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Europe's Electricity Networks

How to face growing electricity demand, power generation variability and customers expectations?

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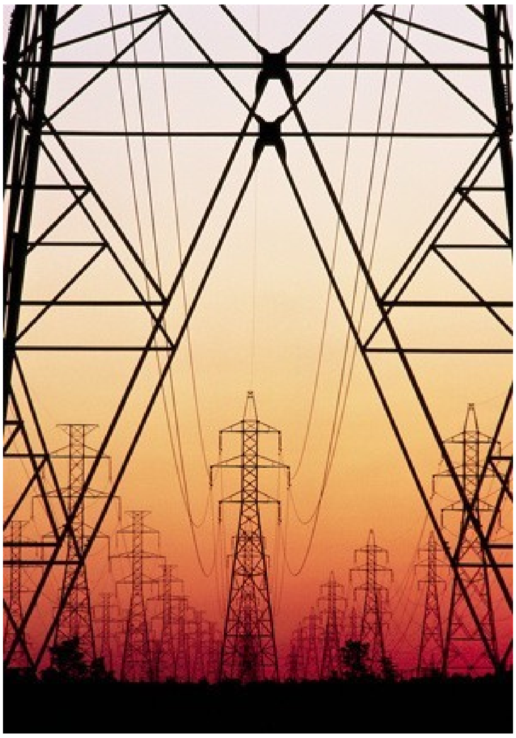

Global demand for electricity is rising. The IEA World Energy Outlook suggests that, in the absence of curtailment, through energy efficiency measures, demand will double by 2030 compared with 2005. As electricity is key to prosperity and progress and as on the other hand the power sector is one of the biggest polluters, a policy is being worked out, worldwide, to secure power supply based on indigenous and/or reliable and sustainable resources to reduce exposure to fuel price volatility, to promote innovation and economic growth while taking on board environmental protection. Renewable energy is one of the contributors to this program. However increasing the share of intermittent and scattered power generation including a number of small or very small power plants implies a new model which should include price to consumers, sustainable production, reliability and technical performances.

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Europe is evolving towards a low carbon society. The power sector could be profoundly affected if this evolution is going on at the current or at a higher pace.

Power generation is likely to be more and more variable and scattered and in some cases in remote places as, for example, offshore windfarms or photovoltaic power production south of Europe.

On the demand side, customers are concerned with information and control over their consumption and could be more active stakeholders in the global power system. They could be at the same time power producer and consumer.

Cities will play an important role. As 71% of the world's carbon emissions come from urban centres, cities are at the front line of the battle for a new low carbon economy. Some cities already launched energy saving projects like Amsterdam and Berlin. The Berlin Energy Agency, a public-private partnership, initiated a project aiming at generating 60% of Berlin's power from co-generation by 2020. Moreover across Germany, a federal programme is boosting the investment in small co-generation units producing less than 50 kW. The number of such units is rising rapidly in Berlin, 50 of them being added in 2009 to some 280 that were in operation in 2008. In Amsterdam, as of September 2009, 700 homes were equipped with smart meters that give consumers a clearer sense of how much gas and electricity they use. However, as an adviser to the city stated: we have new possibilities for sustainability but the network has to be smartened.

IEA (International Energy Agency) expects the aggregate global energy demand to double from current levels by 2020 as well as electricity's share in final energy consumption by 2030.

At the end of 2008, worldwide wind power amounted to 121 GW and the corresponding energy production to 260 TWh and they are constantly increasing. In Germany, the wind power penetration is currently above 7% according to AWEA (American Wind Energy Association). Renewable energy share by 2020 is expected to be 33% of which 15% wind, 8% bio-energy and 4%hydro.

The need for a progressive implementation of a smarter grid has been emphasized by the power cuts that have occurred over the last years. Indeed those outings raised questions about the grid's ability to cope with the addition of intermittent and distributed energy sources or at least demonstrated the necessity for an integrated European electricity network subject to proper regulation.

