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# MONITORING REPORT 2013

RESEARCH & DEVELOPMENT ROADMAP 2013–2022

European Network of  
Transmission System Operators  
for Electricity

entsoe



**COVER PICTURE:**

Nikola Tesla, with Roger Boskovich's book "Theoria Philosophiae Naturalis", in front of the spiral coil of his high-frequency transformer at East Houston St., New York

Nikola Tesla, (10 July 1856 – 7 January 1943) was a Serbian-American inventor, electrical engineer, mechanical engineer, physicist, and futurist best known for his contributions to the design of the modern alternating current (AC) electrical supply system.

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# DRAFTING TEAM



**BERARDO GUZZI**

R&D expert  
Terna, Italy



**CARLOS LLANOS**

R&D Senior Advisor  
REE, Spain



**ISABEL ALVITE**

R&D and Innovation Management  
REN, Portugal



**MANUEL GALVEZ, PHD**

R&D Project Leader  
Elia, Belgium



**THONG VU VAN, PhD**

R&D Advisor  
ENTSO-E, Belgium



**VLADIMIR STANOJEVIC, PHD**

Project Manager  
EMS, Serbia



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# INTRODUCTION

R&D Monitoring Report 2013 is an annual publication that assesses the research and development (R&D) work performed in various capacities throughout the European electricity sector within the overarching R&D Roadmap 2013–2022.

The report commences with background information on the monitoring process and concentrates on overall recent R&D achievements, gap analyses and recommendations for subsequent years. The report concludes with details on recent R&D achievements for each cluster, as well as background on the methodology used to monitor the projects presented in Appendix 1– R&D Achievements and Gaps; and with the complete results from the project surveys given in Appendix 2.

## AIMS & OBJECTIVES

The first main objective of this report is to inform stakeholders about our recent R&D work and share new knowledge. Furthermore, it allows us to monitor our progress in pursuing the destinations of R&D Roadmap 2013–2022. With this knowledge at their disposal, the Research Development Committee (RDC) at ENTSO-E is able to write the specifications for Implementation Plan 2015–2017.

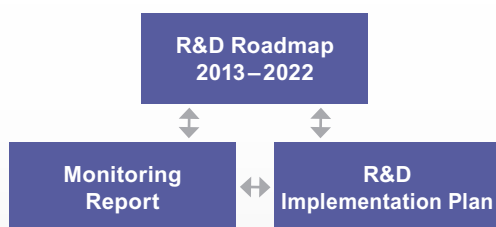


Figure 1: Inter-linking between different R&D deliverables

# RATIONALE AND METHODOLOGY

## CLUSTERS AND FUNCTIONAL OBJECTIVES

The monitoring exercise is done to check the progress and achievement of the R&D Roadmap. The R&D activities required to address the challenges of a rapidly shifting energy paradigm are grouped into six distinct, yet strongly interdependent Clusters. These clusters facilitate collaboration between stakeholders while providing a shared repository of ideas. This not only prevents redundant R&D, but also is highly cost-effective and exploits synergies inherent in Europe.

Each Cluster is broken down into a group of Functional Objectives (FO) on issues requiring collective management to prevent redundant R&D and thus ensure the complete coverage. The functional objectives are subdivided into multiple Specific Tasks (ST). The STs are addressed by a range of European and national R&D projects, whereby each project may cover one or even several STs and in turn apply to multiple FOs and Clusters.

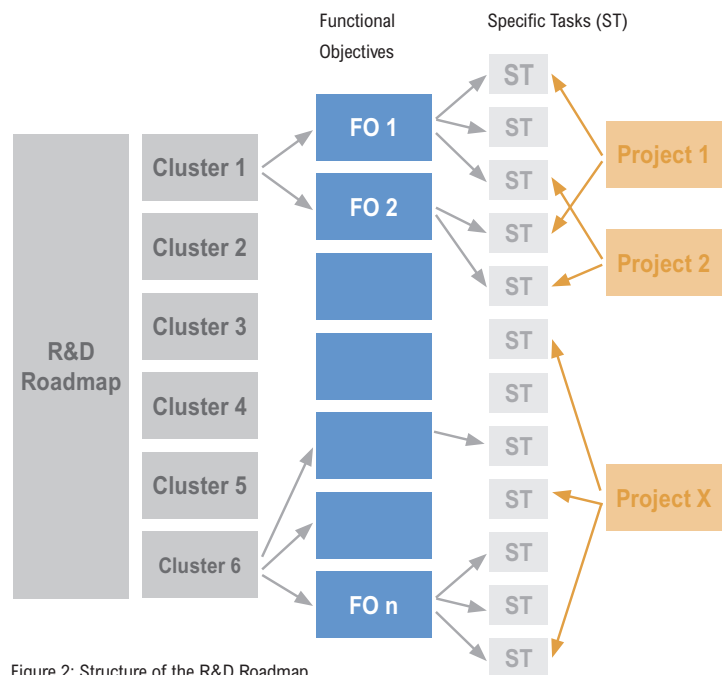


Figure 2: Structure of the R&D Roadmap



## ADAPTED METHODOLOGY

The monitoring methodology we applied in this report differs somewhat from what was used in Monitoring Report 2012. This year, our assessments are based on R&D Roadmap 2013–2022, which represents a major upgrade over R&D Plan 2011. However, the quantification of fulfilment percentage<sup>1)</sup> is done in the same direction without applying the weighting factors among clusters.



Figure 3: Process of the monitoring exercise

The process includes three steps: gathering information, processing information and packaging results. The Working group Monitoring and Knowledge Sharing (WG MKS) gathers the information via a questionnaire sent to project coordinators, whose projects are related to the objectives contained in the R&D Roadmap, both European and National. The template is designed to ask for information in relation to the project's contribution to different specific task of Functional Objectives, its timing and budget status. The information is then elaborated so as to give a complete overview of the R&D Roadmap advancements.

tion were funded either through the European Commission, member states or directly from TSOs.

A questionnaire was sent to each project coordinator to gather information on the various R&D projects across Europe at both European and national levels. The questionnaire was updated to comply with the new destinations in R&D Roadmap 2013–2022. The results indicated how each project contributed to its corresponding specific tasks, functional objectives and clusters. Hence it was possible to assess the completion statuses of specific clusters and functional objectives and ultimately the achievements of the entire Roadmap. Furthermore, project coordinators were asked to assess project efficiency and effectiveness as well as their milestone achievements and budget scenario.

Finally, the completion status of each FO, cluster and the Roadmap were then determined by assigning percentages to the following progress indicators:

- **Completed** – percentage of objectives that have been successfully finished
- **Ongoing** – percentage of objectives that are currently being worked on
- **Proposed** – percentage of objectives that have been proposed but are awaiting approval
- **Not started** – percentage of objectives where no work has commenced or been proposed

The progress indicators for each specific task of an FO were averaged to obtain the progress status of the FO itself. In contrast to Report 2012, no weighting was applied to the progress indicators of the clusters. Thus each FO within a cluster contributes equally to the overall progress status of the cluster, just as each cluster contributes equally to the progress of the Roadmap as a whole.

## SURVEY OF R&D PROJECTS

As shown in detail in Appendix 2, a total of 38 R&D projects were taken into account for this report. We selected those projects that we deemed to be relevant to TSOs and that had been performed within Europe. Furthermore, all projects under considera-

1) Reader may check a methodology to quantify fulfilment percentage of the R&D activities in the last Monitoring report 2012.

Project Level	Project Status			Total
	Proposed	Ongoing	Completed	
European	1	11	7	19
National	1	12	6	19
Total	2	23	13	38



FOR A COMPLETE LIST OF THE SURVEYED PROJECTS AND ALL OF THE RESULTS, REFER TO APPENDIX B.

Table 1: Summary of considered R&D projects related to TSO business at EU and national levels



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# MOVING FORWARD – R&D ACHIEVEMENTS

The detailed monitoring analyses of this report indicates that we have already reached many of the R&D Roadmap 2013-2022 destinations and technical objectives. It is essential to continue the progress by focussing on the remaining areas that are either currently under proposal or have yet to be started.

## ➔ TOP R&D ACHIEVEMENTS IN 2013:

**1. Three new European projects** (Best Paths, Garpur, InspireGrid)<sup>1)</sup> were started or under negotiation in 2013 .

1) Garpur, InspireGrid started in 2013 and Best Paths starts in early 2014.

**2. Four European projects** (Twenties, Optimate, Pegase and Safewind) have been successfully completed since the previous Monitoring Report 2012.

**3. Successful demonstration results from the Twenties project** have shown that the power infrastructure can be used much more efficiently than it currently is. By using the combined effect of dynamic line rating and power flow controlling devices to manage the flows in the European grid, more wind infeed can be integrated into the European grid, and local congestions can be alleviated in a flexible manner. Leading-edge research in short-term forecasting of wind power (Safewind) and 'high wind ride through control' (Twenties) have been successfully tested.

**4. A direct-current circuit breaker prototype was tested successfully (Twenties).** This establishes confidence in continuing the Best Paths project.

**5. Powerful new algorithms and full-scale prototypes have been developed in the Pegase project.** These can be run on the European Transmission Network model for state estimations, dynamic security analyses, optimisations and real-time dispatcher training.

**6. An open platform has been developed that simulates a wide range of market design variants and compares economic efficiency in the presence of massive intermittent generation capacities (Optimate).** This assessment provides the benefits per type of portfolio as well as costs and benefits, environmental impact and security of supply for the entire European power system.



## CLUSTER PROGRESS

Figure 4 provides an overview of progress of the R&D Roadmap and its clusters. As indicated, Clusters 1 to 3 have achieved the highest degrees of completion while many projects have yet to be started in Clusters 4, 5 and 6.

