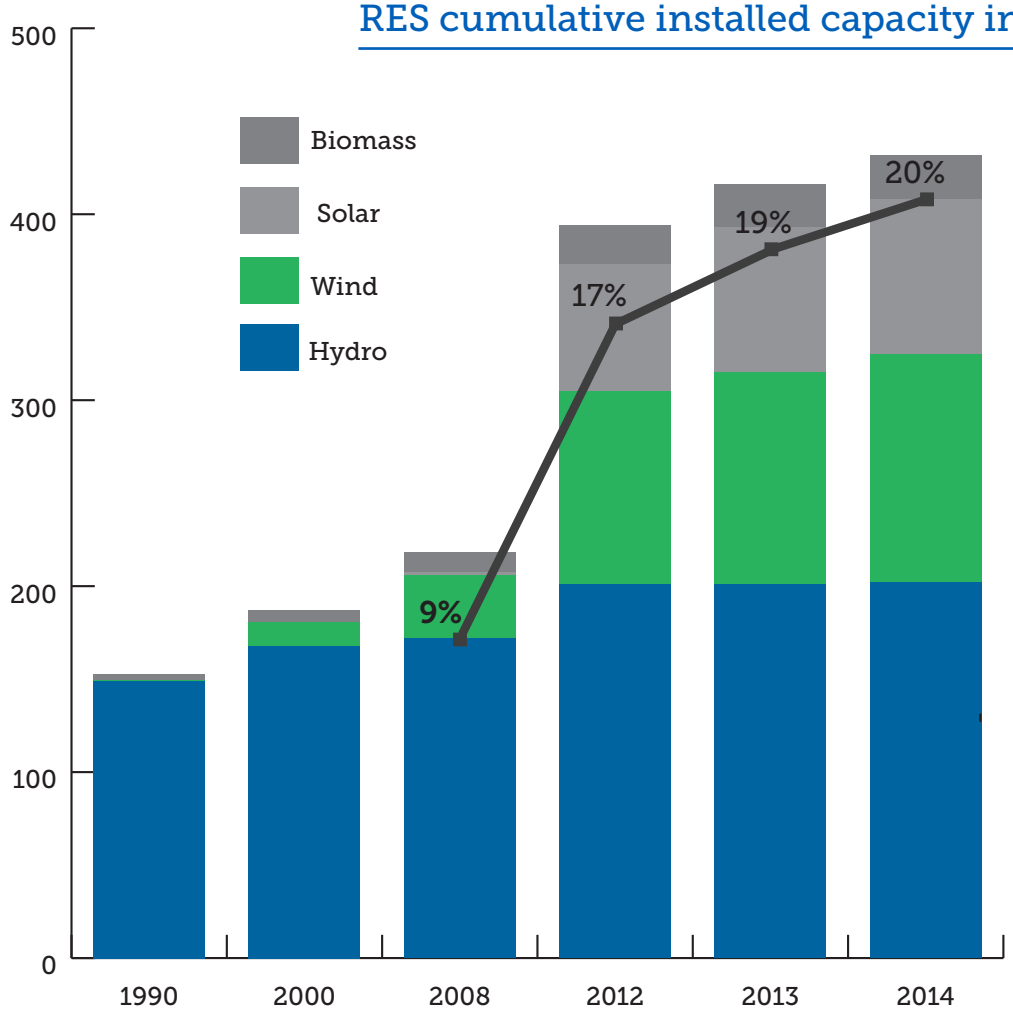


Source: GSE

Electricity generation from Renewable Energy Sources (RES) has grown significantly within the European power sector during the past decade. At the end of 2014, more than 30% of Europe's total electricity generation came from RES (wind, solar, biomass, geothermal, hydro). Although at European level wind and solar generation only, account for around 5% of total generation, this percentage highly varies among Member States.