Power failure in the German electricity grid in November 2006 caused blackouts across Western Europe affecting some 10 million households across Belgium, Germany, Italy, Spain and Eastern Europe , the biggest collapse (through a domino effect) in at least 30 years.

The existing transmission and distribution grids are primarily designed for one way flow of electricity to distribute it from centre to periphery. But electricity generated, for instance, by wind farms and small domestic renewable installations follow the opposite route. With the growing implementation of large scale intermittent renewable energy generation, distributed power production and electrical vehicles, the networks are no longer adequate in Europe.

The purpose of this paper is to discuss the problems and obstacles relating to the improvements of power transmission and distribution and to the transition to smarter networks to cope with the challenges of increasing energy demand, high penetration of intermittent energy sources and distributed generation. It will also comment on the relating European policy.

1. Power grid operation

Today's electricity grid is designed to ensure power flow from centralized supply sources to fixed, predictable loads. The grid systems are commonly run by natural monopolies (national or regional entities) under energy authorities control. A power grid consists of two networks:

- a transmission network which conveys electricity over long distances at high voltage;

- a distribution network that operates at a lower voltage and takes the electricity to homes and businesses.

The European power system has been designed to supply electricity from centralized generation to the end users via the above two networks, using one way communication between utilities and customers. In other words energy flows from the highest voltage to the lowest. This one directional energy flow is the basic concept of all network infrastructures and operational procedures.

The reliability and the continuous availability of the electrical system is a major concern of all industrialized countries. Maintaining the security of supply implies to drastically limit the number of outages and their duration.

Until recently power systems were developed on the basis of monopolistic models integrating generation, transmission and distribution. Each system was responsible for the security of power supply, the regulation of frequency (through primary and secondary regulation) and voltage as well as the availability of power capacities for balancing possible power deficits and the availability of electrical networks allowing extra-power transmission.

The liberalization of the electric markets in Europe (EC 96/92 and CE 2003/54) has led to replacing vertically integrated structures by horizontal ones and resulted in an increased number of players because of : the unbundling, the market opening to competition and the participation of new-comers.

As a consequence, some data and information considered as giving a competitive advantage are not easily available. Moreover some players are focusing on commercial transactions and are not concerned with the physical properties of the electrical system. They consider that it is the duty of the network operators to secure the optimum fluidity of the electrical market.

Moreover competition, environmental concerns, pressure from regulators and uncertainties resulting from local and European legislation induce less investments. To secure a sufficient return on investment the operators tend to run their installations at their physical limits. The reliability of the electrical system is at stake. It is a problem of balancing costs and reliability.

However reduced capacity margins are partially solved by aggregating power systems but this requires to provide sufficient interconnection capacities. This issue is addressed below.

On top of that, during the last decades, the European sector faced a growing opposition against the construction of new transmission lines due among others to the so called NIMBY effect as further explained in the chapter dedicated to the challenges under "social opposition".

The electricity grids that serve European consumers today have evolved over more than a hundred years. However new challenges arising from:

- ageing assets;
- technical breakthroughs;
- renewable energy sources;
- integration of distributed generation and consumers participation in the power business;
- plug-in cars;
- supergrids;
- integrated approach between TSO's and DSO's[1];

call for fresh thinking. Current grids have served well but will not be adequate in the future.

2. Smarter grids

The European electricity system is facing fundamental changes mainly due to:

[1] Transmission System Operator, Distribution System Operator.

- the liberalization of the electric markets;
- the ambitious targets set by the EU aiming at a 20% share for "renewables" in the final energy demand by 2020 with the priority in dispatch given to RES[2] as well as very generous incentives to promote them;
- distributed generation.

The high penetration of intermittent renewable energies resulting from the drive for low carbon generation affects following parameters of the network:

- transient and voltage stability that implies reactive power compensation including;
- dynamic reactive power requirement;
- short-circuit;
- equipment selection;
- power levelling and energy balancing;
- system services also called ancillary services;
- resource and local forecasting;
- system planning;
- power quality;
- network and interconnection capacities.