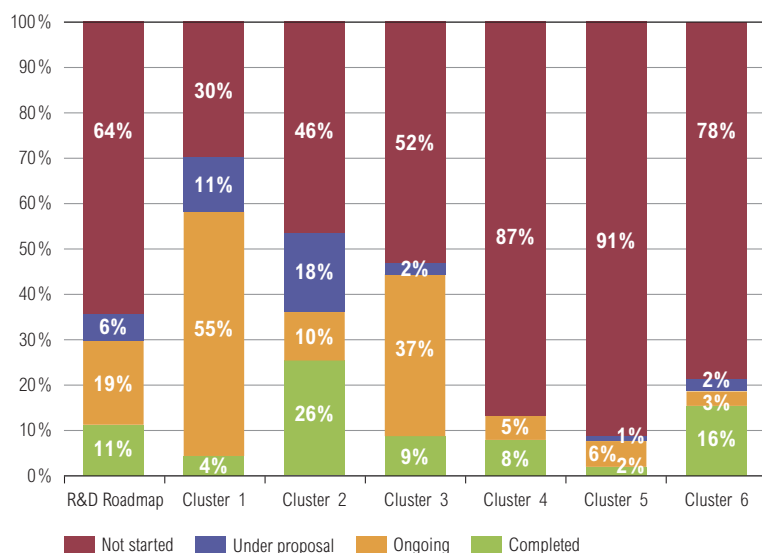


Figure 4: Cluster progress based on R&D Roadmap 2013–2022

### CLUSTER 1 – GRID ARCHITECTURE

This Cluster provides a set of scenarios and methods for developing network infrastructure that hosts massive amounts of renewable energy sources and growth in demand with acceptable network investments and operating costs beyond 2020. R&D is advanced and well covered owing to contributions from eHighway2050, Realisegrid, Inspiregrid and six other European and five national projects.

### CLUSTER 2 – POWER TECHNOLOGIES

This Cluster addresses the affordability and technical performance of components of emerging technologies that can significantly improve the operations of the interconnected transmission systems. Work is quite advanced due to R&D contributions from Twenties, Best Paths (upcoming) and six other European and nine national projects.

### CLUSTER 3 – NETWORK OPERATION

This Cluster studies ways of operating transmission systems that maintain high security of supply at reasonable costs. R&D is quite advanced with several significant projects underway: After, Pegase, iTesla, Umbrella, Safewind, upcoming Garpur, and other five European and eleven national projects.

### CLUSTER 4 – MARKET DESIGN

This Cluster studies ways and means of facilitating interaction between European electricity markets and the pan-European grid. The aim is to achieve a more efficient and integrated market by optimizing the energy mix at the pan-European level while ensuring security of supply. There are many R&D gaps in this Cluster. Around 13% is covered largely through Optimate, Ecogrid and other three European and three national projects.

### CLUSTER 5 – ASSET MANAGEMENT

This is a new Cluster that is developing cost-effective asset management strategies while optimising CAPEX and OPEX of the existing infrastructure. Currently, around 9% is covered owing to partial contributions from three European projects (Best Paths, GARPUR and InspireGrid). Work in this cluster will demonstrate how to utilise advanced measurement technology, improve our understanding of system constraints and develop optimal maintenance and replacement strategies in a grid where new and old assets coexist.

### CLUSTER 6 – JOINT TSO/DSO R&D ACTIVITIES

This cluster focuses on the TSO/DSO interface and new smart grid services at the DSO level and their utilisation for regulation and ancillary services. There are still many R&D gaps in this Cluster. Around 21% is covered owing to the contribution from Ecogrid and five other European and ten national projects.



**REFER TO APPENDIX A FOR A DETAILED MONITORING ANALYSIS OF THE R&D PERFORMED FOR EACH CLUSTER AND ITS FOs.**





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# GAPS AND RECOMMENDATIONS

As explained in the previous section, analyses were performed for each Cluster in order to identify the key R&D gaps. Part of these remaining topics is assigned as priorities for consideration in the Implementation Plan 2015–2017. In fact, as much as 64% of the destinations in R&D Roadmap 2013–2022 have yet to be started. This is understandable because R&D has only been underway since 2010 at the ENTSO-E level.

## AREAS REQUIRING HIGH R&D PRIORITIES:

- 1. Asset management:** to counteract the growing uncertainties of component life brought by renewable infeeds, a healthy, long-life infrastructure must be realised that effectively utilises capital assets.
- 2. Integration of novel power technologies:** to continuously provide technological solutions to increasing demands in transmission capacity and flexibility, and to accelerate the deployment process.
- 3. Market designs:** new market mechanisms for balancing, ancillary services and aggregator agents at the European level to support security of supply and fair trading.
- 4. Improved coordination between boundary grids:** emerging ancillary services from aggregated small-energy sources, demand response and management at DSO level provide extra means and system services for TSO operation. This will be the starting point of a chain of joint research and innovation activities required to improve cooperation between networks and to define the new active role of electricity customers.





## ➤ HARMONISATION OF R&D PROJECTS

The results of the project surveys indicate that there are only 38 R&D projects directly related to TSO business. Relative to the scope and operating range of ENTSO-E and its constituent TSOs, this is actually quite a low number. Furthermore, the topics of the R&D projects are rather disjointed and funding is fragmented at both the European and national levels. A more coherent approach is needed to increase the synergistic benefits of R&D work.

## ➤ OPEN DISCUSSION

It is important to understand that it will often be impossible to develop one-size-fits-all solutions for all applications. The immense scope of European transmission networks means that there will always be differences in opinions and approaches. Therefore, open discussion should always be encouraged between experts in the European electricity sector.

## ➤ KNOWLEDGE SHARING

Capturing and sharing new knowledge produced in the framework of R&D activities is vital for achieving our Roadmap goals. Systematic approaches are needed in order to perform the capture and sharing of knowledge in a simple and efficient way. This will help embed outcomes and new competences within European electricity industry, and foster new R&D activities at both academic and industry level. Some approaches are being tested within the framework of the Grid+ project and the first results will be available in 2014.

It is paramount to capture and share all new knowledge gained through R&D. Knowledge sharing of this nature, which is mostly restricted between project partners, must be enlarged to reach different stakeholders at the European level. When documented as lessons learnt or best practices, knowledge sharing will not only help to stimulate active participation in R&D activities, but will also help to shape future R&D projects by concentrating work on known R&D gaps.

Finally, R&D results have been applied one way or another in TSO businesses, however, to highlight their contributions to achieve the EU energy objectives, some demonstration with finished R&D projects should be performed. This will be one of the tasks of the WG MKS for next year.

## ➤ R&D GAPS

The gap analyses have shown that significant effort is still required to demonstrate new developments in power technologies. These demonstrations are necessary before deployment projects can proceed. It is important to strike a balance here between testing mature prototypes and preliminary technologies.

Much effort is still required to design and implement the Internal Electricity Market to host new grid users and incentivise new system services. The replacement of existing grid infrastructure is forcing TSOs to search for the best possible balance between investing in new power technologies while optimising and prolonging the performance of existing ones. The TSO/DSO interface must receive significant attention in order to increase system observability and deploy new services that ensure overall system security. For more details on additional results of the gap analyses performed for each Cluster, refer to Appendix I.



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# CONCLUSIONS

As this report clearly demonstrates, we are on the way of reaching our Roadmap destinations and meeting our technical objectives. Comparisons with Monitoring Report 2012 provide many examples where significant progress has been made. At the same time, our identification of R&D gaps allows us to apply corrective measures and assign action priorities for Implementation Plan 2015–2017.

Capturing and sharing new knowledge produced in the framework of R&D activities is vital for achieving our Roadmap goals. Lessons learnt and best

practices will not only stimulate active participation and application of R&D activities, but also help shape future R&D projects.

It is encouraging to achieve progress of R&D activities at European, national and TSO levels, although the R&D is still young for TSOs and the work force is thin. We are optimistic that we will be able to achieve the targets prescribed in R&D Roadmap 2013–2022. However, in order to achieve the goals, we require immense support with respect to financing, time, dedication and resources.







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# APPENDIX A

## R&D ACHIEVEMENTS AND GAPS

Cluster 1 – Grid Architecture .....	14
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# CLUSTER 1 – GRID ARCHITECTURE

This Cluster provides a set of scenarios and methods for developing network infrastructure that hosts massive amounts of renewable energy sources and growth in demand with acceptable network investments and operating costs beyond 2020.

Cluster 1 consists of the following Functional Objectives:

- T1: Definition of scenarios for pan-European network expansion;
- T2: Planning methodology for future pan-European transmission system;
- T14: Towards increasing public acceptance of transmission infrastructure.

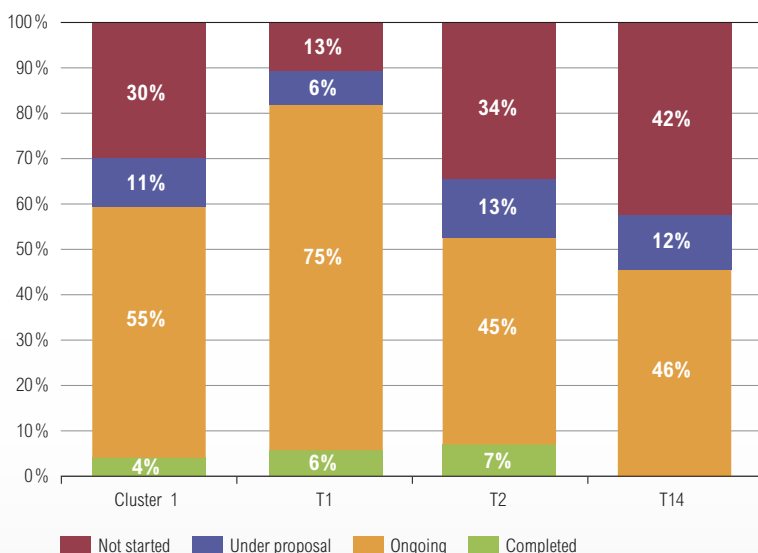
In this Cluster, there are nine European and five national projects.

## ACHIEVEMENTS

The R&D activities in this Cluster are already quite advanced and well covered thanks to contributions from e-Highway2050, Realisegrid, Inspiregrid and six other European and five national projects.

A new method and tool have been developed by e-Highway2050 that supports the planning of electricity highways based on various future power system scenarios, taking into account benefits, costs and risks. Various criteria, metrics, methods and tools must also be developed that help to design an optimal transmission infrastructure (Realisegrid). New planning tools are being developed that deal with large-scale renewable electricity production (Ewis, Best Paths). Combinations of market and grid modelling are also being studied that assess the added value of new grid infrastructures (Ewis). In addition, concepts for managing the electricity grid by 2025 are being investigated at the Danish power system of 2025 with 70% RES. At the regional level, market modelling capacities are being developed.