RES market growth has been driven by a combination of factors, including government policy, rising energy prices and rapidly declining renewable energy costs. The 2009/28/EC Renewable Energy Directive, setting the rules for the EU to achieve its 20% renewables target by 2020, gave a boost to RES development. The Directive specified national renewable energy targets but it was up to each single country to decide promotion schemes. Among the different incentive mechanisms, the ones based on electricity produced, such as feed-in tariffs, variable and fixed premiums or green certificates, have been the most popular. Each mechanism has to be designed taking in due consideration the market fundamentals of a the specific country. Feed-in tariffs for example,

RES cumulative installed capacity in Italy



Source: 1990-2008 Eurostat; 2012-2014EntsoE

the most widespread mechanism at EU level providing for long term price risk hedging, are hardly compatible with a market based approach and are very difficult to correct if not properly set. Motive enough for most of EU countries to switch to variable premiums, favouring renewables market integration even though without completely eliminating the market distortion caused by the incentive.

Generous incentive schemes and declining technology costs made it very attractive for stakeholders to invest in renewable capacity with a skyrocketing increase of installations in a limited number of year. Whereas the renewable sector was experiencing a rapid growth causing a drastic change in the generation mix and dispatching patterns in most countries, European electricity markets, designed for a generation mix mainly based on fossil fuels were shaken, as they did not follow the same fast-changing path. Countries such as Germany and Italy (the pioneers of Solar PV installations) are struggling to integrate a high share of renewables, both from a market as well as from a physical perspective (ability to remotely control RES generation).

Second movers may learn from past policy mistakes and play at an advantage. The type of market in which RES are embedded has a relevant role in determining the best development path. This development has to be consistent with the wider energy policy framework, market design and grid structure, instruments have to be designed to avoid interferences while taking in due consideration the long term design of the wider power sector. Leveraging on European experiences, it is necessary to think of new incentive systems that ensure investments at reasonable costs, are politically credible in the long run and avoid distortions in the electricity market. As a result, "best practices" may be less about adopting existing policies, but rather about combining a wide range of policy design elements into a market fundamental's based policy framework, flexible and well-adapted to the needs of the country.

Designing a Renewable policy is much more than designing an incentive system because all relevant aspects of the market have to be addressed in order to cope with all the potential issues.

The electricity system is going through a period of great change. The regulatory context has changed over a short time, driven by both national and EU policies, with a progressive de-carbonization of the economy.

Globally it was in the 1990s that the issue of sustainable economic development first emerged, especially in relation to the impact that the excessive greenhouse emissions have on the environment. One of the main results of this was the development of renewable energy sources, in particular wind and solar power. Renewables have quickly progressed from a marginal to a significant contribution and are now widely considered to be a core element of domestic and European energy policy.

Italian scenario - The situation has also changed in Italy. Since 2003, there has been a strong increase in the installed capacity from both thermoelectric and renewable sources, with approximately 50 GW of new power, leading to significant levels of available resources. Renewables have recorded growth rates which reach double figures: from slightly over 1 GW installed in 2005 to approximately 27.5 GW today (data provided at the end of 2014). In terms of electricity generation, in 2009 – which marked the turning point in the renewables explosion – wind and PV accounted for 3% of the generation mix, while by the end of 2014 it was at 14%.