A proportion of the electricity generated by large conventional power plants are and will be displaced by distributed generation or DG (power stations generating electricity very close to the site of consumption), renewable energy, demand side management and energy storage.

For the transmission system operators, DG entails two major constraints:

> "It is not centrally operated, meaning that the power injected into the network at any given moment depends solely on the needs of one or more industrial processes (cogeneration units) or on weather conditions (wind, photovoltaic, ocean) and/or local demand. In other words, these units are not available to network operation when an increase or decrease in the power generated in a given geographical area is required for the safe operation of the system.
>
> The number of decentralized generators is increasing at distribution network level, the flow of energy between transmission and distribution networks is changing direction depending on the level of generation and demand. Once local demand fluctuates at the same rate as electricity prices, network operators will be confronted with energy flows whose direction and magnitude cannot be anticipated for more than a few minutes, providing the necessary data is available"[3].

Distribution grids will become active and will have to accommodate bidirectional flows. However the global impact of distributed generation on the system only appears when DG penetration reaches a certain percentage of the total power generated.

As an extreme case, a regional network completely fed by DG would be totally out of control because idle power stations would not be able to deliver vital services (system services): voltage regulation, frequency regulation, generation/load balancing. Moreover the slightest short-circuit in the high voltage grid would produce a voltage drop spreading all over the grid because of lack of reactive power.

To overcome the infrastructure and operational challenges resulting from the above, the European electricity grid must be upgraded with smarter technologies, including Flexible AC Transmission Systems (FACTS)[4] and energy storage.

Europe's electricity networks must therefore be:

- *Flexible,* responding to both customers needs and to the above changes and challenges. Sources of flexibility are: the quantity of fast response capacity in the generation portfolio; storage availability; transmission interconnection capacity to adjacent power systems; demand side management (DSM) and response: the potential of consumers to alter their electricity use in response to supply abundance/shortage. Customer tariff systems with incentives are in that respect a big driver.

[2] Renewable Energy System.

[3] "Smart European Electricity Power system for the 21st century", Daniel Dobbeni, CEO of Elia, Belgium.

[4] FACTS is defined by IEEE as a power electronic based system and other static equipment that provide control of one or more AC transmission system parameters to enhance controllability and increase power transfer capability.

Existing regulation is too slow. Currently the frequency regulation requirement as a percentage of the peak load dispatch, should be increased to cope with the integration of wind and solar resources as defined by the EU.

- *Reliable*.
- *Economic*, providing best value through renovation, efficient energy management and level playing field competition and regulation.

This implies:

- harmonizing regulation and commercial frameworks in Europe to facilitate cross-border trading of power and grid services;
- sharing technical standards and protocols that will ensure open access, enabling the deployment of equipment from any chosen manufacturer;
- developing information, computing and telecommunication systems.

The active networks improve the grid operation by efficiently linking power sources with consumer demands allowing both to decide how best to operate in real time.

The purpose of a smarter grid is to implement a modern information technology based network allowing a much better management of supply and demand in real time taking into account, among others, consumers impacting the consumption peaks and the fact that homes begin generating more wind and solar electricity, enabling them to sell surplus energy back to their utilities.

The first step is to install "smart meters" replacing the old electric meters. The objective is to get the consumers more involved into the grid operation. These smart meters enable a detailed analysis of the consumption of electric devices installed in the houses: refrigerator, washing machine, air conditioning and so on.

This kind of information is useful for both the operator who can better anticipate the power demand and for the users who will adapt his way of life by programming himself the time when the appliances are to work. This should be associated with a tailor made pricing, the prices being higher when the demand is stronger. The EU wishes that 80% of the population be equipped with smart meters within 2020.