### PROGRESS OF CLUSTER 1 – GRID ARCHITECTURE



European Projects	Status
1 Best Paths	Proposed
2 e-Highway2050	Ongoing
3 Ewis	Completed
4 Garpur	Ongoing
5 Inspiregrid	Ongoing
6 Life	Ongoing
7 Realisegrid	Completed
8 Real-Smart	Ongoing
9 Twenties	Completed

National Projects	Status
1 Concept for management of the future electricity system 2025	Completed
2 Development of early warning systems (PMU/WAMS)	Ongoing
3 Development of market modelling capacity	Ongoing
4 Kriegers Flak	Ongoing
5 PoStaWind	Completed

FO	Specific Tasks of Functional Objectives	Comments
T1	<b>T1a.</b> – Define pan-European network expansion scenarios; identify maximum volume of RES and DER for pan-European network; analyze a combination of electricity and gas.	Analysis of the combination of electricity and gas should be done.
	<b>T1d.</b> – To provide offshore grid design: optimization methods for grid capacity, technology and topology taking into account wind power characteristics, i.e., low capacity factor.	Advanced grid designs.
T2	<b>T2a.</b> – Investigate state-of-the-art planning software, technology portfolios and different regulatory frameworks.	Shall address more specifically the regulatory framework.
	<b>T2c.</b> – Develop new algorithms and database functions for network simulation; enabling the integration of new emerging technologies such as HVDC, Gas Insulated Line, FACTS and storage.	More work necessary on network simulation of new devices.
	<b>T2g.</b> – Develop planning software to optimise location, coordination, control and integration of technologies within existing and future system architecture.	Needs European solution.
	<b>T2i.</b> – Proposal for network investment mechanisms at EU level.	Investment mechanisms at EU-level need a detailed study.
T14	<b>T14b.</b> – To contribute to developing and/or updating European guidelines on good practice in transparency and public engagement and permitting process.	EU-level guidance must be considered.
	<b>T14c.</b> – To produce guidelines for the construction of overhead power lines with reduced visual and environmental impact compared to existing construction guidelines and to ensure these guidelines are applicable across Europe.	EU-level guidance must be considered.
	<b>T14d.</b> – Analyze new technologies with reduced visibility of conductors, using coatings and nano-technologies.	Specific mention should be made of nanotechnologies and coatings.
	<b>T14e.</b> – To propose new tower designs for overhead power lines with less visual impact, audible noise and EMF; in some cases also with reduced sag of overhead lines.	EMF and audible noise reductions are not considered.
	<b>T14f.</b> – To develop methodologies and software to evaluate bird collisions, human and animal exposure to EMF, audible noises, etc.; reduction of impact.	EMF and audible noise reductions are not considered.
	<b>T14g.</b> – To providing methods for physical protection of the grid infrastructures against potential dangers: natural catastrophes, terrorism, cyber attacks etc.	Not started.

## CLUSTER 2 – POWER TECHNOLOGIES

This Cluster addresses the affordability and technical performance of components of emerging technologies that can significantly improve the operations of the interconnected transmission systems.

Cluster 2 consists of the following Functional Objectives:

- T3: Demonstration of power technology to increase network flexibility and operation means;
- T4: Demonstration of novel network architectures;
- T5: Interfaces for large-scale demonstration of renewable integration.

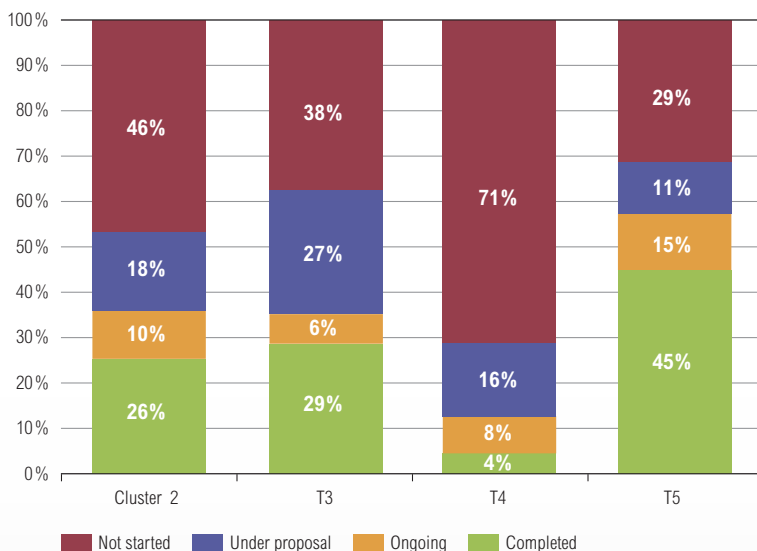
In this Cluster, there are eight European and nine national projects.

### ACHIEVEMENTS

This Cluster is one of the most advanced due to significant R&D contributions.

Many important power technologies were demonstrated in Twenties such as power devices and power flow management, direct-current (DC) grid structures, balancing fast winds in storm conditions, balancing winds using virtual power plants, and system services provided by wind farms. The follow-up proposal Best Paths will demonstrate large-scale integration of innovative transmission systems and operational solutions for inter-connecting renewable electricity production. An offshore multi-terminal solution is also being considered by Kriegers Flak. Other projects demonstrate 220 kV static synchronous series compensator (SSSC) devices for power flow control, wind power to heat pumps, demand response technology (DRT), early warnings system with power management units (PMU) and wide-area monitoring systems (WAMS).

#### PROGRESS OF CLUSTER 2 – POWER TECHNOLOGIES



European Projects	Status
1 Anemos Plus	Completed
2 Best Paths	Proposed
3 Ewis	Completed
4 Pegase	Completed
5 Real-Smart	Ongoing
6 Safewind	Completed
7 Storage	Ongoing
8 Twenties	Completed

National Projects	Status
1 220 kV SSSC device for power flow control	Ongoing
2 Cell controller pilot	Completed
3 Early warnings system (PMU/WAMS)	Ongoing
4 From wind power to heat pumps	Completed
5 Kriegers Flak	Ongoing
6 Management of the future electricity system 2025	Completed
7 PoStaWind	Completed
8 Sumo	Ongoing
9 Wampac	Proposed



FO	Specific Tasks of Functional Objectives	Comments
T3	<b>T3c.</b> – To demonstrate controllable off- and onshore solutions for vendor-independent, HVDC multi-terminal networks used to coordinate power flow, frequency control as well as protection and communications requirements.	Still needs large-scale demonstration at a major site.
	<b>T3d.</b> – To implement solutions for wide-area monitoring systems and demonstrate how to utilise such information in a coordinated manner during operations.	Must become an EU level project.
	<b>T3e.</b> – To investigate the influence of parallel routing of DC and AC lines on the same tower or parallel paths in order to facilitate existing infrastructure paths in an optimal manner.	Issues related with utilisation of DC lines within AC grid using the same infrastructure have yet to be covered.
T4	<b>T4a.</b> – To demonstrate on a large-scale new power technologies (incl. new materials) such as HVDC VSC, superconductivity, energy storage, fault current limiters and other promising technologies for joint management of on- and offshore networks.	There are still several issues not fully covered at EU-level (storage, superconductivity, fault current limiters...).
	<b>T4b.</b> – To validate various technology options to increase transmission capacity through selective reinforcement or implementation of an ultra-high voltage transmission system (“Super Grid”) or DC backbone.	Does not yet take ultra high voltage issues into consideration.
	<b>T4c.</b> – To propose new schemes to extend synchronous areas in the pan-European grid and connect these with back-to-back HVDC to increase their utilization and reduce the complexity of balancing, planning and operation.	Must become an EU level project.
	<b>T4d.</b> – To do research on the devices and concepts required to materialise multi-terminal DC grids which are to cope with current system needs and sources such as offshore generation.	Work still must be done on HVDC devices for a multi-terminal grid.
	<b>T4e.</b> – To coordinate offshore networks interconnected with various control areas; methods for coordinating load-frequency control, DC voltage control; other technologies required for DC (VSC) network.	More research is still required on how to coordinate various control areas.
	<b>T4f.</b> – To implement HVDC solutions to enhance reliability – bi-polar or mono-polar DC schemes.	Reliability issues still have to be addressed.
	<b>T4g.</b> – To determine standard DC voltage; Since VSC technologies eliminate the need for transformers, investment and maintenance costs will be reduced significantly. Weight and space are cost drivers particularly for offshore installations.	Not started.
T5	<b>T5a.</b> – To validate the contribution of RES to voltage and frequency control, balancing using VPP.	Large EU-level demonstration on voltage and frequency control.
	<b>T5b.</b> – To monitor and control the network in order to avoid large-scale intra-zone oscillations.	Large EU level demonstration is necessary.
	<b>T5d.</b> – To demonstrate with stakeholders various technologies for deploying energy mix from conventional and renewable resources.	Only contributions from a national project until now, a project is still required at the EU level.

## CLUSTER 3 – NETWORK OPERATION

This cluster studies ways of operating transmission systems that maintain high security of supply at reasonable costs.

Cluster 3 consists of the following Functional Objectives:

- T6: Innovative tools and methods to observe and control the pan-European network;
- T7: Innovative tools and methods for coordinated operation with stability margin evaluation;
- T8: Improved training tools and methods to ensure better coordination at the regional and pan-European levels;
- T9: Innovative tools and approaches for pan-European network reliability assessment.

In this Cluster, there are eleven European and eleven national projects.

European Projects	Status
1 After	Ongoing
2 Anemos Plus	Completed
3 Ewis	Completed
4 Garpur	Ongoing
5 InspireGrid	Ongoing
6 iTesla	Ongoing
7 Pegase	Completed
8 Real-Smart	Ongoing
9 Safewind	Completed
10 Twenties	Completed
11 Umbrella	Ongoing

National Projects	Status
1 Cell controller pilot project	Completed
2 Concept for management of the future electricity system	Completed
3 Demonstration of power load control mechanisms	Ongoing
4 Development of early warning systems	Ongoing
5 Energy data feed	Ongoing
6 Käva2	Ongoing
7 Management of future electricity system	Completed
8 PoStaWind	Completed
9 Samrel	Ongoing
10 Substation 61850	Ongoing
11 Wampac	Proposed

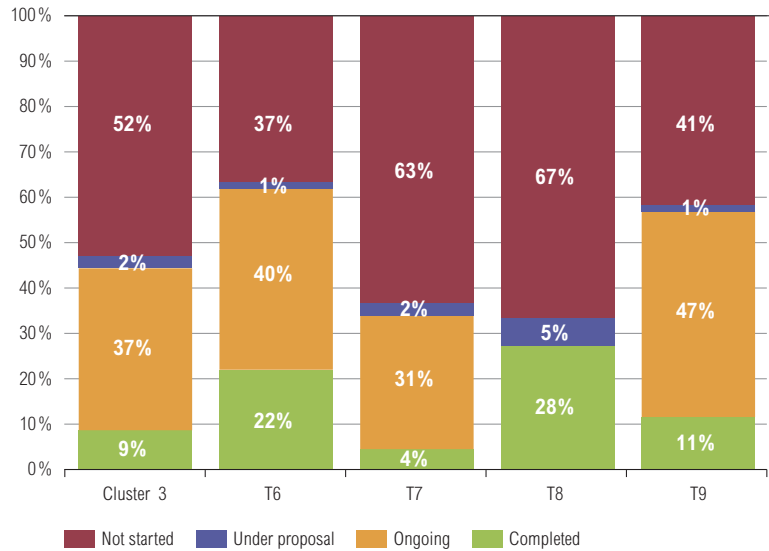


## ACHIEVEMENTS

R&D is quite advanced with several significant projects underway.