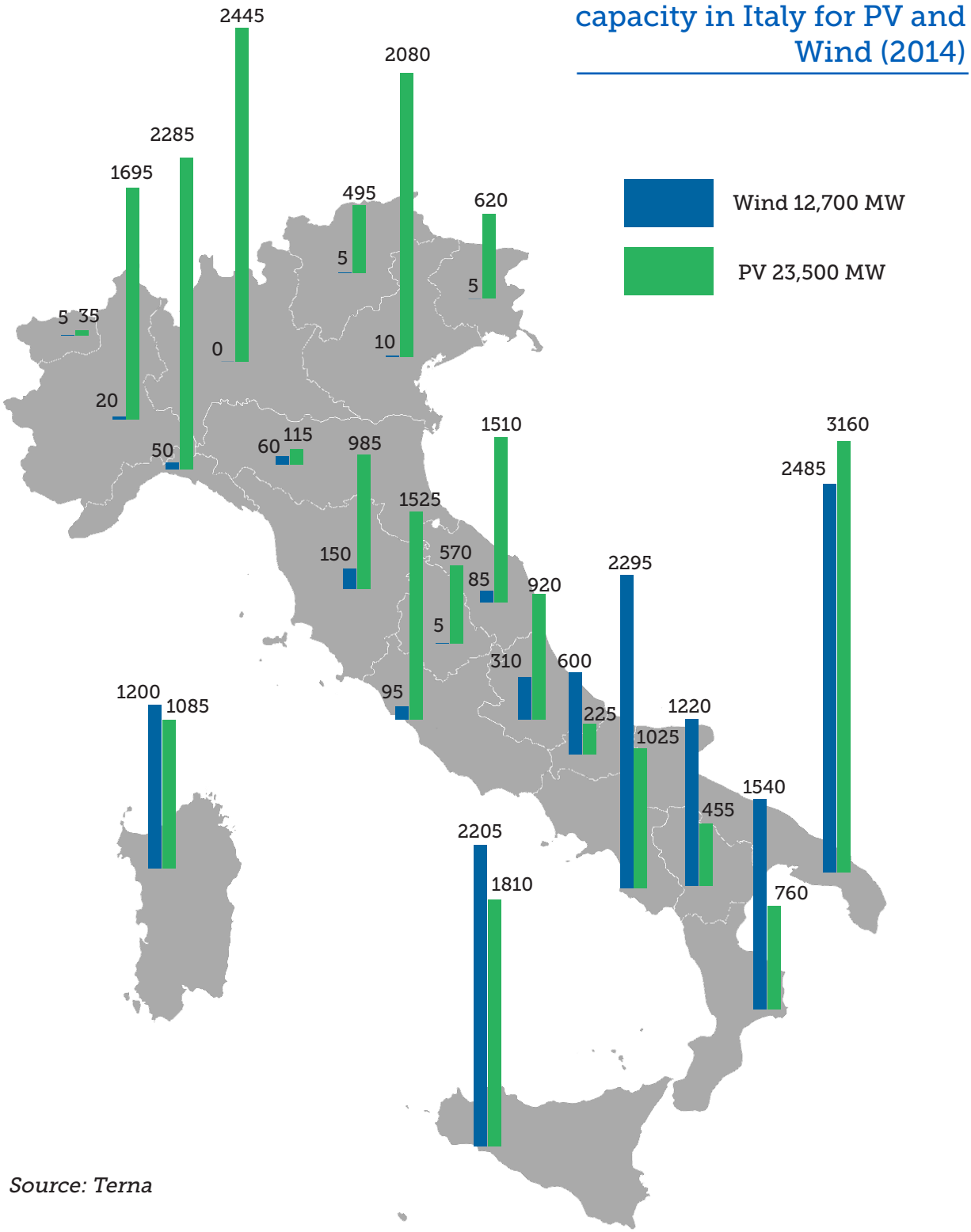
A new challenge - The remarkable growth of renewables and Europe's energy and climate objectives for 2030, set new challenges for grids and power stations, requiring the promotion of scientific debate and a cooperative approach, also involving local communities. The grid is a "friend" to renewable sources and is the only instrument which allows these sources to be fully integrated in the electricity system, "capturing" their full value. The change in generation infrastructure has led to a change of energy flows on the network, resulting in the need to upgrade it so that energy can be transported from the new plants to the place of consumption. The increase in renewables has also required an increase in the reserve capacity, i.e. energy which is ready to be fed into the grid to offset the characteristic fluctuations in intermittent sources.