Using real time information from embedded sensors and automated controls to anticipate, detect and respond to system problems; a smart grid should automatically avoid power outages, power quality problems and service disruption.

"It is expected that DSO's will have a more prominent role in system security in the future and a role in enabling DG to contribute to the system security"[5].

There is a significant need for DSO's to install higher distribution capacity wires and cables. Today in many European countries there are no explicit incentives for expansion and modernization of the transmission and distribution networks through tariff systems. On the contrary, those activities are often regulated through a price cap mechanism with no incentives to encourage quality of services although there is a system of penalties linked to quality of service.

Of course before tackling grid improvements, focus should be made on smoothing the variability i.e. reducing peaks and troughs. Following factors have a smoothing effect on variability:

- system-wide aggregation: if the combined outputs of many variable-RE power plants, based on different resources and located over a wide area, are considered jointly, their net variability is smoother than that of individual plants;
- aggregation of different technologies.

A smart grid implementation is a progressive process (an incremental approach). It will exhibit following key characteristics:

- self-healing and resilient. A smart grid will perform real time self assessments to detect, analyse and respond to subnormal grid conditions. Through integrated automation, it will self heal, restoring grid components or entire sections of the network if they become damaged. The modernized grid will increase the reliability, efficiency and security;
- integration of advanced and low carbon technologies;

[5] Eurelectric.

- plug and play scalable and interoperable capabilities. It will permit a higher transmission and distribution system penetration of intermittent energy and distributed generation;
- improved management: in the event of a peak in demand, a central system operator would potentially be able to control both the amount of power generation feeding into the system and the amount of demand drawing from the system;
- asset optimization and operational efficiency;
- consumers inclusion: engaging them as active participants in the electricity market;
- power quality.

3. Challenges

The need to strengthen Europe's electricity networks, to meet growing electricity demand, to support rational use of energy, to develop a trans-European electricity market and integrate more distributed sustainable generation resources, present major challenges. This is all the more true that a number of studies on integration of large levels of renewable energy concluded that above 15/20% intermittent renewable energy penetration levels, traditional planning and operational practices will not be sufficient. And with about 933 TWh of RES generation in 2020, compared to 3,657 TWh of consumption by that time, about 25% of power demand in the EU will be supplied by RES with a large percentage of intermittent RES.

A survey conducted by Euroelectric shows that DSO's do not always support the same view (as for example the choice between the whole smart grid concept or only components of it, e.g. smart metering) although a smarter system is felt to be a necessity for the integration of distributed generation, intermittent energy sources and so on. The implementation of smart grids is facing a number of challenges.

Smarter power system implementation phasing

A smarter network concept represents a paradigm shift in the electrical world. This is in itself something of a barrier as it must evolve from the existing system which cannot be simply turned off while necessary upgrades are installed. There is a limited ability of the utilities to rapidly transform their business and operational environment to take advantage of smart grid technologies.

A new approach to managing power systems will need to develop over time that includes more interchangeability: electricity customers who could also be micro-generators which implies system balances or distribution network operation that becomes more and more similar to high voltage transmission grid. A major focus of TSO's is to ensure coordinated operation in a more complex future grid and operation procedures especially in emergency conditions.

However it should be kept in mind that enhanced market rules and mechanisms can prove up to a certain point, cheaper and quicker solutions to remove congestion for instance than grid development.

Investment paradoxes

New variable energy (var-RE) projects may have difficulty to finalize without first having secured access to transmission (smart or not). On the other hand, without some guarantee of new power capacity, transmission owners have no incentive to build new transmission lines. A vicious circle develops, postponing development of new generation as both power production and transmission developers fear a stranded asset should the other fail to materialize.

On the other hand the uncertainty related to the stochastic behaviour of intermittent RES, the lack of visibility of future RES, the possible change of energy policy promoting heat production instead of renewable power generation or the possible formation of a "renewable" bubble are some more parameters that make investment decisions in power transmission risky.

