Transforming Europe's Electricity Supply – An Infrastructure Strategy for a Reliable, Renewable and Secure Power System

European Academies easac Science Advisory Council

What planning processes are required for a European grid to ensure that investments in capacity to transmit electrical energy are made in the right places?

- How should a European grid be operated to ensure that the maximum benefit is extracted from a given infrastructure?
- What are the implications of current and prospective developments in transmission technologies for meeting environmental, operational, energy efficiency and investment needs?

European energy policy seeks to create a pan-European competitive electricity market and to increase substantially the generation of electricity from renewable resources. In the coming years these two factors will require significantly increased transfer of large amounts of electrical energy across long distances and national borders in Europe. However, the existing European electricity grid infrastructure, and generally low levels of integration and co-ordination in the planning and operation of the grid, will not support such transfers of electricity and consequently the achievement of Europe's energy policy goals. EASAC (the European Academies Science Advisory Council) has therefore examined the developments that are required in the planning, operation and infrastructure of the European electricity grid.

The study's conclusions and recommendations for each of these three questions are summarised below. EASAC considered that a much more co-ordinated and harmonised approach to planning is needed, based on common grid planning principles, practices and scenarios. Specific recommendations are:

- Common European models of the grid and the electricity market need to be developed which simulate power flows, power and energy exchanges, and the economics of electricity generation and transmission. Dynamic models of each of the four synchronous regions in Europe are also needed. These developments may appropriately be achieved through a collaborative initiative of the transmission system operators. European countries should also share grid data to enable more detailed simulations for different regions.
- A set of common, and mandatory, grid planning principles should be defined at a European level for short- and long-term planning. Issues they should address include defining the way future scenarios are created and defining the credible faults and acceptable consequences of them. Plans need to be regularly updated.
- Given the scale of the European grid, there will inevitably need to be a combination of top-down and bottom-up planning processes that operate in a well-understood framework. Unco-ordinated local decisions will inevitably lead to difficulties.
- The approach taken to planning for operational security of supply requires further research. Decisions need to be taken about operational security of supply for Europe as a whole.
- Increased use should be made of revenues generated through congestion management to fund investment projects to strengthen transmission capacity.
- The successful realisation of an effective European transmission system will require human resources with the necessary skills to be in place. This capacity must be planned for and appropriate training and career development schemes put in place.

The operation of the European grid will need to be through a more co-ordinated approach based on substantially enhanced levels of data sharing. Effective market mechanisms must be developed to produce correct pricing signals to ensure effective grid development and operation. The market must be compatible with the physical infrastructure and operation. Specific recommendations are:

- To the extent that incentives and subsidies are used, they need to be harmonised across Europe to get an optimal transmission system and to give the correct price signals.
- Congestion needs to be managed in a co-ordinated manner on a European Union (EU) system basis. As the system becomes more integrated, there will be an increasing need for EU-wide control systems based on real-time information from advanced telemetry and the use of activating controls in real-time. This may require research and development.
- Issues of demand-side participation will need to be addressed, and a better understanding needs to be

developed of the implications for electricity transmission of developments in load diversity, for example caused by the large-scale introduction of heat pumps or electric cars.

The transmission capacity of existing networks should be improved through the application of appropriate control technologies, but in all scenarios extensions to the grid are required. Although the choice of transmission technology will depend on the particular circumstances, high voltage direct current transmission technology is developing rapidly and should be considered as an appropriate method of bulk power transmission from point to point. Also, transmission cable technology, both alternating current and direct current, is improving, allowing higher voltage operation and greater power transmission capacities, and consequently reducing the cost differential compared with overhead lines. These developments are significant in relation to public objections to new overhead lines because of their visual impact. However, it is not anticipated that it will be technically and economically feasible to replace all *existing* overhead line transmission circuits with buried cables.

Future European research and development on transmission technologies should ensure continuing progress in reducing investments costs, environmental impacts and energy losses, and may include, for example, development of gas-insulated and high-temperature superconducting transmission lines.

EASAC is the platform through which the national science academies of the EU member states work together to provide independent, evidence-based advice about the scientific aspects of public policy to those who make or influence policy within the European Institutions. The full report of the study is available at http://www.easac.org/document.asp?id=31.

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EASAC – the European Academies Science Advisory Council – is formed by the national science academies of the EU Member States to enable them to collaborate with each other in providing advice to European policy-makers. It thus provides a means for the collective voice of European science to be heard.

Its mission reflects the view of academies that science is central to many aspects of modern life and that an appreciation of the scientific dimension is a pre-requisite to wise policy-making. This view already underpins the work of many academies at national level. With the growing importance of the European Union as an arena for policy, academies recognise that the scope of their advisory functions needs to extend beyond the national to cover also the European level. Here it is often the case that a trans-European grouping can be more effective than a body from a single country. The academies of Europe have therefore formed EASAC so that they can speak with a common voice with the goal of building science into policy at EU level.

Through EASAC, the academies work together to provide independent, expert, evidence-based advice about the scientific aspects of public policy to those who make or influence policy within the European institutions. Drawing on the memberships and networks of the academies, EASAC accesses the best of European science in carrying out its work. Its views are vigorously independent of commercial or political bias, and it is open and transparent in its processes. EASAC aims to deliver advice that is comprehensible, relevant and timely.

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