Methodologies are being developed for identifying vulnerability. Global risk assessment and contingency planning is being studied in the After project. iTesla provides a toolbox that supports future operation of the pan-European grid. Umbrella is developing algorithms for optimising network operation and control actions under consideration of operational uncertainties. A new project (Garpur) is developing and evaluating new system operations methodology for risk-based security criteria. Stochastic approaches have been provided by Anemos Plus. PoStaWind is investigating the possibility of large-scale integration of renewable energy systems (RES) in a demonstration grid (Nordic) and studying how this will affect the power phase, voltages and frequency stability.

### PROGRESS OF CLUSTER 3 – NETWORK OPERATION



## GAPS

FO	Specific Tasks of Functional Objectives	Comments
T6	T6. – Innovative tools and methods to observe and control the pan-European network.	There is still work to do on sensors, models, forecasting and the coordinated use of novel technologies; and some demonstration at EU-level.
T7	T7. – Innovative tools and methods for coordinated operation with stability margin evaluation.	There is still work to be done in most specific tasks in order to assure a coordinated operation.
T8	T8c. – To provide training, but also certification, to operators on a validated European power system model and improve emergency response procedures.	Common procedures for emergency scenarios should be developed and tested. Training and certification on a validated European System model is recommended.
	T8e. – To develop and test common procedures for emergency scenarios.	
	T8f. – To enable operator training by specifying the training simulator of the future, including the validation of critical algorithms.	
	T8g. – To enable experimentation on what future training should include and who should be involved in order to learn and test the benefits of coordination mechanisms in stable and critical situations	

## CLUSTER 4 – MARKET DESIGN

This cluster studies the ways and means to facilitate interactions between the European electricity markets and the pan-European grid. The aim is to achieve a more efficient and integrated market by optimizing the energy mix at the pan-European level while ensuring security of supply.

Cluster 4 consists of the following Functional Objectives:

- T10: Advanced pan-European market tools for ancillary services and balancing, including active demand management;
- T11: Advanced tools for capacity allocation and congestion management;
- T12: Tools and market mechanisms for ensuring system adequacy and efficiency in electric systems integrating very large amounts of RES generation.

In this Cluster, there are five European projects and three national projects.

### ACHIEVEMENTS

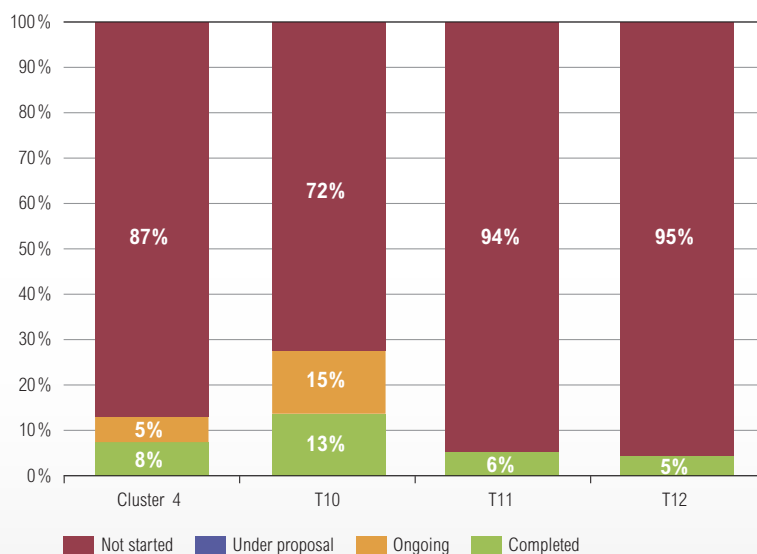
There are many R&D gaps in this Cluster. Around 13% is covered largely through Anemos Plus, Optimate and the other European and national projects. Different processes and market mechanisms have been taken into account by Optimate, which developed a simulation platform for modelling European electricity markets.

A means of flexibly utilising different resources and thus better integrate renewable energy systems (RES) has been developed that links technology capabilities with potential market mechanisms. This covers the optimisation of hydro storage to better management of wind farm portfolios in electricity market (Anemos Plus), the use of residential heat pumps to manage fluctuations in wind and market signals (From wind to heat pumps). The impact of integrating RES on inertia and how 'synthetic inertia' – that can potentially be provided by converters from RES and distributed energy resources (DER) – will affect existing speed governor systems (PostaWind) has also been investigated.

European Projects	Status
1 Anemos Plus	Completed
2 Ecogrid EU	Ongoing
3 e-Storage	Ongoing
4 Optimate	Completed
5 Real-Smart	Ongoing

National Projects	Status
1 Energy data feed	Ongoing
2 From wind power to heat pumps	Completed
3 PoStaWind	Completed

### PROGRESS OF CLUSTER 4 – MARKET DESIGN





<b>FO</b>	<b>Specific Tasks of Functional Objectives</b>	<b>Comments</b>
<b>T10</b>	<b>T10a.</b> – To model aggregated RES/DER, flexible conventional generation, demand and storage systems to be used for market design, market mechanisms and simulation tools for planning and operation purposes.	Still needs more modelling, mainly on DC links, flexible generation and demand and storage systems (e.g. batteries, CAES, flywheels, super-capacitors, etc.).
	<b>T10b.</b> – To design market mechanisms for incentivizing both maximization of the provision of ancillary services (including aggregated RES, cogeneration and high-efficiency production, demand, storage, etc.) and the minimization of the use of ancillary services; the aim is to harmonise the requirements of provider licenses with supervision, control and recording of services provided.	Still needs more work on the market design for the provision and use of ancillary services (RES, production and demand, storage systems, etc.).
	<b>T10c.</b> – To develop a new tool for detailed analyses of various balancing market designs to identify best practices and to perform large-scale experiments with metered customers that demonstrate the costs and benefits of demand-side management required at the pan-European level.	Still needs large-scale experiments of balancing markets at EU level.
	<b>T10d.</b> – To design and develop mechanisms and platforms for cross-border balancing and power reserve services, moving towards possible future development of regional/pan-regional platforms and even markets based on economic and technical analyses, all the while operating within the required security margins.	Some numerical simulations of cross border balancing have been performed, but most of the task is still missing.
	<b>T10e.</b> – To develop a set of data exchange templates and information and communication technology (ICT)infrastructure to enable ancillary and balancing services at the EU level.	Some work has been done at national level, but most of the task is still missing.
<b>T11</b>	<b>T11a.</b> – To investigate interactions between system operations and dynamic capacity and reserve allocation methods at the regional and pan-European levels to cope with uncertainties from RES, load and system disturbances.	Not started.
	<b>T11b.</b> – To model strategies in view of improved congestion management and to analyze the possibility of more efficient options, if any exist, for the pan-European electricity market.	There is a platform to perform studies, but most of the task is still missing.
	<b>T11c.</b> – To expand flow-based market coupling in areas with interdependent flows, based on successful experience.	Some numerical simulations have been performed, but most of the task is still missing.
	<b>T11d.</b> – To develop an algorithm for computing potential extra capacities in real time or as closely as possible; taking into account security criteria and without the need for counter-trading issues.	Not started.
	<b>T11e.</b> – To performing risk-benefit analyses and develop an interface using the Congestion Management Module.	Not started.

FO	Specific Tasks of Functional Objectives	Comments
T12	<p><b>T12a.</b> – To design market mechanisms that allow participation of RES (active and reactive power control), storage devices and conventional generation shift to ensure system adequacy and efficiency.</p>	<p>There is a platform to perform studies, but most of the task is still missing.</p>
	<p><b>T12b.</b> – To design investment incentive regimes that promote conventional and RES generation flexibility, new transmission capacity and to foster storage systems.</p>	<p>Not started.</p>
	<p><b>T12c.</b> – To design grid tariff mechanisms for active demand-side management to correlate the load curve and RES integration.</p>	<p>Not started.</p>



# CLUSTER 5 – ASSET MANAGEMENT

This is a new Cluster that is searching for the most cost-effective asset management strategy. It will enable the use of advanced measurements, better knowledge of constraints, and optimal maintenance and replacement strategies in a grid where new and old assets must necessarily coexist.

Cluster 5 consists of the following Functional Objectives:

- T15: Developing approaches to determine and to maximise the lifetime of critical power components for existing and future networks;
- T16: Development and validation of tools which optimise asset maintenance at the system level, based on quantitative cost/benefit analysis;
- T17: Demonstrations of new asset management approaches at EU level.

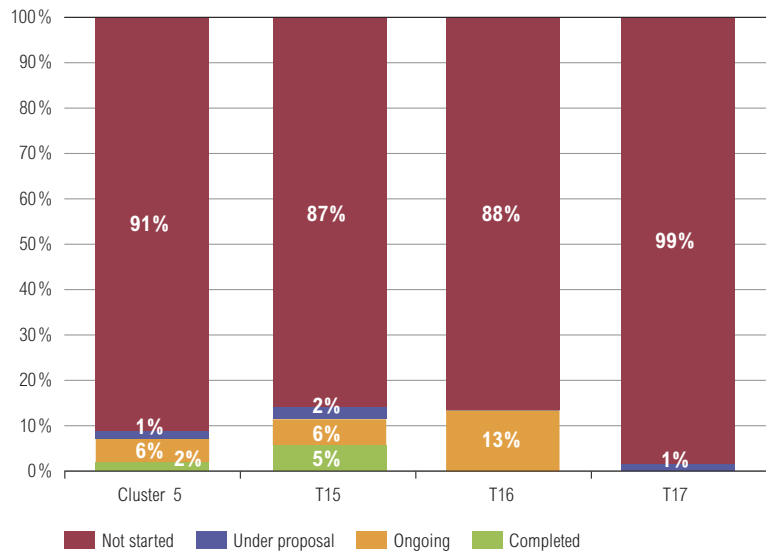
European Projects	Status
1 Best Paths	Proposed
2 Garpur	Ongoing
3 InspireGrid	Ongoing

In this Cluster, there are three European projects.

## ACHIEVEMENTS

Ongoing work in the Garpur project is refining models and/or developing new ones to predict the deterioration process of main grid components and how this can determine failure probability.