The investments in European transmission capacities are too low. If the EU keeps on that pace, network saturation and/or instability will lead to increased energy costs. Member states gave so far few indications about incentives for smart systems and for harmonizing the different markets organizations.

Recent experience showed that this deficit in investments is jeopardizing the development of sustainable energy: the average overall design, permitting and construction time of wind farms is about three years whereas it takes up to 10 and even 15 years to build new transmission lines.

Stable frameworks and optimum allocation of risks between customers, utilities and governments will be the key to accessing the cheapest capital possible.

Cross-border connections

In spite of the key importance of electricity transmission, the amounts invested in efficient cross-border power infrastructures in Europe are rather low. Only 5% of the yearly investments for the electrical networks in the EU, Norway, Switzerland and Turkey are allocated every year to increasing cross-border transmission capacities. Because of lack of investments in power lines (cross-border and domestic) each national power market will have to provide more additional production capacity to meet unexpected peak demand or generation shut-down[6].

On the other hand the increased use of international interconnections among power systems for every day system balancing, increases the need for collaboration among adjacent system operators. Regulating compatibility among national/regional interconnected systems may be assisted by a formal regulating body with powers extending over the whole area covered such as the FERC[7].

Most European transmission projects are late. Causes for delays are:

- complexity of planning and permitting
- procedures which varies from member state to member state. This is the case when several Authorities are concerned or in case of long permit procedures because of consultations;
- financing difficulties in particular relating to integration of green electricity or cross-border connections;
- delays in cross-border capacity increase by some grid operators because of inappropriate incentives or due to reluctance of vertically integrated utilities to damage their own business.

Social opposition

"The implementation of the required grid reinforcement or construction of new transmission capacities turn out to be more and more difficult due to affected local communities and their representation or environmental organizations. This social opposition usually comes on top of already long and complex permitting procedures"[8].

This situation endangers the timely completion of infrastructure projects and the achievement of the European policy targets. The use of underground cables can speed up the permitting process although at a cost.

Another important issue within the permitting process is the public acceptance of new transmission lines due to the electromagnetic field concerns.

Regulation

Large intermittent renewable energy penetration requires increased regulation.

Due to their large time constants, wind turbine generators can hardly contribute to primary regulation. Their contribution to the secondary regulation is technically impossible for some types of wind turbines (e.g. the

[6] Communication of the Commission to the European Council and Parliament, sec(2007)12.

[7] Federal Energy Regulating Commission, USA.

[8] ENTSO-E,"ten years network development plan 2010/2020" , March 2010. This situation endangers the timely completion of infrastructure projects and the achievement of European policy targets. The use of underground cables can speed up the permitting process although at a cost. Another important element within the permitting process is the public acceptance of new transmission lines due to the electromagnetic field concerns.

ones provided with a stall pitch control) and difficult to implement for the other ones. If it is technically possible for wind turbines operating at variable speeds and provided with fast pitch actions and with appropriate alternator, to adjust their production according to the EMS[9], such contribution raise a number of questions:

- who will be paying for the lost production?
- who will be refunding the loss if the wind turbine owner is unable to deliver the production?
- how will the priority be managed between several wind farms which will be asked to reduce their production?

It should be noticed that "load following" related problems are the most stringent ones and constitute the most restricting factor for large wind power penetration since the magnitude of existing thermal generators like steam and gas combined cycle power plants have limited flexibility and technical minima. Also the start-up and shut-down periods needed are usually rather long and do not allow frequent start/stop to avoid premature ageing of the equipment.

"Wind penetration has also severe effects at the DSO's level, i.e. the medium voltage networks. The main issues concern local effects on power quality and windturbine generators" (WTG's) performance during disturbances. These disturbances are of two types:

- disturbances during the normal system operation (mainly voltage dips) since various factors contribute to voltage fluctuations at the terminal of a wind turbine;
- disturbances resulting from faults (short circuits).

