

THE FUTURE OF EUROPEAN ELECTRIC POWER SYSTEM

Abstract

The report presents the last current problems in the areas of the competitive electricity market of European dimension. Efficient transmission and distribution of electricity is a fundamental requirement for European citizens, societies and economies with essential energy resources. The need to renew Europe's networks, meet growing electricity demand, enable a trans-European electricity market and integrate more sustainable generation resources (including renewable sources). Report also presented the new vision of European networks – Smart Grids Technology Platform – the goals in the next 20 years.

1 INTRODUCTION

The process means that electricity-market liberalisation is based on steady progress on a range of multiple factors, not on reaching "ideal" conditions under a few selected criteria. Key characteristics of electricity, such as the physical and economic limitations on transport and the huge investments needed - both quite unheard of for any other industrial commodity - cannot be brushed away. They must on the contrary be basic considerations when assessing electricity markets and the structures of the electricity industry.

Simplification will simply not do. A simplified vision of European electricity markets based on a "copperplate" of transmission lines allowing for free flows of electricity all over Europe will not suffice. And that other, opposing, simplification - a vision of an "atomised" electricity industry operating within national or sub-national borders - will not do either.

Building competitive and international electricity markets thus requires progress on a range of multiple factors including:

• Ensuring a competitive environment

- Effective implementation by Member States of the existing European legislative framework
- Independent operation of transmission and distribution systems
- Independent national regulators
- Openness to new entrants
- Internationalisation of electricity companies
- Market pressure from international customers
- Choice between suppliers
- Easy supplier-switching

• Developing liquid and transparent wholesale markets

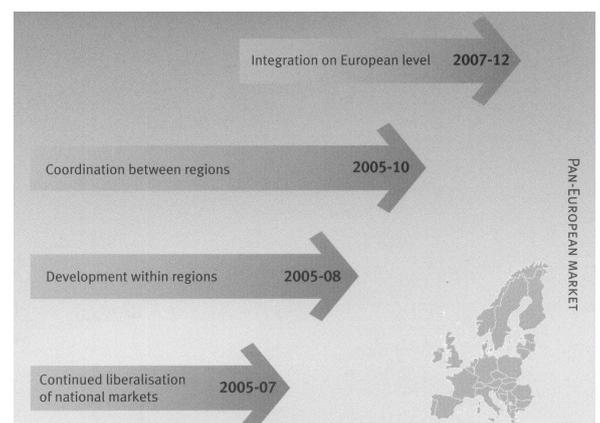
- Expansion of wholesale markets via regional markets as a stepping stone to a European market
- Wholesale market liquidity including participation from the demand side
- Abolition of cross-border fees
- Implementation of coordinated, market-based congestion management for interconnections
- Network reinforcement from a regional/European perspective
- Availability and transparency of key market and network data

• Cooperation of main stakeholders

- Seamless cooperation between power exchanges
- Seamless cooperation between transmission system operators
- Seamless cooperation between national regulators on cross-border and Europe-wide issues¹

The main goals for the future give the EURELECTRIC's "Roadmap to a Pan-European Market" is based on liquid wholesale markets as the key drivers to regional market development. The roadmap provides a detailed set of measures working in parallel to first dismantle the remaining barriers at national level through immediate and effective implementation of the European Electricity Market Directive; to achieve regional markets by 2009; and complete their integration on a European scale by 2012. (Fig.1). The joint direction is the developing regional markets as the milestones in the European integration.

Fig.1. EURELECTRIC Road Map to a European electricity market – parallel approach



Source: A Competitive Electricity Market of European Dimension: a Goal Within Reach, UNION OF ELECTRICITY INDUSTRY, Euroelectric, The World Forum on Energy Regulation III, 10 October 2006, p.7

The electricity market liberalization is the process which focused the main of topics in the whole integration of countries of European Union.

¹ A Competitive Electricity Market of European Dimension: a Goal Within Reach, UNION OF ELECTRICITY INDUSTRY, Euroelectric, The World Forum on Energy Regulation III, 10 October 2006

2 THE EUROPEAN FUTURE ELECTRIC SYSTEM

The objectives of European energy policy are competitiveness, sustainability and security of supply. The energy markets and networks are the heart of the energy system and must evolve to meet the new challenges to provide all customers with a highly reliable, cost effective and sustainable power supply. In the further future, customers will have more control over their use of energy, e.g. by choice in the degree of reliability, by automated energy saving schemes and power quality. The latter because of more sensitive home equipment like quality of life enhancing medical apparatus (respiratory aids, heart monitoring etc.), requiring high availability and excellent power quality. Real time price information systems and advanced control of power now are being developed and are essential for achieving the goals. Power markets are in a transition phase towards a new equilibrium between costs, performance and risk.

