Report

The European grid needs to be modernised and expanded to continuously allow for a secure provision of electricity while integrating an increasing share of energy from renewable sources. Already today, the existing grid is often operating at its limit and immediate action is needed to fix current shortcomings. In addition, a grid for the longer-term perspective of a largely renewables based future has to be developed.

Doing so has to be the joint effort of a large and diverse group of stakeholders for two reasons:

1. Bringing together representatives from different experts fields will allow to develop robust future demand, consumption, generation and transmission scenarios based on thorough knowledge. Potential alternatives such as different grid technologies, energy efficiency, different storage opportunities, decentralised solutions, smart grids etc. can be thoroughly discussed and their suitability to reduce the need for new grids can be duly considered. Furthermore, transparency can be increased whether grids are really needed for an increased use of energy from renewable sources vs. fossil fuel or nuclear power.
2. Involving the broader public, especially via civil society organisations, will support that societal knowledge and societal values are reflected in an appropriate way. This will help to avoid the impression that the developed roadmap is the result of the cooperation of an "elite inner circle". Active support and promotion of the determined need for grids by trusted civil society organisations will become possible.

The chances to built the needed grid is hence increased on two levels: first because the "minimum" needed amount of grids is identified, thus reducing the overall need for new grids. Second because by assuring only those grids are being built that are really needed resistance will be reduced. Projects are less likely to fail due to opposition at later stages.

There is unfortunately no off-the-shelf solution available which would tell how to do the joint planning of such a complex topic. The current lack of experience on how to organise such a process can only be overcome by taking a learning-by-doing approach to move ahead on this.

First steps of joint grid determination are being made and allow to gather the required experience. The two most comprehensive an prominent examples are ENTSO-E's approach to develop a European ten-year-net-development plan (see www.entsoe.eu/index.php?id=185) and the new legislative procedure introduced in Germany (see www.netzentwicklungsplan.de) to identify grid requirements of national priority. While currently showing room for improvement both in terms of time horizon covered and regarding the implementation of participative measures, both approaches can be considered important steps in the right direction. They increase early stakeholder involvement, transparency and offer opportunities to participate for different stakeholder groups.

A need that has been determined at EU or national level will affect populations at an often much later point in time. Usually, the realisation of being individually affected by a grid project raises concern and an inclination to oppose. While there would be good reason to be proud and in favour of the service that a working electricity grid provides, grids are perceived as a burden so far. Assuring that the need for the grid has been determined via a transparent and legitimate process as introduced above, is one cornerstone to prevent some of the opposition. Additionally, it is important to involve stakeholders at the local level from an early point in time, to actively respond to their worries and concerns by being transparent and take their suggestions and propositions into consideration where possible. In addition new ways that help to create positive identification with grid projects should be established, such as allowing the public to invest in grids or other tools of benefit sharing.

Data transparency is an important element to successful need determination and implementation of grid projects on a variety of levels:

- High transparency of technological and load data allows for better knowledge based grid planning so to assure that neither too much nor too little grid is planned.
- Real-time data on generation and consumption allow to reduce insecurity on what is happening in the grid. Reserves that are needed to balance out unexpected events can be reduced and energy from renewable sources can be better integrated. Exchange of such data over a wider geographic area increases the resilience and efficiency of such a system. The optimal usage of the grid is thus supported.
- Data transparency on load flows also allows to demonstrate an interested public that there is a concrete need to expand energy grids and to overcome a concern of "secretiveness".

Sharing data with external stakeholders is again a topic for which the right approaches have to be found. Client confidentiality, business secret and technical and format issues have to be solved. Again, steps are being taken on a variety of levels (e.g. new data sharing legislation in Germany, voluntary initiatives by TSOs) and important learnings are being gathered at the current stage.

Summary of presentations

Welcome Speech – **Lex Hartmann,** TenneT

In his welcome speech, Lex Hartmann shared his views on the challenge that the German energy turnaround (Energiewende) causes. Many perceive the Energiewende as a decision for the increased integration of energy from renewable sources. In reality it has been a very fast decision against nuclear, initiated without a clear plan on the further proceedings. Due to this shortcoming, German provinces currently develop their own plans on future energy generation and transmission. This results in an accumulation of plans that are neither necessarily reasonable nor feasible from the holistic perspective.

