



SCIENCE AND TECHNOLOGY OPTIONS ASSESSMENT

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Smart grids / Energy grids

The large-scale deployment of smart electricity grids in Europe

Policy goals

From the policy perspective, the large scale deployment of smart grids is expected to provide a decisive contribution to the European energy strategy, by making it possible:

- to transmit and distribute up to 35% of electricity generated from renewable sources – both dispersed and concentrated - by 2020, and to achieve a completely decarbonised electricity production by 2050;
- to integrate national networks into a market-based, truly pan-European network, guaranteeing a high quality of electricity supply to all customers and engaging them as active participants in energy efficiency;
- to anticipate and prepare for new developments such as the electrification of transport;
- to substantially reduce capital and operational expenditure for the operation of the networks while fulfilling the objectives of a high-quality, low-carbon, pan-European, market-based electricity system.

Current perspective: trends, barriers and open issues

From the techno-economic viewpoint, three major trends characterise the current dynamics of the electricity sector: the growth of the electricity share in the overall energy demand, the growth of the share of renewables in the overall electricity generation, and the emergence of efficient solutions to integrate electricity generated from intermittent sources into the grid. While the current trends, along with most of the available forecasts, point to a continuing growth of the electricity demand in the future, the emergence of advanced thermal technologies (solar, geothermal, biomass) may result in partly curbing such growth. On the other hand, the predictable increase in the cost performance of distributed generation might contribute to making off-grid solutions more competitive.

In any case, the deployment of smart grids calls for technological advances not only in the field of energy technologies, but even most importantly, in the area of ICT-based solutions for the extensive data exchange that characterises smart grids.

The large-scale deployment of smart grids has direct implications for citizens and users. In addition to the well-known privacy and security issues, and to the concerns at times expressed in relation to possible health effects, consumers express doubts about the energy saving effects of smart grids, as well as about their equity implications, calling for a major change of attitude on behalf of utilities to actively involve end-users and facilitate their empowerment.

The advocated transition from conventional grids to smart grids entails a profound restructuring of the value chain: full and bidirectional interconnection between all nodes in the network, and the need to ensure real-time exchange of consumption data calls for radical changes in the business models of operators, based on a clear and reliable identification of the benefits induced by the new system and of the extent to which each actor can ultimately accrue his/her fair share of such benefits.

On the regulatory side, a new framework that adequately responds to the needs of an effective deployment of smart grids is needed. Regulation should primarily aim at ensuring the most effective type and level of incentives to stimulate the investments required by the transition towards smart grids, while ensuring a level playing field in the sector.

Policy recommendations

The deployment of smart grids raises a variety of challenges that are directly relevant for policy-makers and stakeholders. Summary recommendations are displayed in the table below under the basic headings of Technology, Regulation, Business, Economics and Society.

Intervention areas	Recommendations
Technology	<p>R1 - Research funds should prioritise projects and initiatives (including large-scale pilots) that concentrate on the operational integration of technologies along the entire value chain. Particular emphasis is recommended on the integration of ICT devices and services at all steps of the chain.</p> <p>R2 - Project design and appraisal for smart grid deployment should consider alternative or complementary solutions for different climate zones, and different contexts of renewable generation availability, based on consumption profiles.</p>
Regulation	<p>R3 - A new regulatory framework must be devised. The key issue to be addressed by regulation is to ensure the right balance in the sharing of costs, benefits and risks.</p> <p>R4 - The new regulatory framework must provide the right incentives for utilities to invest in smart grid technologies and solutions, failing which the innovation process will inevitably be hampered. Incentives from the regulatory framework should therefore encourage the actors to seek benefits from efficiency increases rather than additional sales.</p>
Business	<p>R5 - New business models must be devised and tested with the primary goal of ensuring customer participation, to support energy efficiency and demand response, including more smart appliances and less of the current bulky regulation rules. In parallel, to ensure fair benefits to the involved stakeholders, business models have to transform the highly complex market mechanisms into simple transactions for their customers.</p> <p>R6 - While market platforms for the aggregation of distributed energy resources on the supply-side are highly developed, additional research and experimentation must be promoted on the demand-side, especially considering that the experience so far indicates a strong correlation between platform profitability and consumer engagement.</p> <p>R7 - New business models must ensure that customers can enjoy:</p> <ul style="list-style-type: none"> • Visible and credible monetary savings (at least 10%); • Ease of use of home automation systems and other enabling technologies; • Retained control over own consumption. <p>R8 - In the short term, the successful development of innovative business models will require that:</p> <ul style="list-style-type: none"> • utilities fully acknowledge the potential benefits of transforming the formerly limited customer relation into a mutually profitable partnership; • stakeholders are strongly encouraged to jointly establish the new technology framework, with its standards and its real-time economics; • policy-makers provide continuing support to smart meter investments; • fair cost-sharing schemes are devised to exploit the full potential benefits; • new business model concepts systematically involve the customer beyond the meter.
Economics	<p>R9 - Smart grid investments should be seen neither as a substitute, nor as fully additive to conventional grid investments (replacement, extensions), as future investment costs include both "conventional" and "smart" components.</p> <p>R10 - An innovative, targeted approach to cost benefit analyses of smart grid projects must be promoted and adopted, which makes it possible to account for:</p> <ul style="list-style-type: none"> • the heterogeneity of the technologies involved and their differentiated lifetime; • the time-related value of energy consumption; • indirect and external effects.
Society	<p>R12 - Information and communication campaigns must be deployed to ensure an adequate level of customer motivation, and to overcome a number of currently widespread misconceptions, such as the over-estimation of the impacts of smart meters (both positive and negative).</p> <p>R13 - A two-pronged approach is required, combining a legal and regulatory framework that safeguards the basic privacy rights and principles, with a cooperative approach between service suppliers and customers that should guarantee not only transparency, but, most importantly, the empowerment of customers, if only through the provision of "opt out" alternatives.</p>

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