PROGRESS OF CLUSTER 5 – ASSET MANAGEMENT



## GAPS

FO	Specific Tasks of Functional Objectives	Comments
T15	<b>T15a.</b> – To identify the parameters (climate conditions, operating conditions, potential for hardware and software, among others) that impact the life span of components.	Not started.
	<b>T15b.</b> – To establish evaluation/estimation protocols for component statuses that are comparable across TSOs, with in-depth analysis and shared experiences.	Not started.
	<b>T15c.</b> – To develop a methodology to determine and expand the life span of components including conventional components (conductor, insulator, tower, breaker, etc.) and new components such as power electronic devices and digital devices.	There is work ongoing that will cover approximately half of the issues considered.
	<b>T15d.</b> – To propose dedicated, intelligent monitoring and analysis of results from equipment operation.	Some work is ongoing, but most of the task is still missing.
	<b>T15e.</b> – If necessary, specify new measurement devices and associated ICT system.	Some work is ongoing, but most of the task is still missing.



FO	Specific Tasks of Functional Objectives	Comments
<b>T15</b>	<b>T15f.</b> – To assess the environmental impact (noise, leakage, etc.) and safety for workers or nearby inhabitants (especially in case of failure), taking into account aging processes and technical obsolescence.	There is work ongoing that will cover approximately half of the issues considered.
	<b>T15g.</b> – To validate the added value of individual lifetime assessment compared to an average assessment of several similar components based on generic parameters (age of equipment, switching steps, etc.).	Not started.
	<b>T15h.</b> – To assess the benefits of partially renewing small components (joints, etc.) or adding new protective layers (paint coating) to extend life span. A methodology is to be developed that assesses the capability of each component to be partially repaired or where the coating is to be replaced.	Not started.
	<b>T15i.</b> – To develop new ways of detecting component failure based on failure models.	Not started.
<b>T16</b>	<b>T16a.</b> – To define methods and tools to optimize asset management at the system level. The proposed methodology provides an assessment of the costs and benefits of different asset management strategies. The methodology proposes a risk-based approach at the system level, including interactions between equipment, impacts on security and quality of supply and also environmental and safety constraints. The organization of maintenance work, availability of spare parts (supply chain, quantity of spare parts and location) are part of the global optimization challenge.	Some work is ongoing, but most of the task is still missing.
	<b>T16b.</b> – To provide tools for dynamic management of outage planning & maintenance schedules.	Not started.
<b>T17</b>	<b>T17a.</b> – To utilise embedded ICT to monitor individual assets and to define a method of supervision based on this information at the system level for several TSOs in parallel.	Not started.
	<b>T17b.</b> – To implement robotics for problem detection as well as to intervene in hostile environments and avoid the need for human maintenance. These include UAV to inspect overhead lines and robots that move while “grabbing” the conductors.	Not started.
	<b>T17c.</b> – To implement maintenance activities with the network “on”, especially for DC equipment.	Not started.
	<b>T17d.</b> – To propose scaling-up and replication rules for new asset management approaches at the pan-European level.	Some work is ongoing, but most of the task is still missing.



# CLUSTER 6 – JOINT TSO/DSO R&D ACTIVITIES

This cluster focuses on TSO/DSO interface and new smart grid services at the DSO level and their utilisation for regulation and ancillary services.

Cluster 6 consists of the following Functional Objectives:

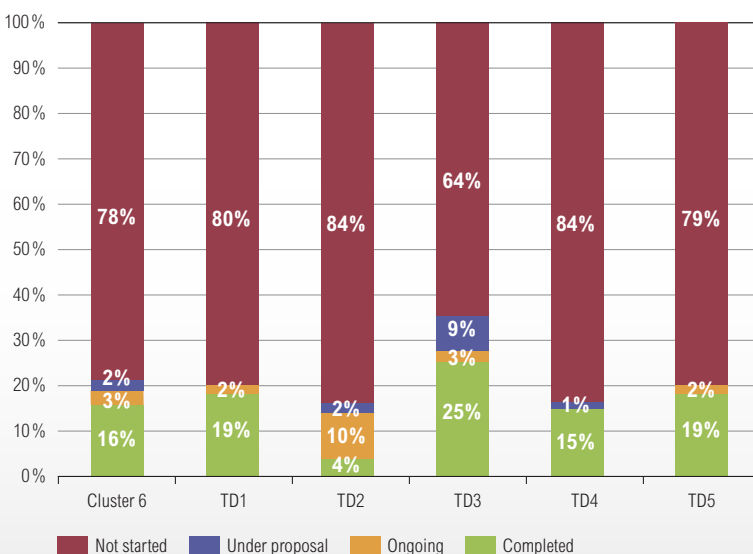
- TD1: Increased observability of the distribution system for transmission network management and control;
- TD2: The integration of demand side management at DSO level into TSO operations;
- TD3: Ancillary services provided through DSOs;
- TD4: Improved defence and restoration plan;
- TD5: Methodologies for scaling-up and replicating.

In this Cluster, there are six European and ten national projects.

## ACHIEVEMENTS

The Ecogrid project has demonstrated new balancing mechanisms with a 5-minute real-time price response system that provides additional regulation power from smaller customers with both reducible demand and excessive load in periods. Risk estimation indices related to connect distributed generation has been addressed in the Proba project. The Increase European project elaborates on tools to overcome technical challenges and also defines a new business model that allows customers connected at the low-voltages to provide ancillary services. Furthermore, the Gredor project will develop several tools for modelling the interaction between electricity providers (DSOs and TSOs) in the market. By demonstrating power load control mechanisms, it will be possible to develop solutions for aggregating load data and consequently increase efficiency and security at the DSO level.

### PROGRESS OF CLUSTER 6 – JOINT TSO/DSO R&D ACTIVITIES



European Projects	Status
1 Anemos Plus	Completed
2 Ecogrid EU	Ongoing
3 Increase	Ongoing
4 Real-Smart	Ongoing
5 Safewind	Completed
6 IvolvDSO	Proposed

National Projects	Status
1 A complete and normalised 61850 substation	Ongoing
2 Belgium east loop active network management	Completed
3 Cell controller pilot project	Completed
4 Concept for management of the future electricity system	Completed
5 Demonstration of power load control mechanisms	Ongoing
6 Energy data feed	Ongoing
7 From wind power to heat pumps	Completed
8 Evcom	Completed
9 Gredor	Ongoing
10 Proba	Ongoing



FO	Specific Tasks of Functional Objectives	Comments
TD1	<p><b>TD1a.</b> – To improve short-term (15', 1h, 3h) and long-term (5-day) forecast engines for PV, wind, CHP and loads.</p>	<p>Some work has been done on wind power forecasting, but most of the task is still missing.</p>
	<p><b>TD1b.</b> – To develop new modelling methods and tools for steady-state (static parameters) and dynamic analyses (capacities up to 1 MW).</p>	<p>Not started.</p>
	<p><b>TD1c.</b> – To deliver methods and tools for planning new DER connections at the TSO/DSO boundary (response to new connection requirements).</p>	<p>Some work is ongoing at national and EU levels, but on a limited scale.</p>
	<p><b>TD1d.</b> – To develop new methodologies for data processing at various system levels (DSO, TSO).</p>	<p>Some work is ongoing at national level, but most of the task is still missing.</p>
	<p><b>TD1e.</b> – To design new architecture, control systems and communications (including GIS assistance) that allow multiple new generators to be connected and share information with TSOs.</p>	<p>Not started.</p>
	<p><b>TD1f.</b> – New integrated functions (scaling-up techniques) and solutions for technical aggregation of DER data acquisition capabilities for improved DER production observability.</p>	<p>Some work has been done at national level, there is a need for an EU-level project.</p>
TD2	<p><b>TD2a.</b> – To define demand requirements and data required by TSOs for the pan-European planning tool.</p>	<p>Some work has been done at national level, but most of the task is still missing, and there is a need for an EU-level project.</p>
	<p><b>TD2b.</b> – To demonstrate active customer involvement with “indirect” feedback (provided post-consumption) and “direct” feedback (real-time) and suitable operations designed to achieve a reduction in peak demand (10–15 %).</p>	<p>Some work has been done, but most of the task is still missing.</p>
	<p><b>TD2c.</b> – To model customer/load behavior and segmentation and quantify the degree of flexibility provided by distribution networks, e.g., through reconfiguration or other methods.</p>	<p>Some work has been done, but most of the task is still missing.</p>
TD3	<p><b>TD3a.</b> – Novel ways of providing ancillary services through loads and their impact on transmission networks; the highly variable and unpredictable nature of DER and RES places new constraints on these ancillary services.</p>	<p>Still work to do on this issue :Impact on transmission networks due to new constraints on ancillary services resulting from unpredictable nature of DER and RES.</p>
	<p><b>TD3b.</b> – Simulation environments to demonstrate the viability and options of ancillary services provision by aggregated loads at DSO level.</p>	<p>Need for accurate simulation models to demonstrate the viability and options of ancillary services provision by aggregated loads at DSO level.</p>
	<p><b>TD3c.</b> – Technologies and tools for active and reactive power control of DER, with TSO/ DSO coordination to provide extra power flow control, load management and islanding.</p>	<p>Need to foster the TSO/DSO coordination.</p>

FO	Specific Tasks of Functional Objectives	Comments
TD3	<b>TD3d.</b> – New actors and market models that enable DER to provide ancillary services.	More work needed on market models and mainly in new actors.
	<b>TD3e.</b> – New models that describe products and services to be tested on selected segments of customers and their impact on future ancillary services in the presence of large-scale DER integration.	Not started.
	<b>TD3f.</b> – New market models that account for the price-sensitive nature of loads and consequently their increased flexibility.	Some work has been done at national level, but most of the task is still missing, and there is a need for an EU-level project.
	<b>TD3g.</b> – Analysis of legal, contractual and regulatory aspects of ancillary services provided by distributed generation and/or loads, allowing for more aggregated business models.	Some work is proposed at European level, but most of the task is still missing.
TD4	<b>TD4a.</b> – To develop simulation tools and methods that detect weaknesses in the system with respect to reconnecting DER and storage systems.	Some work is ongoing, mainly on the contribution of DER to provide services to the system, but most of the issues have not started.
	<b>TD4b.</b> – To develop simulation tools and methods of assessing the risk of break-downs during reconnection.	
	<b>TD4c.</b> – To develop simulation tools for interactive system restoration including advanced forecast tools developed in TD1 for wind, solar PV and other variable RES.	
	<b>TD4d.</b> – To address regulatory and technical challenges that implement restoration plans at the pan-European level.	
	<b>TD4g.</b> – To train operators about the evolution of national regulatory schemes in order to foster coordination efforts.	
TD5	<b>TD5a.</b> – To investigate the acceptable levels of risk and uncertainty in studies in order to adequately assess the scaling-up and replication potentials of solutions and their requirements.	Some work is ongoing, mainly at national level and on data exchange protocols and on the definition of open standard data models that ensure interoperability; but most of the issues have not started.
	<b>TD5b.</b> – To document the methodology for future project participants so that they can assess the experimental data requirements required to design a smart grid demonstration.	
	<b>TD5c.</b> – To develop information models for the smart grid security, taking into account business interactions and the physical processes of delivering electricity, and also the disruption of business communications, or of the delivery of electricity.	
	<b>TD5d.</b> – To analyze data exchange protocols that reinforce interoperability constraints at the pan-European level with an adequate level of security.	
	<b>TD5e.</b> – To study appropriate confidentiality constraints in the developed toolbox to ensure appropriate sharing of results while at the same time preserving stakeholder interests.	
	<b>TD5f.</b> – To define open standard data models that ensure interoperability between different data exchange protocols for smart grid applications and to increase competitiveness.	