In this context, TSOs have a key role in assuring that a more holistic and consistent plan is being developed. This plan has to take into consideration the viewpoints of different societal stakeholders. Since this responsibility is new for TSOs they have to grow into it. Mr. Hartmann underlines that while important steps have been made, TSOs as monopolists have traditionally little incentive to innovate. They therefore welcome the push by civil society and research institutes to address grid expansion challenges and provide innovative solutions and through this accompany TSOs on their journey.

Welcome Speech – **Antonella Battaglini,** Renewables-Grid-Initiative

In her opening speech, Antonella Battaglini pointed out that Europe needs an energy grid that integrates energy from both centralised large-scale and decentralised sources. Depending on who is being asked, different statements are made on how much of which type of grid is needed. This causes a problem on two levels: first, because the question which grids are really needed remains without a robust answers. Second, because the resulting doubts lead to opposition against grid projects.

It is therefore essential to find ways of jointly defining the need for grids. Only if a big group of stakeholders from different parts of society is involved in the discussion and able to share both expertise and opinions on how a future grid should look, it will be possible to come up with robust answers.

Throughout the later discussion, Antonella Battaglini in addition underlined that while the grid is currently at its limits and the "patient has high fever", it is insufficient to only deal with the symptoms. Hence, the current mandate for TSOs to assure stability and secure supply within national borders will not allow to solve issues over the long-term. Instead, it is essential to implement a multi-stakeholder approach with a European perspective to define what energy mix we, as a society, want for the future and discuss how to realise this future.

What future for the European power grid – **Prof. Dr. Carlo Jaeger**, Global Climate Forum

Carlo Jaeger started by noticing that power grids are achievements of humankind on a par with agriculture, harbours, cities, etc. Nonetheless, there is little pride and recognition that these grids are an integral part of our global culture. The problem is not how to explain to people that they must accept the nuisance of power lines because they are necessary to provide the pleasures of modern consumption. The task is to develop the grids of the future as a piece of our shared heritage, something people identify with as the Dutch identify with their polders or the Japanese with their Shinkansen. This task is especially urgent in Europe, where in the Euro-crisis the sense of a shared heritage is rapidly fading – together with the capability to solve common problems.

Securing future energy supply – based to a large extent on renewables –is such a common problem Europe is facing. It is a problem democracies are perfectly able to solve, but only if there is an open and honest debate about how to define the problem, what alternatives to consider, and why some should be discarded, other ones pursued. With regard to the European power grid, such a debate is still missing. The Renewables Grid Initiative is amongst the pioneers that deserve credit for starting the necessary conversation.

Of course, for public debates to be effective they have to be geared to concrete actions. With regard to the European power grid, such actions need to enable European citizens to experience that citizenship as real and that grid as "our grid". An example of such an action: issuing financial assets for internet investment in selected interconnectors between the power grids of different countries, combined with European project bonds for those interconnectors. This can connect the prospect of a safe financial asset for people who usually don't invest in such things with a debate about the relevance of the power grid for the energy systems of the future.

Why we need grids NOW - a technical perspective – **Carsten Siebels**, TenneT

To illustrate the insufficiency of the current grid situation, Carsten Siebels showed the increase in the amount of instances that require an active intervention in the grid in the control area of the German TSO TenneT. Caused by both the nuclear phase-out and the increasing share of generation from renewable sources, an exponential growth of interventions can be observed (2003: 2 interventions , 2004: 15, 2005: 51, 2011: 989, 2012 - Q 1: 300).

The projected further growth of offshore wind farms and decentralised renewable power generation additionally drives the need for grid modernisation and expansion.