More specifically, during the normal system operation the following may appear:

- slow voltage variations due to change in power flows when the WTG's are switched on/off;
- fast voltage variations due to changes in wind speed; these variations of voltage amplitude may cause "flickering" effects;
- short duration voltage dips during switching (on/off) of the WTG's;
- voltage distortion due to harmonics.

During network faults, the presence of WTG's can lead to:

- malfunctioning of protection equipment since it is designed to operate within strictly radial structure of the network;
- increased stress of circuit breakers since the short circuits are additionally fed by the WTG's;
- islanding of parts of the grid fed solely by WTG's which might cause failure of the end-use equipment. Such phenomena are more possible in the presence of high capacitance equipment (such as cables)."

Technology

A smart grid brings together a number of technologies at different stages of their maturity lifecycle. In some cases technologies could have significant risks because de facto or agreed standards have not emerged. Further technological developments are still needed for a smarter operation of the power system as for example in power storage.

Energy storage is essential for mediating against intermittent power production, ensuring continuous supply, increasing energy autonomy and expanding distributed generation. Storage mitigates the consequences of mistakes in forecasting, removes barriers in connecting renewable sources to a variety of grids, shifts demand peaks by storing off-peak energy to sell back to the grid during peak times and could avoid expensive grid upgrades.

However technologies like condensators, electrochemical accumulators, inductances and compressed air storage in underground cavities (ADELE[10] pilot plant is expected to start up in 2013) need further research for profitable industrial applications. Denmark is studying the possibility of huge sea water reservoirs to store wind power. An atoll of 23 km² could store 160,000 MWh and would be provided with turbines totalling 5,000 MW, an investment of 6 billion EUR.

[9] Energy Management System.

[10] RWE, General Electric, Zublin and German national central for spatial research.

Further developments are also required for power electronic in new production units, Flexible AC Transmission System (FACTS), Flexible Line Management (FLM) and operating IT.

Digital communication networks and more frequent information on consumption patterns raise concerns about cyber insecurity and potential misuse of private data. These issues are not proper to smart grids but are cause for concern on what is a critical network infrastructure.

Another challenge concerns the use of underground cable and overhead line in a "meshed" system because they have different transmission properties.

Research

There is a deficit in research and development too often considered as an expenditure that can be avoided in the short term, and as risky in terms of return on investment. Nevertheless it is of the essence :

- to analyse the impact of intermittent and distributed generation on grid operation costs;
- to optimize DG operation (system services, power storage);
- to evaluate the impact of DG on operation costs of centralized generation;
- to assess the contribution of DG and intermittent energy sources on the power system reliability and voltage quality.

4. Super-grids

Besides the development of smarter grids, a complementary way to address the challenges described above is the construction of supergrids.

Indeed aggregating power systems offers among others the advantage of sharing reserves on a wider scale and more flexibility. Small supply and demand areas are more vulnerable to interruptions in supply and unexpected changes in demand. It may thus be economically efficient to seek an European solution for balancing power rather than national ones. For instance, the massive amount of fast controllable hydropower in the Nordic and other mountainous countries of Europe could be used as real time balancing power for those areas where a large part of electricity generation could be provided by non-controllable primary energy.

However the expansion of a synchronous area beyond a certain size brings less and less technical advantages whereas drawbacks may increase.

A number of super-grids are under operation or being studied in Europe:

- *The Nordic power market* which includes Denmark, Sweden, Norway and Finland. It has facilitated very strong wind energy development in Denmark as the Danish can rely on Norwegian and Swedish hydropower for balancing.
- *Baltic-Nordic network* consisting of: creating an integrated electricity market connecting Estonia, Latvia and Lithuania together; and increasing link between Denmark, Finland, Germany, Sweden, Poland and the three Baltic countries.
- *North Sea super-grid*. Within 2020/2030, windpower could reach 68,000 MW in the North Sea and supply 13% of the current electricity demand of the seven neighbouring countries: UK, France, Belgium, the Netherlands, Germany, Denmark and Norway. To enable the system to operate properly, the windfarms should be interconnected through an undersea cable network. Such a project would contribute to solving the problem of power fluctuation and improve the predictability of windpower. Indeed if, for example, wind is weakening off the Belgium coast, a Danish windfarm could take over. In this way balancing can be attained while limiting instability risks. All the more so that the grid would be interconnected with Norway with its large hydrocapacity. This latter could be

a buffer absorbing the excess production of windturbines when demand is low or compensate for a deficit of power generation.