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# APPENDIX B

## PROJECT LIST

This year, surveys were sent to each project coordinator to gather information on the various R&D projects across Europe (at both European and national levels). The survey collected general information about the project, its contribution to the R&D Roadmap, how results were being disseminated (knowledge sharing), as well as key performance indicators and statuses in terms of results, overall milestones, timing and budget scenario.

The results show how each project contributed to its corresponding Specific Tasks, Functional Objectives and Clusters. Hence it was possible to assess the completion statuses of specific Clusters and Functional Objectives and ultimately the achievements of the entire Roadmap.

The following table lists all 38 projects that were taken into account for R&D Monitoring Report 2013. 19 of these projects are being performed at the European level while a further 19 are being performed at the national level. The criteria for the selection of the projects has been their relevance for TSOs and their expected contribution to the ENTSO-E R&D Roadmap and to the fulfilment of the EU energy policy goals; although only projects that have provided answers to the survey were finally taken into account. Furthermore, all projects under consideration were funded either through the EU, member states or directly from TSOs.

List of R&D projects contributing to the R&D Roadmap .....	30
Project sheets .....	32

## LIST OF R&D PROJECTS CONTRIBUTING TO THE R&D ROADMAP

No	Project	Status	Level
1	220 kV SSSC device for power flow control	Ongoing	National
2	A complete and normalised 61850 substation	Ongoing	National
3	AFTER	Ongoing	European
4	ALMACENA	Ongoing	National
5	ANEMOS Plus	Completed	European
6	Belgium East Loop network	Completed	National
7	BEST PATHS	Proposed	European
8	Cell controller pilot project	Completed	National
9	Concept for management of the future electricity system	Completed	National
10	Development of early warnings systems (PMU/WAMS)	Ongoing	National
11	Development of market modelling capacity	Ongoing	National
12	Ecogrid EU	Ongoing	European
13	e-HIGHWAY 2050	Ongoing	European
14	Energy Data Feed	Ongoing	National
15	e-STORAGE	Ongoing	European
16	EVCOM	Completed	National
17	EWIS	Completed	European


No	Project	Status	Level
18	From wind power to heat pumps	Completed	National
19	GARPUR	Ongoing	European
20	GREDOR	Ongoing	National
21	INCREASE	Ongoing	European
22	InspireGrid	Ongoing	European
23	iTESLA	Ongoing	European
24	KÄVA2	Ongoing	National
25	Kriegers Flak	Ongoing	National
26	LIFE	Ongoing	European
27	OPTIMATE	Completed	European
28	PEGASE	Completed	European
29	PoStaWind	Completed	National
30	PROBA	Ongoing	National
31	REALISEGRID	Completed	European
32	REAL-SMART	Ongoing	European
33	SAFEWIND	Completed	European
34	SAMREL	Ongoing	National
35	SUMO	Ongoing	National
36	TWENTIES	Completed	European
37	UMBRELLA	Ongoing	European
38	WAMPAC	Proposed	National


# PROJECT SHEETS


220 kV SSSC DEVICE FOR POWER FLOW CONTROL	
<b>Project Coordinator:</b> Vicente Gonzalez	<b>Company:</b> Red Eléctrica de España (Spain)
<b>E-mail:</b> vgonzalez@ree.es	<b>Phone:</b> +34-91-650-20-12
<b>Address:</b> Conde de los Gaitanes, 177 – 28109 Alcobendas (Madrid, Spain)	
<b>Start/End:</b> 2009/2014	<b>Current status:</b> Ongoing
<b>Budget:</b> € 5.5 million	<b>Funding scheme:</b> Granted by PSE during 2009–2010 and INNFACTO during 2011–2014 (Spanish R&D Programs)
<b>Members of the consortium:</b> - TSOs: REE (ES) - Others: INGETEAM (ES), INCOESA (ES)	
<b>Brief project description:</b> Design, construct, set up in operation and test a FACTS (SSSC) to prevent overload situations in the 220 kV transmission grid and reduce the measures that the System Operator has to make for solving overloads, like reduce the meshing of the network or curtail wind production.	
<b>Key words:</b> FACTS, SSSC, Power flow control, Power electronics	
<b>Website of the project:</b> None	
<b>Functional objectives:</b> T3	


A COMPLETE AND NORMALISED 61850 SUBSTATION	
<b>Project Coordinator:</b> Vicente Gonzalez	<b>Company:</b> Red Eléctrica de España (Spain)
<b>E-mail:</b> vgonzalez@ree.es	<b>Phone:</b> +34-91-650-20-12
<b>Address:</b> Conde de los Gaitanes, 177 – 28109 Alcobendas (Madrid, Spain)	
<b>Start/End:</b> 2009/2015	<b>Current status:</b> Ongoing
<b>Budget:</b> € 4.2 million	<b>Funding scheme:</b> Financed 100 % by Red Eléctrica de España
<b>Members of the consortium:</b> - TSOs: REE (ES)	
<b>Brief project description:</b> Use the standard IEC61850 as a means to improve the design, maintenance and operation of the substation automation systems. Design a standard substation considering the existing and new solutions developed by the vendors collaborating in the project. Build and set-up in operation a IEC61850 HV substation.	
<b>Key words:</b> 61850 standardization, Digital substation, Process bus	
<b>Website of the project:</b> None	
<b>Functional objectives:</b> T6, TD5	



<b>AFTER A Framework for electrical power systems vulnerability identification, defense and Restoration</b> 	
<b>Project Coordinator:</b> Emanuele Ciapessoni	<b>Company:</b> RSE – Ricerca sul Sistema Energetico (Italy)
<b>E-mail:</b> Emanuele.Ciapessoni@rse-web.it	<b>Phone:</b> +39-02-39-92-57-66
<b>Address:</b> RSE – Via Rubattino 54, 20134 Milan (Italy)	
<b>Start/End:</b> Oct. 2011/Sept. 2014	<b>Current status:</b> Ongoing
<b>Budget:</b> € 5.0 million (€ 3.5 million granted)	<b>Funding scheme:</b> Granted by 7th Framework Programme (Call FP7-SEC-2010-1)
<b>Members of the consortium:</b> - TSOs: Elia (BE), Terna (IT), ČEPS, a.s. (CZ) - Others: ENEA (IT), SINTEF EN (NO), SINTEF ICT (NO), Genoa University (IT), UCD University (IE), City University (UK), ALSTOM Power (FR), SIEMENS (DE), JRC (BE)	
<b>Brief project description:</b> AFTER addresses vulnerability evaluation and contingency planning of the energy grids and energy plants considering also the ICT systems used in protection and control. Main addressed problems concern high impact, wide spread, multiple contingencies and cascading.	
<b>Key words:</b> Security, Risk assessment, Emergency control, Defense, Restoration	
<b>Website of the project:</b> www.after-project.eu	
<b>Functional objectives:</b> T7, T9	

<b>ALMACENA</b> 	
<b>Project Coordinator:</b> Belén Díaz-Guerra	<b>Company:</b> Red Eléctrica de España (Spain)
<b>E-mail:</b> bdguerra@ree.es	<b>Phone:</b> +34-91-650-20-12
<b>Address:</b> Conde de los Gaitanes, 177 – 28109 Alcobendas (Madrid, Spain)	
<b>Start/End:</b> 2009/2013	<b>Current status:</b> Ongoing
<b>Budget:</b> € 4.0 million	<b>Funding scheme:</b> Presented to EU FEDER
<b>Members of the consortium:</b> - TSOs: REE (ES)	
<b>Brief project description:</b> Installation and testing of 1 MW electrochemical battery in a substation of the transmission grid.	
<b>Key words:</b> Energy Storage, Load shift, RES integration	
<b>Website of the project:</b> None	
<b>Functional objectives:</b> T2	

ANEMOS Plus 	
<b>Project Coordinator:</b> Dr. George Kariniotakis	<b>Company:</b> ARMINES/MINES ParisTech (France)
<b>E-mail:</b> georges.kariniotakis@mines-paristech.fr	<b>Phone:</b> +33-0-4-93-95-75-01 (ext. 7599)
<b>Address:</b> MINES-ParisTech/ARMINES, Centre for Energy & Processes (CEP), P.O. Box N° 207, 06904 Sophia Antipolis Cedex (France)	
<b>Start/End:</b> Jan. 2008/June 2011	<b>Current status:</b> Completed
<b>Budget:</b> € 5.7 million	<b>Funding scheme:</b> Granted by 6th Framework Programme
<b>Members of the consortium:</b>	
<ul style="list-style-type: none"> <li>- TSOs: REN (PT), REE (ES), EIRGRID (IE), SONI (GB), PPC (System Operator of Crete Island, GR), EDF-Guadeloupe (System Operator of Guadeloupe Island, FR)</li> <li>- Others: EWE (DE), Acciona Energia (ES), DONG Energy Generation (DK), Danish Technical University (DK), OVERSPEED GmbH (DE), Energy &amp; Meteo Systems GmbH (DE), ENFOR (DK), University Carlos III Madrid (ES), INESC Porto (PT), CENER (ES), University College of Dublin (IE), University of Antilles &amp; Guyane (FR), National Technical University of Athens-ICCS (GR)</li> </ul>	
<b>Brief project description:</b> Advanced tools for the management of electricity grids with large-scale wind generation, demonstration.	
<b>Key words:</b> Wind energy, Wind power forecasting, Decision making under uncertainty, Reserves estimation, Congestion management, Scheduling, Wind/storage coordination, Optimal trading, Uncertainties management, Demonstration.	
<b>Website of the project:</b> <a href="http://www.anemos-plus.eu/">http://www.anemos-plus.eu/</a>	
<b>Functional objectives:</b> T6, T7, T10, TD1	