2005 year there are the start the project SmartGrids – European Technology Platform for Electricity Networks of the Future. SmartGrids is a new concept for electricity networks in Europe. The initiative responds to the rising challenges and opportunities, bringing benefits to all users, stakeholders and companies that perform efficiently and effectively.

The European Commission's 2006 Green Paper 'A European Strategy for Sustainable, Competitive and Secure Energy' emphasises that Europe has entered a new energy era. The overriding objectives of European energy policy have to be sustainability, competitiveness and security of supply, necessitating a coherent and consistent set of policies and measures to achieve them.

Europe's electricity markets and networks lie at the heart of our energy system and must evolve to meet the new challenges. The future trans-European grids must provide all consumers with a highly reliable, cost-effective power supply, fully exploiting the use of both large centralised generators and smaller distributed power sources throughout Europe

The SmartGrids vision is about a bold programme of research, development and demonstration that charts a course towards an electricity supply network that meets the needs of Europe's future. Europe's electricity networks must be:

- Flexible: fulfilling customers' needs whilst responding to the changes and challenges ahead;
- Accessible: granting connection access to all network users, particularly for renewable power sources and high efficiency local generation with zero or low carbon emissions;
- Reliable: assuring and improving security and quality of supply, consistent with the demands of the digital age with resilience to hazards and uncertainties;
- Economic: providing best value through innovation, efficient energy management and 'level playing field' competition and regulation.

Key elements of the vision include:

- Creating a toolbox of proven technical solutions that can be deployed rapidly and cost-effectively, enabling existing grids to accept power injections from all energy resources;
- Harmonising regulatory and commercial frameworks in Europe to facilitate cross-border trading of both power and grid services, ensuring that they will accommodate a wide range of operating situations;
- Establishing shared technical standards and protocols that will ensure open access, enabling the deployment of equipment from any chosen manufacturer;
- Developing information, computing and telecommunication systems that enable businesses to utilise innovative service arrangements to improve their efficiency and enhance their services to customers;

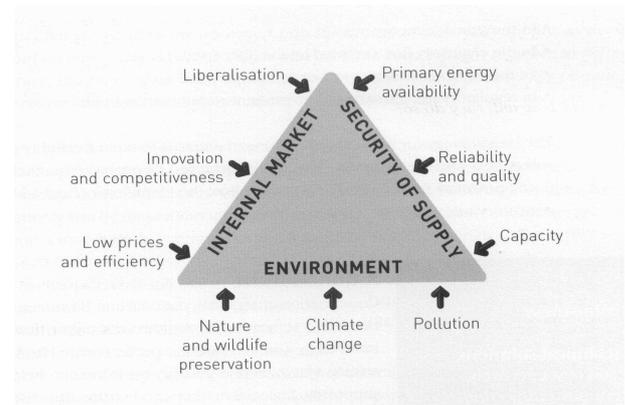
- Ensuring the successful interfacing of new and old designs of grid equipment to ensure inter-operability of automation and control arrangements.

The current climate demands change in the way electricity is supplied. As the internal market develops, European citizens will start to benefit from greater choice and lower costs. Fossil fuels are running out and the security of electricity supplies is under threat. Environmental issues have moved to the fore and the EU must meet targets set, its presented Fig 2., the main elements are:

The European Internal Market: This market evolution, associated with an efficient regulatory framework, will promote economic growth and play a key role in the EU's competitiveness strategy. Increasing competition will encourage efficiency and spur on technological progress and innovation. As a result, the internal market is expected to provide benefits to the European citizens such as a wider choice of services and downward pressure on electricity prices.

Security and Quality of Supply: Modern society depends critically on a secure supply of energy. Countries without adequate reserves of fossil fuels are facing increasing concerns for

Fig.2 The main factors of SmartGrids



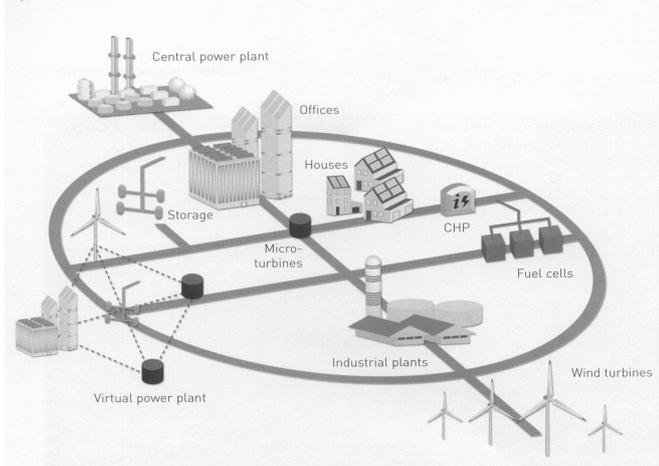
Source: European SmartGrids Technology Platform Vision and Strategy for Europe's Electricity Networks of the Future, European Commission, EUR 22040, Luxembourg, Office for Official Publication of The European Communities, 2006, p.13

primary energy availability. Furthermore, the ageing infrastructure of Europe's electricity transmission and distribution networks is increasingly threatening security, reliability and quality of supply. The Future Power System combines millions of active participating customers that sometimes produce and sometimes consume electricity and connects the local distribution grids with the large scale transmission backbone using advanced electronics, communications and control. The future power system characteristics are presented by Fig.3. Dispersed generation and renewable energy sources are already part of today's power system. They have been connected to the network, but do not play a role in power system management. This 'fit and forget' policy is possible as long as the share of these sources is low. However, if this policy is maintained in the future the power system will become increasingly more difficult to manage, with high associated costs and inefficiencies.

