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ANALYSIS AND SCENARIOS OF ENERGY INFRASTRUCTURE EVOLUTION

PRELIMINARY STUDY

Final report

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ABSTRACT

The goal of this BfE funded activity was to launch a project proposal to be submitted to the seventh framework programme of the EU. The outcome is a description for the projected IRENE-40 project.

The IRENE-40 project will identify strategies for investors and regulators to build a more secure, ecologically sustainable and competitive European electricity system. The strategies will be presented in a roadmap, i.e. a timeline with actions and a description of development stages towards future electricity networks over the coming 40 years. It will provide investment strategies for the individual stakeholders.

The roadmap will rely on a scenario selected from a set of options, identified during the project and in discussion with the stakeholder community. Its preparation will be supported by a series of robust but flexible tools dedicated to the assessment, forecast and deployment of new technologies, network development strategies and market/regulatory analyses.

The roadmap and scenarios will explore options like HVDC, storage integration, synchronisation of national networks, etc. addressed in the topic Call.

RTD activities will be organised in four sequential work packages dedicated to fact finding, technologies and component deployment, solutions for more sustainable, secure and competitive networks and the formulation of the roadmap.

In advance of submission, the project plan, partnership and dissemination/exploitation actions have received the support of prominent members of the stakeholder community from across the breadth of Europe.

The project partners are Europe's best for the work required and will deliver the necessary outputs. The partners are from nine of the leading organisations/companies from across Europe. The Work Programme contains a robust instrument that catalyses dialogue with all parts of the European stakeholder community and drives dissemination and exploitation of the freely-available outputs. This is supported by a process to guarantee sustainability of action post-project, e.g. to allow alternative scenarios to be investigated by stakeholders. The total budget for this 4-year project is €5.52 M with €3.84 M contributed by the EC.

Project goals

The objective of this project was the study and the preparation of a proposal for topic 2007-ENERGY-7.3.4 “Analysis and Scenarios of Energy Infrastructure Evolution” in the seventh framework programme of the European Communities.

Project activities and outcomes

Performed work and acquired knwoledge

During the project, the following activities have been carried out:

- Analysis of the call documentation
- Analysis of European policies and research objectives
- Formation of an adequate partnership and determination of a strong coordinator
- Development of a work plan for the RTD activities
- Discussions with the EUresearch network
- Preparation of a proposal document

The proposal IRENE-40 “Infrastructure Roadmap for Energy Networks in Europe” was submitted on 28 June 2007. The coordinating institution will be Areva T&D UK, ETH Zurich the biggest single partner and work package 1 leader within the project.

Description of the IRENE-40 project

The objectives of the IRENE-40 project are:

O1.1 Gather relevant generation, consumption and market models
O1.2 Develop a method for the localisation of weak network points
O2.1 Find strategies for the deployment of upcoming technologies
O2.2 Build a technology database
O2.3 Determine the impact and value of demand side participation
O3.1 Elaborate network development strategies
O3.2 Develop infrastructure scenarios
O4.1 Set up a roadmap
O4.2 Identify investment strategies
O5 Constitute a Project Platform

The IRENE-40 project will address the current lack of a global system-wide and long-term strategic development perspective for Europe’s electrical power system infrastructure and establish an interface with the development of other energy systems (mainly natural gas or hydrogen). It will focus on assembling available knowledge created within former specific projects as well as delivering quantitative methodologies which can be applied to entire networks. The results from the following EU projects will, among others, be carefully reviewed: ENCOURAGED (Energy corridor optimisation for the European markets of gas, electricity and hydrogen), CASCADE MINTS (Technology options and effective policies to reduce greenhouse gas emissions and improve security of supply) and ERMINE (Electricity research road map in Europe).

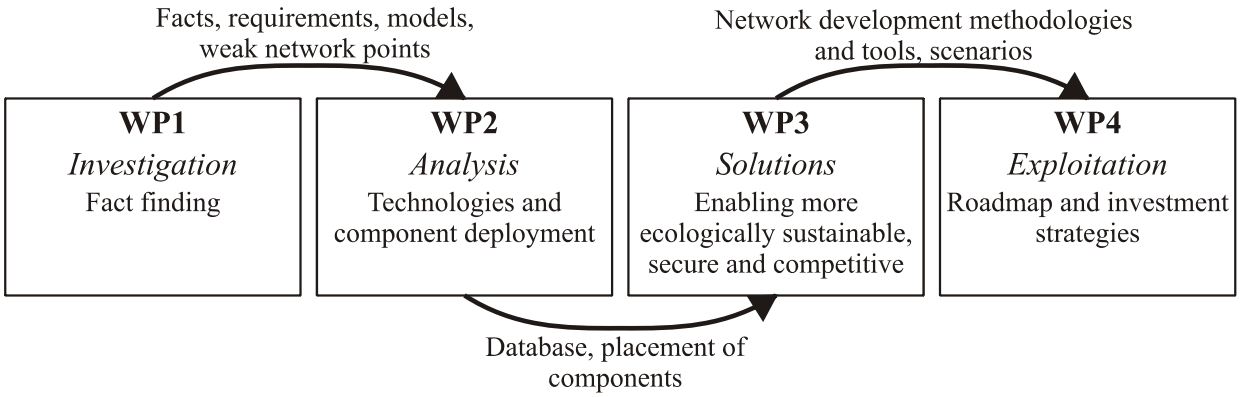

Figure 1: Relations among the RTD work packages in IRENE-40.