ACTIVE NETWORK FEASIBILITY ASSESSMENT ON THE BELGIUM EAST LOOP NETWORK 	
<b>Project Coordinator:</b> Vanessa De Wilde	<b>Company:</b> Elia (Belgium)
<b>E-mail:</b> vanessa.dewilde@elia.be	<b>Phone:</b> +32-22-49-55-71
<b>Address:</b> Culliganlaan,1G – 1831 Diegem (Belgium)	
<b>Start/End:</b> Sept. 2010/June 2011	<b>Current status:</b> Not specified
<b>Budget:</b> Not specified	<b>Funding scheme:</b> Funded 100 % by Elia
<b>Members of the consortium:</b>	
<ul style="list-style-type: none"> <li>- TSOs: Elia (BE)</li> <li>- Others: ORES (BE), Smarter Grid Solutions (UK)</li> </ul>	
<b>Brief project description:</b> The project aims at designing an active network solution based on the power systems analysis. It will define principles of access for generators to perform a curtailment assessment that will help to estimate how often limits are threatened. The project will provide guidelines for the active network solution deployment as well as a cost estimate.	
<b>Key words:</b> Active network management, Distributed generators, Curtailment assessment	
<b>Website of the project:</b> None	
<b>Functional objectives:</b> T12, TD1	

## BEST PATHS



**Project Coordinator:** Vicente Gonzalez

**Company:** REE

**E-mail:** vgonzalez@ree.es

**Phone:** +34-91-625-98-10

**Address:** Paseo Condes Madrid

**Start/End:** Jan. 2014/Dec. 2017

**Current status:** final negotiation phase, Grant agreement signature forthcoming

**Budget:** € 63.0 million, EU funding € 35.5 million

**Funding scheme:** FP7

**Members of the consortium:**

- TSOs: REE, Terna, Elia, 50Hertz, Statnett, Mavir, Energinet.dk
- Others: Nexans, Toshiba, Prysmian, 3M, Gamesa, and others

**Brief project description:** To demonstrate HVDC for connecting offshore RES, multi-terminal HVDC, HVDC – HV AC interface, repowering of AC corridors, and superconductivity, to propose dedicated, intelligent monitoring with temperature measurements for dynamic line rating.

**Key words:** HVDC, HVDC grids, HVDC interoperability, rehabilitation of HVDC links, superconductors, AC repowering

**Website of the project:** None

**Functional objectives:** T1, T3, T15

## THE CELL CONTROLLER PILOT PROJECT



**Project Coordinator:** Not specified

**Company:** Energinet.dk (Denmark)

**E-mail:** kbe@energinet.dk

**Phone:** +45-23-33-89-54

**Address:** Tonne Kjaersvej 65, 7000 Fredericia (Denmark)

**Start/End:** Nov. 2004/Oct. 2011

**Current status:** Completed

**Budget:** € 13.4 million

**Funding scheme:** Funded 100 % by Energinet.dk

**Members of the consortium:**

- TSOs: Energinet.dk (DK)
- Others: SydEnergi Net (DK), Spirae Inc (USA), Energynautics GmbH (DE), Kalki Tech (India), Tjæreborg Industri (DK), PonPower (DK)

**Brief project description:** The project is to help adapt the Danish power system to future requirements by increasing the extent of system control and monitoring to ensure that power generation and consumption balance.

**Key words:** Virtual power plant, ancillary services, reliability

**Website of the project:** None

**Functional objectives:** T3, T5, T6, TD3

## CONCEPT FOR MANAGEMENT OF THE FUTURE ELECTRICITY SYSTEM



**Project Coordinator:** Not specified

**Company:** Energinet.dk (Denmark)

**E-mail:** kbe@energinet.dk

**Phone:** +45-76-22-45-35

**Address:** Tonne Kjaersvej 65, 7000 Fredericia (Denmark)

**Start/End:** Jan. 2009

**Current status:** Not specified

**Budget:** Not specified

**Funding scheme:** Not specified

**Members of the consortium:**

- TSOs: Energinet.dk (DK)
- Others: Danish Energy Association (DK)

**Brief project description:** To describe and calculate a “Danish business case for full Smart Grid dissemination” from a socio economical perspective.

**Key words:** Not specified

**Website of the project:** None

**Functional objectives:** T1, T2, T3, T5, T6, T10, TD1, TD3, TD4

## DEVELOPMENT OF EARLY WARNINGS SYSTEMS (PMU/WAMS)



**Project Coordinator:** Not specified

**Company:** Energinet.dk (Denmark)

**E-mail:** kbe@energinet.dk

**Phone:** +45-76-22-45-35

**Address:** Tonne Kjaersvej 65, 7000 Fredericia (Denmark)

**Start/End:** 2006/2012

**Current status:** Ongoing

**Budget:** Not specified

**Funding scheme:** Financed 100 % by Energinet.dk

**Members of the consortium:**

- TSOs: Energinet.dk (DK)
- Others: CET, DTU (DK), Universitetet of Kassel (DE)

**Brief project description:** The purpose is to develop systems that can monitor the overall power system state and alert system operators and other protection systems for critical situations in the power system.

**Key words:** None

**Website of the project:** None

**Functional objectives:** T2, T5, T6, T7, T9, TD4

## DEVELOPMENT OF MARKET MODELLING CAPACITY



**Project Coordinator:** Erkki Sapp

**Company:** Elering

**E-mail:** erkki.sapp@elering.ee

**Phone:** Not specified

**Address:** Not specified

**Start/End:** 2012/2014

**Current status:** Ongoing

**Budget:** € 0.4 million

**Funding scheme:** national

**Members of the consortium:**

- TSOs: Elering (EE), AST (LV), Litgrid (LT)
- Others: Ea Energy Analyses (DK)

**Brief project description:** Increasing market modelling capacity in Baltic countries based on Balmorel model. Developing long-term energy scenarios for the region.

**Key words:** Market modelling

**Website of the project:** None

**Functional objectives:** T1

## ECOGRID EU



**Project Coordinator:** Ove S. Grande

**Company:** SINTEF Energi AS (Norway)

**E-mail:** Ove.S.Grande@sintef.no

**Phone:** +47-92-60-99-92

**Address:** SINTEF Energy Research, N-7465 Trondheim, Norway

**Start/End:** Jan. 2011/Aug. 2015

**Current status:** Ongoing

**Budget:** € 21.0 million

**Funding scheme:** Granted by 7th Framework Programme

**Members of the consortium:**

- TSOs: Energinet.dk (DK), Elia (BE)
- Others: SINTEF (NO), Østkraft (DK), Siemens (DK, DE), ECN (NL), IBM (DK, CH), EANDIS (BE), EnCT (DE), Tecnalía (ES), DTU-CET (DK), AIT (AU), TUT (EST), Landis + Gyr (DK)

**Brief project description:** The primary focus is to develop a new real time market (5 min prices) as a supplement to the existing balancing markets and to demonstrate how smartgrid technology and flexible DER can contribute to the balancing ability in the future power system with a growing share of intermittent production.

**Key words:** Balancing Market, Demand Response, Smartgrids, intermittent production

**Website of the project:** [www.eu-ecogrid.net](http://www.eu-ecogrid.net)

**Functional objectives:** T10, T11, T12, TD2, TD3

## E-HIGHWAY 2050



**Project Coordinator:** Gérald Sanchis

**Company:** RTE (France)

**E-mail:** gerald.sanchis@rte-france.com

**Phone:** +33-1-41-02-12-80

**Address:** RTE – Tour Initiale, 1 Terrasse Bellini, 92800 Puteaux (France)

**Start/End:** Apr. 2012/Dec. 2014

**Current status:** Ongoing

**Budget:** € 14.6 million

**Funding scheme:** Granted by 7th Framework Programme

**Members of the consortium:**

- TSOs: RTE (FR), Amprion (DE), REN (PT), Elia (BE), APG (AT), Energinet (DK), EKC (YU), PSE (PL), HTSO (GR), REE (ES), Svenska (SE), Transelectrica (RO), CEPS (CZ), Swissgrid (CH), TERNA (IT)
- Others: Sintef (NO), ECN (NL), Technofi (FR), RSE (IT) DENA (DE), ENTSO-E (BE), Brunel (UK), Comillas (ES), IST (PT), Leuven (BE), Ensiel (IT), Tu Berlin (DE), IPE (PL), Eurelectric (BE), Europacable (BE), EWEA (BE), T&D Europe (BE), Poyry (IK), E3G (BE)

**Brief project description:** The overarching goal of the e-Highway2050 project is to develop the foundations of a modular and robust expansion of the pan-European network from 2020 to 2050 which will be required to be on line with the three European energy policy pillars.

**Key words:** None

**Website of the project:** [www.e-highway2050.eu/](http://www.e-highway2050.eu/)

**Functional objectives:** T1, T2, T5

## ENERGY DATA FEED



**Project Coordinator:** Kristo Klesment

**Company:** Elering

**E-mail:** kristo.klesment@elering.ee

**Phone:** Not specified

**Address:** Not specified

**Start/End:** 2012/2015

**Current status:** Ongoing

**Budget:** € 1.0 million

**Funding scheme:** Norwegian Financial Mechanism

**Members of the consortium:**

- TSOs: Elering, Statnett
- Others: Ericsson (EE), CGI (EE, NO), Estonian Renewable Energy Association (EE), DSO (EE), district heating (EE)

**Brief project description:** To design, implement and test an open software platform for energy consumptions monitoring and management from customer perspective capable to interact with grids and to provide data feeds to service providers for an efficient use of energy.

