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PRESS INFORMATION

Towards the super grid for more renewable energy

The Joint Research Centre (JRC) is assessing building blocks and progress to speed up the development and modernisation of the European electricity grids, particularly in the context of the Strategic Energy Technology Plan (SET-Plan) and the forthcoming Energy Infrastructure Package. In this framework, the JRC is conducting targeted research on technological developments towards higher transfer capacity architectures and is monitoring the challenges for redesigning the trans-European electricity networks.

Interconnecting renewables

Today, the European system requires significant upgrade, replacement and addition of infrastructure to ensure a reliable electricity delivery, in particular to integrate the increasingly deployed Renewable Energy Sources (RES).

The European Union (EU) aims in fact at stepping up the share of RES in Europe's final energy consumption to 20% by 2020: this overall objective translates into some 35% share of final electricity consumption covered by renewables by 2020. Renewable electricity generation already accounted for 62% (17 GW) of all newly constructed power-generating capacity in Europe in 2009. Wind energy installations, increasingly larger in size and therefore mainly impacting the power system transmission highways (more than the distribution capillaries), accounted for 38% or 10.2 GW[1].

High Voltage Direct Current (HVDC) and storage towards the super grid

Modernised power grids have a central role to move Europe towards a low carbon energy economy, as underlined by the European Union's Strategic Energy Technology Plan Information System (SETIS), led by the JRC.
The best locations for the generation of renewable electricity are not uniformly distributed across the continent, and are often in places where connections to the electricity network are weak. The energy production from renewable sources also greatly depends on weather conditions. To fully utilise these resources, the power grid must be enhanced to allow electricity to be transported to the main centres of demand and storage. This may drive the evolution of the transmission grid towards a super grid. That is a higher transfer capacity system designed to transport large amounts of electricity over long distances.

HVDC systems will play an important role in connecting high-volume renewable energy generated in remote areas (e.g. offshore) into the main grid. Due to their lower losses and smaller environmental impact, HVDC lines are considered the most suitable technology for this task. As an example, out of the total 47.6 GW of long-distance HVDC installed worldwide from 1962 to 2009, 50% of this capacity has been constructed after the year 2000, and additional 26.5 GW of new long-distance HVDC were under construction in 2009. On a similar note, storage technologies may represent another building block for a future super grid integrating large-sized renewable plants. In particular, around 40 GW of hydro-pumped

[1] JRC *Renewable Energy Snapshots (2010)*

storage plants are in operation in Europe and opportunities may arise from the refurbishment due to ageing of about 50 % of this capacity.
The annex provides detailed information on the work carried out by the JRC to assess the merits of HVDC transmission system and of storage options.

European policy initiatives and role of the Joint Research Centre

Developing and remodelling the electricity grids is an imperative step in the pursuit of the EU's competitiveness, sustainability and security of energy supply objectives for 2020 and beyond. The EU's focus on electricity infrastructure development and innovation has increased considerably:

- The Third Energy Package adopted in 2009 introduced new instruments for increased cooperation between electricity operators and regulators, including a European Network of Transmission System Operators for Electricity (ENTSO-E).

- Dedicated programmes[2] on research and innovation for the electricity networks of the future have just been launched to implement the European Strategic Energy Technology Plan (SET-Plan). They are the European Electricity Grid Initiative (EEGI) and the Smart Grids Joint Programme of the European Energy Research Alliance (EERA).

- A new Energy Infrastructure Package will be presented by the European Commission to the European Council and Parliament in November 2010. It aims at replacing the current framework for trans-European energy networks and better contributing to the development of strategic energy infrastructures.

The JRC performs research on smart/power grids and supports related European Commission policies and initiatives:

- the JRC is contributing to the preparation of an Energy Infrastructure Package - e.g. through the REALISEGRID project - by identifying technological options and barriers to the development of the Trans-European Networks for Energy.

- The JRC is involved in the implementation of the SET-Plan by monitoring and contributing to the European Electricity Grid Initiative and the Smart Grids Joint Programme of the European Energy Research Alliance.

- The JRC has recently developed a comprehensive European grid model[3], in support of EC's policies on critical energy infrastructures. This will enable JRC to contribute also to the EC's work on trans-European energy networks and smart grids.

