

CEPS position document: Super Grid – future “electricity highway”

The ambition of the European Union and individual member states to meet criteria concerning the proportion of renewable energy sources in the energy mix by 2020 and to achieve a CO₂-neutral power supply by 2050 will entail a huge increase in renewable energy source (RES) installed capacity. It is clear that RES should be built in locations with optimum natural conditions, i.e. wind, sunshine and a sufficient head for pumped-storage hydro power plants. Such locations are often remote from electricity consumption centres and, moreover, RES plant output is variable since it depends on natural conditions which can be predicted with only a certain degree of probability. The safe and successful integration of large wind, solar and hydro plants into any power system is thus directly dependent on the existence of a transmission system capable of carrying tens of GWs over thousands of kilometres, i.e. a “SUPER GRID” with “ELECTRICITY HIGHWAY”.

Analysis of the current situation

Ever since the beginning of the transmission system development process, power system voltage levels have been gradually increased in line with increasing amounts of transferred electric power in order to reduce network losses. In Europe (with the exception of the former Soviet Union) such development was completed in the 1980s with the construction of 400kV transmission systems. These systems, however, were not primarily intended for massive cross-border electricity exchanges but, rather, for enhancing the operational security of interconnected power systems. Continental Europe has not seen any significant transmission reinforcement over the past twenty years, with the exception of a number of individual network interconnections and the construction of undersea cable lines.

The European power sector has, over the last few years, been forced to address a number of phenomena which have substantially changed the requirements placed on transmission systems including the ongoing liberalisation of the electricity market, the expansion of cross-border electricity trading and the huge expansion in renewable energy sources with variable power generation, i.e. primarily wind and solar plants. In Germany alone, wind plant installed capacity at the end of 2010 stood at 27,214MW which, it is planned, will double by 2025 (the current minimum electricity consumption in Germany is 35,000MW). Furthermore, the DESERTEC project envisages a gradual increase in solar capacity in the Sahara and the Middle East of up to 470,000MW by the middle of the 21st century!

The limiting factor in terms of the development of such sources is not the economic return on investment; subsidy programmes are available for the construction of RES plants, preferential terms and conditions are already in place and the purchase of the output of RES plants guaranteed. Rather, the problem is the location of areas with the optimum natural conditions for the construction of RES energy facilities which are often situated at great distances from main

consumption centres; this concerns the North Sea and Baltic Sea coasts (wind parks) and especially the desert regions of North Africa and the Middle East. The variable nature of RES electricity generation is a further drawback; total dependence on the strength of the wind and sunlight is clear. Under optimum weather conditions, excess power is generated which must be transported to consumption areas or storage facilities (pumped-storage power plants). Under adverse weather conditions (light or extremely strong winds, night-time and days without sunshine), RES plant outages must be promptly compensated for by accumulated energy or flexible conventional generating plants.

It has been shown that on both the continental and transcontinental scales, where RES plants are dispersed across an area of thousands of square kilometres, fluctuations in generation from wind or solar sources are compensated for and the cumulative total of generating source output is equalised; the electricity consumption curve for such vast areas is flat. An essential precondition, however, is the safe, high-capacity interconnection of all the generation and consumption centres. Sadly, today's European infrastructure is simply not able to carry tens of GWs of power over distances of thousands of kilometres. Hence the idea of a Super Grid – new transcontinental highway criss-crossing the Mediterranean, North Sea and Baltic regions and connecting major European consumption centres and backup sources, i.e. pumped-storage power plants. Dozens of visions of the potential form such a grid should take have been published over the past few years.

Currently, all stakeholders, including those who promote the massive use of renewable energy sources, realise that RES integration without such “electricity highway” is simply not possible. The Florence Regulatory Forum of December 2010 established an Electricity Highway Platform to be monitored by the European Commission and in which ENTSO-E, together with regulators, will play a major role. ENTSO-E, in the summer of 2011, completed its Study Roadmap 2050 which identified all the aspects involved in terms of planning, technology and implementation including economic and benefit analysis. A consortium established under the EU Seventh Framework Programme for Research (FP7) will, between 2012 and the end of 2014, design a module plan within MoDPEHS (Modular Development Plan on pan-European Electricity Highway System) study project for the development of electricity highway up to 2050.

The aim of the MoDPEHS study project is to come up with, by 2014/2015, various potential scenarios for future European power systems, a modular plan for the construction of an electricity highway system and software by means of which the future form of electricity highway, for the reference milestones 2030, 2035, 2040, 2045 and 2050, can be modelled. The result of the study will predetermine the architecture – and localisation – of the pan-European transmission system for the whole of the century.

A powerful consortium consisting of TSOs, electricity generators, distribution companies, universities, research centres, consulting companies etc. is currently being put together, under the auspices of the European Commission, the role of which will be to design a high-quality draft project.

ČEPS's position on “electricity highway”

ČEPS is increasingly being faced with unintentional power flows into the Czech transmission system caused by high wind plant generation in northern Germany and in the North Sea and Baltic regions as well as by the insufficient transfer capacity of German internal north-south transmission

networks. Parallel and loop flows pass through the Polish and Czech transmission systems causing network overload and consequently the non-fulfilment of the N-1 criterion.

ČEPS would welcome any solution which would ensure future RES plant integration and the safe and reliable operation of the transmission systems in our region. The Company views the “electricity highway” project as an ambitious vision and a necessary precondition for the integration of constantly expanding wind and solar capacities with variable generation and is committed to being fully involved in this project.

The investment costs of a transcontinental network which, when completed, will interlink large generation centres with major consumption centres: solar sources in the Sahara and the Middle East, wind parks on the European Atlantic coast and in North Africa, wind plants in various localities in the North Sea and Baltic regions and pumped-storage plants in the Alps with industrial and residential agglomerations across the whole of Europe, will be enormous. ČEPS suggests that careful preparation and planning for such a project is essential and must include all the aspects involved – licensing procedures, funding and network ownership, the safe and reliable operation of the interconnected system including the connection of existing networks, political safety criteria, trading rules, payment for the use of the network and so on, all of which will have to be tackled both within and outside the European Union.

ČEPS is well aware of the strategic importance of the MoDPEHS project. The Company is therefore working hard to be accepted as a member of the consortium so as to be able to influence, through the work of ČEPS experts, the overall direction of this ambitious project.