With a shift towards small-scale dispersed generation, local distribution grids (including mini and micro grids), are gathering a lot of attention in the scientific community and much research funding. However the large-scale part of the power system must not be forgotten: it is not realistic to think of a future power system consisting solely of local distribution grids with generation coming solely from many small-scale generators. Large generators in the

further future will partly be of a renewable nature such as large (off-shore) wind farms and photovoltaic systems.

Fig.3. Vision of a Future Power System



Source: The European Electric Power System of the Future as seen in the ERMInE Project, Background paper for the workshops, European Commission, Community Research, Brussels, 2006

The future transmission system will be very similar to the present day situation, except for more power flows across the transmission network, due to trading and the additional presence of large-scale intermittent sources such as (off shore) wind power plants and photovoltaic systems. The local power distribution system(s) on the other hand may be very different from today. Nearly self-supporting rural, urban or industrial areas will be possible, compared to areas with a more classical (consumption only) behavior. Many generators of different technology based on renewable energy or on combined heat and power will be present here. Furthermore the future electricity customer will be more directly and active involved in the power system as an "owner" of part of the assets on the local distribution level. The customer's concern about environmental burdens will increase and he will progressively become "more in control", demanding sende differentiation (Power Quality and reliability) based on his specific needs.

3. CONCLUSION

Based on these visions, scenarios and prospects a number of consequences follow, such as: increased need for power now steering at the transmission level (bulk power), power flows in both directions at the local distribution level, more balancing needs (due to fluctuating nature of generation) and availability of real time price information and options for differentiating Power Quality and reliability. This gives rise to questions like:

- What will the power exchange layer between transmission (global) and distribution (local) look like?
- How will the emerging shared public-private responsibility for Power Quality and reliability investments be dealt with?
- How will the trilemma — dispersed generation technology - sustainability - security of supply — be solved for micro-generation?
- Which break through technologies will be the response to post-Kyoto requirements?
- What markets (mechanisms) are needed e.g. for balancing?
- How is the transition from the present state of the power system to the desired future accomplished? Which stakeholders must be involved and what is required to speed up the process?

A key question is how the technologies are developing for creating the power system of the future. For power generation a

best guess has been formed for the period 2005-2050 in terms of sustainable or CO₂-reducing technologies and their impact on expected market volume

For transmission and distribution technology, as well as end use technology a similar exercise was done stating the effect on reliability of the technology involved.

The vision for the way towards a properly functioning pan-European market for electricity is based on a series of strongly interlinked wholesale markets resulting in as large price areas as possible and ultimately - if possible - in one single pan-European price area. Achieving this vision will require a number of conditions related to market-places and transmission system operators

REFERENCES

- [1] Szkutnik J., Kolcun M., (red) Technical and economic aspect of modern technology transfer in context of integration with European Union, Mercury – Smekal Publishing House, Kosice, 2004
- [2] Roman A., Szkutnik J., Electrical Industrie in the future in the Europe The 2nd International Scientific Symposium, ELEKTROENERGETIKA EE'2003, Technical University of Kosice September 16-18, 2003, High Tatras,-Stara lesna, Slovak Republic pp. 53-64
- [3] Produktion and services processes in enterprises, Edited by Lucjan Kurzak, The Faculty of management Czestochowa University of technology, Monographs No 4, Czestochowa 2006
- [4] Szkutnik J., Witek A., The analysis of efficiency of investement in the distribution company The 2nd International Scientific Symposium, ELEKTROENERGETIKA EE'2003, Technical University of Kosice September 16-18, 2003, High Tatras,-Stara Lesna, Slovak Republic pp. 173-174
- [5] Szkutnik J. The Directions of the Energy Activity in Relation to the Priorityes of the European Commission., Proceadings of the IIIrd International Scientific Symposium ELECTROENERGETIKA, Stara Lesna, Slovak Republic 2005, s.16

ADRESSES OF AUTHORES

Czestochowa University of Technology, Faculty of Electrical Engineering, ul. Armii Krajowej 17, 42-200 Czestochowa, Poland, Phone: +48 34 3250808, E-mail: szkutnik@el.pcz.czest.pl