For offshore wind-farms, currently grids that allow for transmission of 460 MW are in operation in Germany. 5,300 MW are contracted/under construction, 2,700 MW have been tendered. Furthermore, in 2011 about 20 % of electricity supply came from decentralised renewable energy sources (RES). For 2022 different scenarios with 40-60% of RES exist.

An increase in usage of RES will regularly request to export power when generation exceeds demand and import power when generation is below demand. To handle this a grid which covers large geographical areas is needed. Connecting only directly neighbouring regions with similar generation and consumption patterns cannot balance the situation.

Mr. Siebels concluded that not only the security of supply would decrease if no new grids were built under these circumstances, but also load shedding and costs for Redispatch would increase and installed RES power would not be usable.

Challenges in exchanging data between TSOs - Coreso`s experience – **François Boulet**, Coreso

Coreso is an organisation, which provides operational coordination services to TSOs to improve security of supply levels in Western Europe. As François Boulet described, this is done by pro-actively assessing the security level of the network, proposing coordinated actions to TSOs and coordinating the agreement on remedial actions.

This activity requires detailed data across Europe. Coreso does not hold its own data but uses data provided by the TSOs. This causes challenges on various levels such as complex database management, dependence on data quality and punctual provision of data, limitations of file formats data configuration and IT security.

Beyond the technical challenges, looking at the European perspective implies a new way of cooperation for the TSOs. This is partly perceived as a disturbance as visions within TSOs can differ and political difficulties can arise. In addition, data sharing has to respect confidentiality requests both between TSOs and towards generators. This will always limit transparency. Mr Boulet mentioned that full disclosure of data among TSOs and energy providers could not be expected to be voluntary, in particular regarding the prices of power generation, as the resulting EU-wide competition could drive some companies out of business. This reluctance should be taken into account by regulators who want to promote grid and market integration in Europe.

Mr. Boulet stated that even though data quality is fairly good at this stage, more would be needed in the future. In his view, the definition of suitable network codes is essential to overcome confidentiality vs. transparency issues.

Overview on the current roadmaps and developing a European scenario – **Dr. Enrique Gaxiola**, IRENE-40/Siemens

Enrique Gaxiola introduced the IRENE-40 (Infrastructure Roadmap for Energy Networks in Europe) study. The EU market liberalisation, unbundling and the intention to significantly increase the share of energy from renewable sources drive the need to build a pan-European, multi-GW flow overlay power network. Investment decisions need to be taken today, which will define system aspects of the next 40 years. It is therefore essential to choose efficient technologies and to build a transport grid that reduces the overall cost to provide electricity to European customers. Informed policy developments are a prerequisite to create the necessary confidence for investments in this future grid infrastructure. While a multitude of different studies on European Energy roadmaps is available, they lacked the detailed analysis of how different grid technologies can contribute to a future European energy system based on renewable energies. The IRENE-40 study was commissioned by the EC to close this gap.

As part of the IRENE-40 study, a database on currently available and deployable transmission network technologies was created and strategies on their future deployment developed. The study looked into three network benchmarks with five referenced generation & demand scenarios for possible future infrastructure development. It compared system characteristics such as CO_2 emissions or capacity of main EU transmission corridors and costs. It identified suitable market and investments structures to move towards the renewable energy scenario and proposed incentive strategies to trigger this. The expected final outcome of the study for September 2012 is an analysis of when and where grid networks will have to evolve and which technologies shall be further developed and deployed to support this.

Germany's new approach to consultative need determination and net development planning - TSO perspective – **Marius Strecker**, TenneT

Marius Strecker introduced the new German approach for grid development plans. The plan has a 10-year nation-wide scope, considering the onshore transmission grid, integration of renewable energy sources and development of the European power market. It determines need as required starting and end points – corridors and routes are not yet covered.

Mr. Strecker stated that the plan is an important contribution to realise the German energy turnaround. The identified necessary major expansion and enhancement of the grid needs the cooperation of politicians, TSOs and society. To achieve this, the new process approach has increased instances for public participation significantly. All in all, consultations rounds are now carried out on the scenario framework and the first and second draft of the grid development plan. This was an important step in the right direction. Nonetheless, especially with respect to creating and consulting on the scenario framework, both the time granted by the regulator for doing the required calculations and participation were clearly challenging.