Stakeholders (electrical and electrical + gas TSOs, network owners, and governmental bodies) will be informed at an early stage during the project about its developments: a Project Platform will ensure the dissemination of the developed methodologies and establish a dialogue on the progress of the work within the RTD work packages. A contact to potential next users (e.g. national research programmes) will be established during the project in order to promote the further use and maintenance of the project deliverables after project completion.

The work will be organised in four RTD work packages (WP1-4) as well as a package for management (WP0) and a package dedicated to dissemination and sustainability of action (WP5). Figure 1 shows the relations among the RTD work packages

Work package 0 (Project Management): includes all of the actions necessary to ensure the effective coordination of the consortium, RTD, and leadership of the dissemination and knowledge exploitation activities. It also includes all the activities for assessment of progress and project results. Reflecting the importance of the management activity for the ultimate success of the project, considerable effort has been invested in defining the management structure and the management team. Special attention is also given to external dissemination and exploitation. Major Milestones: M0.2, M0.3, M0.4 Annual project reviews (Months 13, 25 and 37).

Work package 1 (Investigation): An initial fact finding phase will point out the boundary conditions and the general emphasis for the development of electrical network infrastructures and precisely set the scope of the targeted roadmap. The evaluation of the boundary conditions includes the review of consumption / generation models and their adaptation for further use in the creation of infrastructure development scenarios. Markets for energy will be monitored and analysed in order to prepare a description of the evolution of European energy markets to be included in these scenarios. *Major Milestones: M1.1 Targets formulation (Month 8), M1.2 Modelling framework (Month 14)*

Work package 2 (Analysis): The gathered information on consumption / generation and markets will be used to create a set of generic scenarios describing the context in which T&D networks will evolve in the future. Several network development schemes (refits, new components, deployment of new technologies) and deployment strategies for emerging technologies are investigated and gathered in the form of methodologies for network developments. Current and emerging technologies will be described in a database. Forecast methodologies for the component characteristics over time will be derived. *Major Milestones: M2.1 Database (Month 20), M2.2 Scenarios (Month 26)*

Work package 3 (Solutions): A strategy for the coordination of these local network developments in order to achieve the previously identified objectives will then be developed. The possibilities to provide this information in the form of an application guide or a software tool (script, macro or extension to existing packages) will be investigated and implemented. These methodologies will be used in order to develop a set of scenarios (reflecting different options), out of which a preferred scenario will be selected. *Major Milestones: M3.1 Measures for ecologically sustainable, competitive and secure networks (Month 36), M3.2 Scenario evaluation (Month 42).*

Work package 4 (Exploitation): The application of the strategy to the regions of Europe will permit the creation of a roadmap based on a reference scenario, illustrating the general actions to be undertaken and the incentives to be given as well as the perspective of the individual stakeholders and their individual behaviour. The roadmap will cover R&D as well as the deployment of existing and emerging technologies, which will guarantee a neutral position towards specific technologies. *Major Milestones: 4.1 Roadmap (Month 48).*

Work package 5 (Knowledge Dissemination and Sustainability of Action): is the project instrument for establishing and exploiting mechanisms for efficient communication, transfer of knowledge and provision of training to the external user and decision making community. Communication will involve use of existing external forums. More importantly, this WP will establish a Project Knowledge Platform which will provide a forum for enhanced dialogue, two-way knowledge transfer, training and exploitation of the project results and tools. The WP has the important task of ensuring sustainability of action such that the project outputs remain up to date, are fully supported and are available to the EC user and decision making community after completion of the project. *Major Milestones: M5.21 Announcement of first meeting of Project Knowledge Platform (Month 12), M5.22 First training session for use of project tools (Month 37), M5.31 Implementation of Sustainability of action plan (Month 40).*

This work programme was inspired by the work of the European Technology Platform SmartGrids [1],[2].

International cooperation

The preparation of the IRENE-40 proposal required the building of a strong European partnership. Collaborations with the following institutions have been established or reinforced:

- RWTH Aachen, ongoing collaboration
- TU Delft, ongoing collaboration
- ABB (Switzerland/Sweden), ongoing collaboration
- Siemens (Germany), ongoing collaboration
- Areva T&D (France/UK), ongoing collaboration
- Imperial college London, new collaboration
- NTUA Athens, new collaboration
- ECN (energy centre of the Netherlands), new collaboration

Overall appreciation

The preparation of the IRENE-40 permitted:

- The establishment of further relationships to leading institutions in Europe and confirmation of ETH Zurich's value as a strong player
- The creation of a new research effort on the basis of the existing national project "VoFEN" [3].
- The acquisition of practical knowledge in the preparation of Framework Programme proposals at ETH Zurich.

Because the initiative could be taken in Switzerland at ETH Zurich, this can be seen as a reinforcement of ETH Zurich's and Switzerland's position in the European research community in the topic of future electricity networks.

References

[1] European Technology Platform SmartGrids: ***Strategic research agenda for Europe's electricity networks of the future***. 2007, European commission, Directorate general for research: Brussels.

[2] European Technology Platform SmartGrids: ***Vision and strategy for Europe's electricity networks of the future***. 2006, European commission, Directorate general for research: Brussels.

[3] Vision of Future Energy Networks, ***Jahresbericht 2006***, 2006, Bundesamt für Energie, Bern.