What role has Terna played - To better integrate renewables, Terna has focused on strengthening, overseeing and monitoring the grid, with investments in technology to balance energy supply and demand and a coordinated management of transmission and distribution grids: the approximately €9 billion investment made by the company since 2005 has allowed Terna to already provide an increase in power capacity of over 27.5 GW generated from renewables, of which 18.8 GW from solar power and 8.7 GW from wind power. Of this investment, €1.3 billion was aimed exclusively at fully exploiting renewables. Terna's contribution is reflected in a series of actions for the security of the electricity system: strengthening the grid and developing more effective systems for automation, programming, monitoring and control. In Italy, most of the wind and solar power plants are concentrated in the south of the country, and far from the centres of consumption; this means that the energy needs to be transported long distances across the country. For this reason, new power lines and new substations have had to be created, and this need will continue into the future. The grid infrastructures that Terna has built and is currently building for the integration of renewables have already brought benefits in economic, security and efficiency terms. But there are also environmental benefits, this can be seen

in the fact that in 2014 renewable energy sources accounted for almost 40% of Italian electricity requirements.

The grids of the future rise to the challenge set by renewable energy - Electricity grids are strategic infrastructures which play a vital role in the economy of a country. The European Union's energy policy also encourages a progressive increase in investments on infrastructure and electrical interconnections between neighbouring countries. Europe needs to invest in infrastructure to ensure security of supply and to support the development of renewables on a large-scale, diversifying energy sources, also in line with environmental objectives. This also applies to the countries of the Southern Mediterranean: policies are needed which encourage the development of renewables and provide appropriate support for development of the corresponding infrastructure. Furthermore, it's necessary an operational cooperation between TSOs and DSOs for system and overall network security.

Renewables generation capacity in Italy for PV and Wind (2014)