In the future energy scenario that has been selected, the main focus is on efficient north-south connections. Grid reinforcements and optimisations are required on existing routes over a length of 4,400 km. The new construction requirements include 1,700 km of three-phase line routes and 2,100 km of corridors for high voltage direct current lines. The total investments in the next ten years for the expansion of the transportation system amount to approximately 20 billion Euros.

To actually build this grid, further political support and backing is needed. This includes appropriate investment frameworks, ongoing consensus on the "if" and "how" of building the grids and a regulative framework that allows for timely approval procedures.

Germany's new approach to consultative need determination and net development planning - NGO perspective – **Dr. Peter Ahmels**, Deutsche Umwelthilfe

Dr. Peter Ahmels shared his impressions on the new approach for a grid development plan from an NGO perspective. He underlined the importance to set up a dialogue process with all stakeholders, to enable more participation and to duly consider all options to reduce grid expansions.

Dr. Ahmels agreed that the new approach is a significant step towards defining the need for grids in a joint exercise. It is therefore very much welcomed by the NGO community. However, as with any new procedure, this is a learning process and therefore areas for improvement exist for future consultation rounds.

He specified that in the consultation on scenarios, completeness and quality of information and data initially provided was not sufficient to allow for a substantial evaluation. This included data on electrical work or CO_2 emissions and information regarding data sources. Some of the underlying assumptions were questioned by the NGOs. Secondary regulations regarding the future energy concept and the share of renewables were added to the plan based on the input given by NGOs. To allow for this, the time granted for discussion and adjustments had to be extended.

Dr. Ahmels furthermore underlined that in future plans it should be communicated which changes were accepted, which were not and why.

Stakeholders involvement in ENTSO-E`s TYNDP 2012 – **Michael Mieszczanski**, ENTSO-E

Michael Mieszczanski explained the role of ENTSO-E in European net development planning. ENTSO-E is an association of 41 TSOs, in charge of a trans European network serving 532 million citizens. It is legally mandated to develop a TYNDP every second year, which among others covers a generation adequacy outlook, modelling of integrated networks, scenario development based on reasonable needs of system users, identification of investment gaps and barriers to cross border capacity development. The TYNDP takes into account national TYNDPs and regional investment plans. The consistency between those different plans has to be checked by the Agency for the Cooperation of Energy Regulators (ACER).

The procedure to develop the TYNDP is designed as a participatory process. Consultation for the current TYNDP 2012 and the corresponding background scenarios has taken place via several Brussels based workshops and six regional workshops involving more than 300 participants. The official public consultation was run between March and April and triggered 200 comments from 20 organisations. In addition, interventions took place at two dozen events and conferences across Europe.

The TYNDP 2012 foresees 100+ relevant projects, corresponding to the refurbishment or construction of 52,000km of power lines or cables across Europe. The TYNDP considers only projects of European significance. Costs are estimated to add up to € 104 bn. 80 % of the foreseen asset growth is triggered by RES. Due to permitting, financing and public acceptance issues, one third of the ongoing projects are presently delayed.

EU grid planning – challenges and solutions – **Daniel Fürstenwerth**, Renewables-Grid-Initiative

Daniel Fürstenwerth pointed out that grid planning, which is done at the EU level today will affect people across Europe only at a much later stage. This will however not prevent population to ask questions on the plans, especially regarding how the need for a specific grid project was determined. Answering these questions in a satisfying way is challenging, as EU grid planning is a complex task: EU-wide coordination between 27 member states is required, future scenarios on energy generation are unclear and may change and a single best solution for grid development is difficult to find.

It is therefore necessary to put special attention on developing legitimate decision processes The need identified at EU level has to be explained to an affected population as the outcome of a planning exercise done by a multi-stakeholder group in a comprehensive procedure which duly covers the different questions. Consistent objectives, transparent and participatory planning, active dialogue and stakeholder involvement and full adherence to EU environmental legislation will support legitimacy of the grid planning process and enhance acceptance at later stages in grid implementation.