Other projects have been studied around the Mediterranean sea. Another technical feasibility has been conducted by the Europeans and the Russians on the synchronous interconnection between the EU and Russia.

5. Conclusions

Today’s electricity grid is designed to ensure the flow from centralized supply sources to fixed, predictable loads. Until recently power systems were developed on the basis of monopolistic models integrating generation, transmission and distribution. Each system was responsible for the security of supply, the regulation of frequency and voltage and the availability of power capacities for balancing possible power deficits and of electrical networks allowing extra-power transmission.

However the European electricity system is facing fundamental changes because of:

- the liberalization of the electric markets;
- the (too) ambitious targets set by the EU at a 20% share for “renewables” in the final energy demand by 2020 with the priority in dispatch given to RES as well as very generous incentives to promote them;
- distributed generation.

It results from those changes that Europe’s electricity networks must be strengthened and adapted (two-way interactions between generation and demand as well as more sophisticated regulation to integrate intermittent and distributed power supply). Moreover, competition, environmental concerns, pressure from regulators and uncertainties resulting from local and European legislation induce less investments. To secure a sufficient return on investment the operators tend to run their installations at their physical limits. The reliability of the electrical system is at stake.

Although it is well known for quite some time that interconnections and power grid strengthening are key to a single market and to the security of supply and, in spite of the fact that EU decision makers are well aware of it since the launching of the initiative called Trans-European-Networks for Energy (TEN-E) to identify priority projects in the late nineties, it is only in 2009 that real money is being invested for such projects. The EU governments finally agreed to engage cash for electricity (and for gas) interconnectors as a result of the economic crisis to help EU’s economic recovery.

Effective smarter transmission and distribution systems should follow a holistic approach covering generation, demand, transmission, distribution and stakeholders expectations and requirements and should integrate the growing needs of var-RE and conventional power plants in design as they are likely to overlap. This means among others “that system protection schemes, data collection, communication and analysis, planning and operation practices have to be reengineered and that transmission grids will have to take advantage of the best geographical locations for hydro, wind, wave, solar or biomass electricity generation”. Such an approach is essential to avoid repeating some incoherent policies relating to “renewables” and in particular to intermittent energy generation.

This is all the more true that the smarter grid must evolve from the existing system which cannot be simply turned off while the necessary upgrades are installed. There is a limited ability of the utilities to rapidly transform their business to integrate smart grid technologies.

Moreover grid reinforcement or construction of new transmission capacity turns out to be more and more difficult due to an increasing lack of public acceptance. This social opposition comes on top of already long and complex permitting procedures. Unfortunately member states gave so far few indications about incentives for smart systems and for harmonizing the different market organizations. The Commission should be more pro-active. A case in point among others relates to common standards to ensure that infrastructure and system for charging electric cars can be used by everyone. The recharging infrastructure is moving faster than the roll-out of vehicles without coordination between the member states.

The uncertainty relating to stranded costs, the stochastic behaviour of intermittent RES, the lack of visibility of future RES, the possible change of energy policy promoting e.g. heat production instead of renewable power generation or the possible "renewable" bubble, are some considerations that make investment decisions in power transmission and distribution (very) risky.

Before embarking on such a risky journey, enhanced market rules and mechanisms (and energy saving) can prove up to a certain point cheaper and quicker solutions to remove congestions and improve grid operation.

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