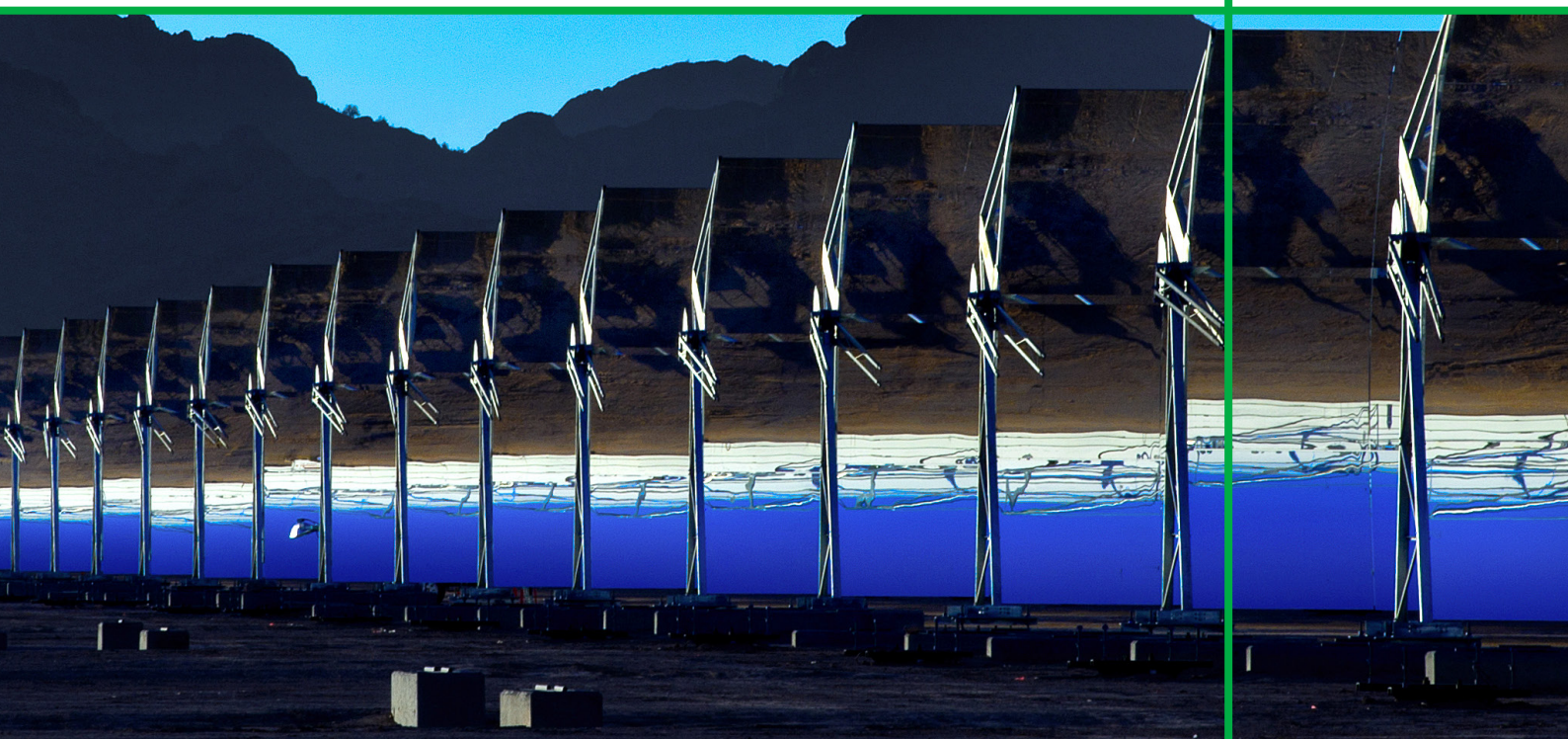
Source: Terna

Med infrastructure: how to meet the energy potential?

The countries of the Mediterranean Basin have been facing new challenges for the development of their Power Systems. On the one hand, the European countries have been putting in place new tools and common practices for planning and managing the System, in order to achieve the European energy targets in terms of market integration and decarbonisation.

On the other hand, the Southern and Western countries have to cope with a rapid increase of the energy demand. The low level of interconnection among these countries, the uneven distribution of the primary resources and the targets for increasing the penetration of renewable energies in the generation mix make the planning process even more complex.

A key-point for an effective development of the Power System is the realization of the interconnection infrastructures necessary to make possible the efficient exploitation of the resources of different systems. In this sense, while for the European countries a clear regulatory framework and common practices for a "European" evolution of the grid exist, the push for the interconnection of the non-European countries among them and with Europe is still too limited. This is due mainly to the lack of the sufficient coordination and of a common legislative framework. For accelerating the integration process, some of the practices and tools developed at the European level could be exported to other countries properly modified considering the specific features of such Power Systems. Among others, the execution of robust and well founded Cost Benefit Analyses for assessing the societal profitability of new investments, as it has been developed in Europe, is a powerful tool for boosting the integration and attracting investors.