The CECRE: Making renewable energy technologies compatible with the security of the system – **D. Jorge Hidalgo López**, Red Eléctrica España

In 2011, 46,7 % of installed capacity in Spain was based on renewable energy sources and more ambitious growth targets have been defined (2011 to 2020: wind 20,775 to 38,000 MW, solar PV 3,977 to 8,367 MW, solar thermoelectric 1,150 to 5,079 MW).

As Jorge Hidalgo explained, limited transmission capabilities to neighbouring countries (3 %) make Spain an "electrical island". This together with the differences between peak (av. 45 GW) and off-peak demand (av. 19 – 25 GW) and the start up time of solar thermal power plants are the main challenges that Spain has to face integrating renewable energy. Nonetheless, the system has been operating sometimes with more than half of its demand covered by renewable energy (maximum coverage of the demand was 60 % on the 16/04/2012).

Observability of generation from renewable sources is one of the main elements that allow managing the complexity. Real time information allows to come up with reliable production forecasts and to avoid demand forecast errors . As a result, the required level of reserve to dispatch manageable generation and so to compensate the variability of the renewable energies can be reduced.

In Spain this has been achieved as a result of the aggregation of all the distributed resources of more than 10 MW in the 'Renewable Energy Source Control Centres' and the connection between them with the 'Control Centre for Renewable Energies of Spain (CECRE)'. This hierarchical structure, together with the applications used to analyse the maximum renewable generation supported by the system, allows the system operator to instruct set-points to limit their output. It even allows to shut down generation sites (in a process called curtailment) when current or expected wind generation causes the system to reach a technical limit. Supervision and control of the renewable generation in real-time decrease the number and quantity of curtailments.

The predictability of new distributed resources coming from the wind has fostered the development of the transmission network and the evolution of its operation in order to cope with power flows that are extraordinarily dependent on the weather conditions. This fact, as a direct consequence of the renewable energy integration maximization, as well as the social and environmental barriers to the deployment of the grid has fostered developing further the network intelligence. This is currently accomplished by progress in new technologies through R&D projects. Among those are the development and in-field installation of new (FACTS-Flexible AC Transmission System) devices to direct and control the power flows and the improvement of the existing assets capacity through the use of dynamic line rating (RTTR – Real Time Thermal Rating) in the Redes 2025 and the E.U TWENTIES projects.

Obtaining public acceptance – **Detlef Matthiessen**, Member of the Schleswig-Holstein Parliament, Green Party

Detlef Matthiessen shared his experiences in gaining public acceptance for grids from the German province of Schleswig Holstein (SH). In SH already today, up to 50 % of the electricity demand are covered by wind power and the government aspires to cover 100 % of the local electricity demand with renewables by 2020.

This will require an increase of both generation and transmission capacities. Matthiessen described that to move towards this direction, it is absolutely essential to achieve the buy-in of the population. In his experience, acceptance for the grid expansion requires thorough explanation of what is going to happen. He stated that because the grid expansion is clearly linked to the production of renewables, the buy-in of the population is

comparatively easy to achieve. Two basic rules are to inform as early as possible and to be absolutely open and honest about governmental plans.

Making the transfer from experiences with citizen wind parks (Bürgerwindparks), Matthiessen explained that acceptance can be triggered by allowing the public to become shareholders/owners of a project. The TSO TenneT is therefore currently developing solutions on how to allow for financial involvement of the public. Citizen cooperatives are one example of how this could be organised.

Explaining the need for grids to an affected population – **Mark Hoff**, ERM

Mark Hoff explained that surveys show a high level of dissatisfaction with politicians among the German population. There are furthermore very limited levels of trust in enterprises while independent entities and NGOs are the winners of trust.

This is a challenging situation for the implementation of major grid projects. People want and expect to be involved, and trust is easily lost if the wrong steps are taken. To avoid escalating societal discussions, it is essential to communicate and approach the public at a very early stage.