[2] Along with these programmes on smart grids, other initiatives on solar energy, wind energy and carbon capture and storage were launched in the SET-Plan conference held in June 2010 in Madrid.
[3] The JRC has built a Europe-wide electricity grid model, embedding data officially provided by the European Network of Transmission System Operators and other key datasets of the European power system. It can be used to run static and dynamic analyses on the European power system via advanced simulation platforms.

Further information

- Information on the JRC session "The electricity transmission grid: How to integrate more renewable energy sources" organised at ESOF 2010 is available at: http://www.esof2010.org/schedule/2/6b
- The activities of the JRC Security of Energy Systems (SES) group - led by Gianluca Fulli - on power system modelling towards smart and super grid architectures are reported at: http://ie.jrc.ec.europa.eu/activities/SES.php
- The 2009 Technology map descriptions of the European Strategic Energy Technology Plan (SET-Plan), including sections on grids and storage, can be downloaded at: http://setis.ec.europa.eu/
- The REALISEGRID publications and results are available at: http://realisegrid.erse-web.it/Publications-and-results.asp

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Note to editors:

The Joint Research Centre JRC
The Joint Research Centre (http://www.jrc.ec.europa.eu) is a Directorate-General of the European Commission providing independent scientific and technical support to European policymaking. The JRC's Institute for Energy provides support to Community policies related to both nuclear and non nuclear energy in order to ensure sustainable, safe, secure and efficient energy production, distribution and use.

ANNEX

HVDC and storage as building blocks for a super grid

The architecture of the current power systems is based on alternating current technologies (which entails that the current periodically reverses direction) for a number of technical, economic and historical reasons. Through the EC REALISEGRID project, the JRC has been actively investigating the relative merits of ***High Voltage Direct Current*** (HVDC) and Alternating Current links[4]. A key theme will be the role that High Voltage Direct Current (HVDC) systems can play in connecting high-volume renewable energy generated in remote areas (e.g. offshore) into the main grid. Due to their lower losses and smaller environmental impact, HVDC lines are considered the most suitable technology for this task and are already preferred to Alternating Current links for medium-long distance submarine interconnection of European systems.

Between 1962 and 2009, a total transmission capacity of 47.6 GW for long-distance High Voltage Direct Current (HVDC) power transmission has been installed worldwide. 50% of this transmission capacity has been constructed after the year 2000, while in 2009 additional 26.5 GW of new long-distance HVDC transmission capacity were under construction. These numbers underline the high growth rate of installed HVDC transmission systems which has been observed in the last years. In addition, since HVDC is a relatively new technology, research and development of higher current and voltage ratings of power electronics will open up new fields of application in bulk-power transmission.

As reported through SETIS, different ***storage*** options are needed to improve the dispatchability of RES electricity. Some of these technologies may represent another building block for a future super grid. Renewable Energy Sources are indeed only available during certain hours of the day or in specific locations, or weather conditions. The storage options range from the use of heat storage capabilities of specific power generation technologies, e.g. Concentrated Solar Power plants, to the reliance on dedicated electricity storage technologies e.g. hydro pumped storage, compressed air energy storage, batteries, hydrogen or fly-wheels. The hydro-pumped storage is the most widely used storage technology today: it pumps water to the higher reservoir in times of low electricity demand and release water to generate electricity in times of high demand. About 100 GW are installed world-wide and some 40 GW are in operation in Europe. Considering that about 75 % of the global potential for hydropower is already deployed in Europe, opportunities may arise from refurbishment due to ageing anticipated to occur by 2030 on about 50 % of the currently installed capacity of hydro-pumped storage in Europe.

In the future, European RES will include offshore and onshore wind energy from north-west Europe and solar energy imported from North Africa and the Middle East. Efficient transmission of this green power to south-eastern and central Europe will be possible using HVDC technologies. HVDC transmission can also be used to maintain the green-power balance within Europe by transmitting power from places with surplus intermittent RES to those with high demand or storage capacity. The energy networks must be modernised to allow Europe to meet its energy policy goals, including the 20/20/20 targets. Such evolution could entail that the transmission grid evolves towards a super grid, that is a higher transfer capacity system, most likely based on direct current technologies, designed to transport large amounts of electricity from remote areas to consumption and storage centres.

[4] REALISEGRID Reports: Improving network controllability by Flexible Alternating Current Transmission System (FACTS) and by High Voltage Direct Current (HVDC) transmission systems; Comparison of AC and DC technologies for long-distance interconnections