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POLITECNICO MILANO 1863

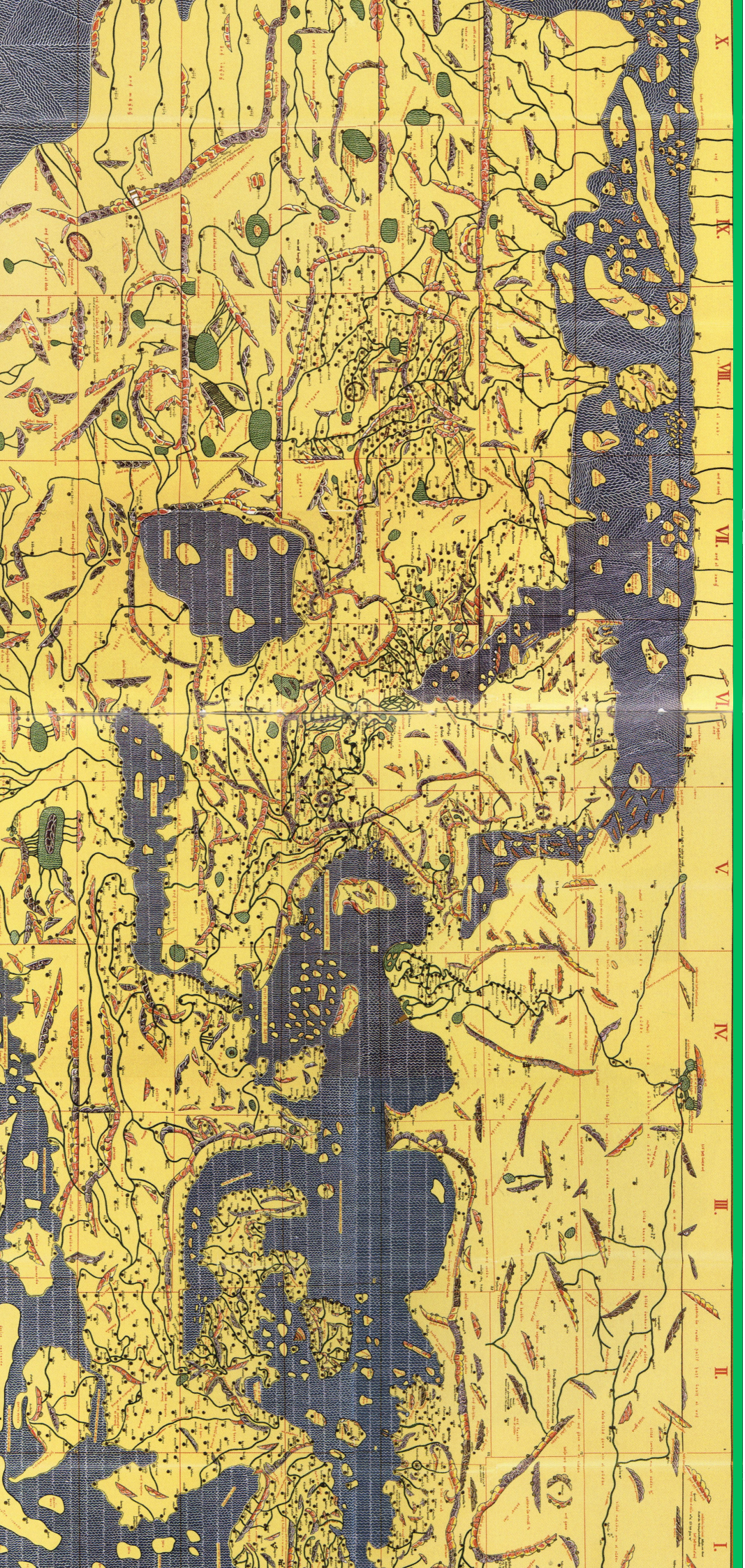
Università Commerciale Luigi Bocconi

POLITECNICO DI TORINO

"What is the Mediterranean?

A thousand things at once.
Not a landscape but countless landscapes.
Not a sea but a succession of seas. Not one civilization, but more civilizations
stacked one on the other. It was not given us as a free paradise, everything
had to be built, often with much more effort than elsewhere.
The Mediterranean is a space-movement."

Fernand Braudel, "La Méditerranée"



About Muhammad al-Idrisi and the Tabula Rogeriana

The Nuzhat al-mushtāq fi'khtirāq al-āfāq (نزهة المشتاق في اختراق الآفاق, lit. "the book of pleasant journeys into faraway lands"), was created by the Arab geographer and scientist Muhammad al Idrisi for the Norman King Roger II of Sicily (two ancient copies are in the Bibliothèque nationale de France, Paris). The book describes the known world, and includes the seventy pages world map, originally on a 100 chilos silver plate.
The map, which you can see on your left, well represents the "upside down" perspective, trademark of RES4MED. As a matter of fact, it is oriented with the South on the top and the North at the bottom, and it was designed for a court in which Muslims, Christians and Jews peacefully cooperated in the middle of the Mediterranean.

Thus, it reminds of how a variety of points of view and a peaceful, cross national, cross religious and cross political collaboration can benefit the whole Mediterranean.
You can then choose how to orient the back cover of this journal, to see the map on the basis of the perspective you would like to take.

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