Legal requirements provide a basis for the necessary involvement of the public. They are however by no means sufficient. Voluntary additional good practice is what makes the difference. The public, policy makers, authorities, NGOs and TSOs all have different roles to play within the communication process.

Policy makers should coordinate political decisions and closely cooperate with TSOs on the local/regional level. They should seek regular discussions with stakeholders and communicate "common" findings. They finally should assure communication on legal matters in layman terms.

NGOs, due to excellent reputation, should fully embrace their societal role shift, from being anti-nuclear demonstrators to becoming RES campaigners. NGOs can play an important role as moderators/translators of the process. They should closely cooperate with TSOs to assure environmental matters are being appropriately addressed.

The main role of authorities lies in the communication of legally mandatory consultation. They run public hearings, evaluate objections, and are needed to make sure the public understands how decisions were being made.

TSOs need to explain the necessity of expansion at an early stage and make clear they do the technical implementation of governmental decisions. They should assure that all relevant stakeholders are brought together to advance the process. They have to provide relevant data and assure legally mandated and voluntary involvement are coordinated.

Overall, to avoid a destructive fear of negative impacts and of loss of control, steps must be taken proactively and at very early stage.

How to deal with the need question? Examples throughout Europe – **Theresa Schneider**, Renewables-Grid-Initiative

Theresa Schneider gave insights into findings she gained during a project on best practices the Renewables-Grid-Initiative is carrying out in 2012. She presented results of interviews she conducted with different European TSOs and local NGOs.

Questions around the need have often a significant influence in public debates. This can be particularly challenging if the public doubts the necessity of a line at a very late stage of the process. Moreover, whether the need was determined in a legitimate procedure or whether the need is proven sufficiently is questioned. Finally, the drivers behind the need can play a role, i.e. the source of energy, which is supposed to be transmitted by the proposed line.

How can stakeholders deal with these challenges? Theresa Schneider divided approaches into three different stages of external stakeholder involvement: explaining the need, discussing it and finally involving external stakeholders in the need definition. When informing the public, different formats on the same matter or illustrations can help to meet different information needs. For explanations and discussions of the need, building up coalitions

with different stakeholder groups can be successful. For instance, it changes the characteristics of discussions if environmental NGOs inform people about the connection between more renewables and the need for grids or if politicians answer questions on the "if" and "why" and TSOs concentrate on the "how". The highest degree of involvement of external stakeholders in the need definition can be seen in Germany, where public consultations are run on the grid development plan (see also presentations from Marius Strecker and Dr. Peter Ahmels).

Reasoning and experiences for the 50Hertz online application on load flow data – **Annika Kießler**, 50Hertz

The current urgency for energy grid expansion in Germany is among others caused by an increase of energy generation from renewables that in some regions happens faster than the expansion of the grid. The resulting production surplus leads to bottlenecks. As Annika Kießler explained, external stakeholders want to be able to see this problem, so to be assured that there is a need for optimising the system and building new lines.

50Hertz has experienced that stakeholders expect a high level of data transparency. The company therefore sees transparency as a key pillar of stakeholder communication. It publishes a yearly almanac with key data on its grid zone, it has employed a transparency officer and it has tackled the controversial issue of publishing load flow data. 50Hertz's experience with the publication of load flow data is such that it is not only a question of providing data at all but also a necessity to find the right format to do so. Data on load flows had already been handed out by 50Hertz in the past upon request. However, this would not stop the requests for data and complaints about a lack of data.

50Hertz has therefore developed a pioneering interactive online tool to continuously show the load flows in its grid. The tool allows to see load flows in the control zone of 50Hertz (24h time lag) during a user-determined period of time and adds information of potential curtailment of energy production entities. The data can additionally be downloaded as an excel-file, thus making further usage of the data a lot simpler than in a printed report.

The 50Hertz transparency officer developed the tool. Input from external stakeholders was and still is being collected to adjust it to the need of the target group. The feedback on the new tool is clearly positive. Requests for sharing and publication of data have clearly declined since the tool has been launched.