**Key words:** Smart grid, demand side management, standardization, ICT

**Website of the project:** None

**Functional objectives:** T10

## ESTORAGE



**Project Coordinator:** Olivier Teller

**Company:** Alstom (France)

**E-mail:** olivier.teller@power.alstom.com

**Phone:** +34-91-650-20-12

**Address:** 82 Avenue L. Blum, 38041 Grenoble (France)

**Start/End:** Oct. 12/Sept. 17

**Current status:** Ongoing

**Budget:** € 23,3 million

**Funding scheme:** Granted by 7th Framework Programme

**Members of the consortium:**

- TSOs: Elia
- Others: Algoé, Alstom, DNV KEMA, EDF, Imperial College London

**Brief project description:** eStorage aims to improve energy management by developing a solution for cost-effective integration of intermittent renewable energy generation into the electrical grid. Objectives:

- Demonstrate technical and economic feasibility of upgrading an existing fixed speed pumped hydro storage to variable speed technology.
- Enhance the functionality of IT systems to develop grid management solutions in line with real-time market systems
- Quantify the benefits of an EU-wide rollout of variable speed pumped hydro storage's under alternative scenarios.
- Propose changes to the market and regulatory frameworks, to support appropriate business models for flexible energy storage in the EU.
- Develop and assess technology solutions allowing the upgrade of 75 % of European pumped hydro storage to variable speed to obtain additional capacity for flexible load balancing

**Key words:** variable-speed pumped hydro storage, energy management, market and regulatory framework

**Website of the project:** <http://estorage-project.eu/>

**Functional objectives:** T4, T10

## EVCOM



**Project Coordinator:** Not specified

**Company:** Energinet.dk (Denmark)

**E-mail:** kbe@energinet.dk

**Phone:** +45-76-22-45-35

**Address:** Tonne Kjaersvej 65, 7000 Fredericia (Denmark)

**Start/End:** Jan. 2008/Dec. 2010

**Current status:** Ongoing

**Budget:** Not specified

**Funding scheme:** Financed 100 % by Energinet.dk

**Members of the consortium:**


- TSOs: Energinet.dk (DK)
- Others: Danish Energy Association (DK), a number of Danish DSO's (DK)


**Brief project description:** The primary purpose is to establish a concept for electric vehicles and their communication with the power system. The concept disseminated to the standardization work and to relevant stakeholders.

**Key words:** None

**Website of the project:** None

**Functional objectives:** TD5

<b>EWIS European Wind Integration Study</b> 	
<b>Project Coordinator:</b> Hubert Lemmens	<b>Company:</b> Elia (Belgium)
<b>E-mail:</b> hubert.lemmens@elia.be	<b>Phone:</b> +32-25-46-71-01
<b>Address:</b> Keizerslaan, 20 – 1000 Brussel (Belgium)	
<b>Start/End:</b> 2007/2010	<b>Current status:</b> Completed
<b>Budget:</b> € 4.0 million	<b>Funding scheme:</b> Granted by 6th Framework Programme
<b>Members of the consortium:</b> - TSOs: Elia (BE), Transpower GmbH (DE), 50Hertz Transmission (DE), Amprion GmbH (DE), CEPS (CZ), Eirgrid (IE), Energinet.dk (DK), HTSO (GR), National Grid (UK), PSE (PL), REE (ES), REN (PT), RTE (FR), Tennet TSO B.V. (NL), Verbund (AT) - Others: EC, EWEA, Eurelectric, EFET, IEA, Tradewind	
<b>Brief project description:</b> EWIS has focused on the immediate network related challenges by analysing detailed representations of the existing electricity markets, network operations, and the physical power flows and other system behaviours that result. The starting point was the actual conditions in 2008 with future challenges assessed against realistic representations of network extensions and reinforcements taken from national development plans. In general, detailed information on user and network developments are only available for a limited number of future years and so 2015 was chosen as a suitable horizon for assessing how current plans will address future challenges. Given the importance of the 2020 targets, however, the study examined the prospects for further developments beyond 2015. Provided important input for TYNDP 2010, the system needs for Network Pilot Code and system security aspects for the future coordinated and stable operation of the Pan European transmission system.	
<b>Key words:</b> None	
<b>Website of the project:</b> www.wind-integration.eu	
<b>Functional objectives:</b> T2, T3, T5, T9	

<b>FROM WIND POWER TO HEAT PUMPS</b> 	
<b>Project Coordinator:</b> Not specified	<b>Company:</b> Energinet.dk (Denmark)
<b>E-mail:</b> kbe@energinet.dk	<b>Phone:</b> +45-76-22-44-06
<b>Address:</b> Tonne Kjaersvej 65, 7000 Fredericia (Denmark)	
<b>Start/End:</b> 2010/2012	<b>Current status:</b> Not specified
<b>Budget:</b> € 1.0 million	<b>Funding scheme:</b> Financed 100 % by Energinet.dk
<b>Members of the consortium:</b> - TSOs: Energinet.dk (DK) - Others: Danish Energy Authority, Centre for Energy Savings (DK)	
<b>Brief project description:</b> To control 300 intelligent heat pumps as if they were one big energy storage facility capable of storing electricity as heat.	
<b>Key words:</b> None	
<b>Website of the project:</b> www.styrdinvarmepumpe.dk	
<b>Functional objectives:</b> T5, T10, T12, TD2, TD3, TD4, TD5	



## GARPUR



**Project Coordinator:** Oddbjorn Gjerde

**Company:** SINTEF Energy AS

**E-mail:** oddbjorn.gjerde@sintef.no

**Phone:** Not specified

**Address:** Not specified

**Start/End:** Sept. 2013/Aug. 2017

**Current status:** Ongoing

**Budget:** € 10.84 million

**Funding scheme:** Granted by 7th Framework Programme

### Members of the consortium:

- TSOs: Statnett (NO), Elia (BE), RTE (FR), Landsnet (IS), Energinet (DK), CEPS (CZ), ESO EAD (BU)
- Others: Sintef (NO), Université de Liège (BE), Reykjavik University (IS), KU Leuven (BE), Aalto University (FI), TU Delft (NL), University of Strathclyde (UK), University of West Bohemia (CZ), Norwegian University of Science and Technology (NO), Technofi (FR), University of Duisburg-Essen (DE), Technion Israel Institute of Technology (IL), Technical University of Denmark – DTU (DK)

**Brief project description:** GARPUR designs, develops and assesses new probabilistic reliability criteria and evaluates their practical use while maximising social welfare as they are implemented progressively over the next decades at a pan-European level. The new management methodologies encompass multiple business activities (system development, asset management, system operation) that, in turn, ensure coherent decision-making at the respective time horizons. After practical validation by the TSOs, these alternatives are analysed with the help of a quantification platform. Pilot tests are performed by individual TSOs or (when appropriate) a group of TSOs. An implementation roadmap is delivered for deployment of the resulting technical and regulatory solutions to keep the pan-European system reliability at optimal socio-economic level.

**Key words:** None

**Website of the project:** None

**Functional objectives:** T1, T2, T9, T16

## GREDOR



**Project Coordinator:** Damien Ernst

**Company:** Université de Liège (ULg)

**E-mail:** damien.ernst@ulg.ac.be

**Phone:** Not specified

**Address:** Not specified

**Start/End:** Feb. 2013 /Jan. 2017

**Current status:** Ongoing

**Budget:** € 4.34 million

**Funding scheme:** National (Walloon region)

### Members of the consortium:

- TSOs: Elia (BE)
- Others: Université de Liège (BE), FPMons (BE), ORES (BE), TECTEO (BE), EdF Luminus (BE), Tractebel Engineering (BE)

**Brief project description:** GREDOR is a smartgrid project in Wallonia covering the economic and technical aspects of the new long term planning, operational and real time processes to be redesigned with the DSOs and market actors. The focus is on the MV network but the interrelationships with the HV and MV grid will be analyzed. GREDOR will propose several market options to model the interactions between the grid operators and the market players and will develop decision supporting tools for the 3 timeframes. The proposal is in line with the conclusions of the REDI platform managed by the Walloon regulator CWAPE.

**Key words:** None

**Website of the project:** <https://gredor.be/>

**Functional objectives:** TD1, TD3

## INCREASE



**Project Coordinator:** Bart Meersman

**Company:** Ghent University (Belgium)

**E-mail:** Bart.Meersman@ugent.be

**Phone:** +32-497-66-71-68

**Address:** Sint-Pietersnieuwstraat 41, 9000 Ghent (Belgium)

**Start/End:** Sep. 2013/Dec. 2016

**Current status:** Ongoing

**Budget:** € 4.39 million

**Funding scheme:** Granted by 7th Framework Programme

**Members of the consortium:**

- TSOs: Elia (BE).
- Others: Ghent University (BE), EANDIS (BE), Liander (NL), Elektro Gorenjska (SL), Stomnetz Steiermark (AT), Aristotle University of Thessaloniki (GR), Joanneum Research Forschungs-gesellschaft (AT), Technical University Eindhoven (NL), University of Ljubljana (SL), Alenco (BE), Korona d.d. (SL), Mastervolt International (NL).

**Brief project description:** The INCREASE project will focus on how to manage renewable energy sources in the LV and MV networks, to provide ancillary services (towards DSOs but also TSOs), in particular voltage control and the provision of reserves. INCREASE will enable distributed RES (DER) and loads to go beyond just exchanging power with the grid, enabling DSO to evolve from congestion manager to capacity manager, resulting in a more efficient exploitation of the current grid capacity, facilitating thus higher DER penetration at reduced cost. The INCREASE simulation platform will enable the validation of the proposed solutions and provides the DSOs with a tool they can use to investigate the influence of DER in their distribution network. Validation will be performed by lab tests and field trials in real-life operational distribution networks.

**Key words:** None

**Website of the project:** None

**Functional objectives:** TD1, TD3

## INSPIREGRID



**Project Coordinator:** Not specified

**Company:** RSE

**E-mail:** Not specified

**Phone:** Not specified

**Address:** Not specified

**Start/End:** Sep. 2013 / –

**Current status:** Not specified

**Budget:** Not specified

**Funding scheme:** FP7

**Members of the consortium:**


- TSOs: RTE


**Brief project description:** To analyse the needs, concerns, wants and expectations of the stakeholders and general public; to develop suitable processes for an effective communication and real participation of the stakeholders and general public; to improve the existing methodologies to estimate and to represent the effects (impact and benefits) of transmission projects in Europe using a multi-criteria and multi-stakeholder framework.


**Key words:** None


**Website of the project:** None

**Functional objectives:** T14, T6, T15

iTESLA 	
<b>Project Coordinator:</b> Christian Lemaitre	<b>Company:</b> RTE (France)
<b>E-mail:</b> christian.lemaitre@rte-france.com	<b>Phone:</b> +33-1-39-24-40-78
<b>Address:</b> RTE/DES, 9 rue de la porte de buc, bp561, 78005 Versailles Cedex (France)	
<b>Start/End:</b> Jan. 2012/Dec. 2015	<b>Current status:</b> Ongoing
<b>Budget:</b> € 19.4 million	<b>Funding scheme:</b> Granted by 7th Framework Programme
<b>Members of the consortium:</b> - TSOs: RTE (FR), Elia (BE), NGC (UK), REN (PT), Statnett (NW), HTSO (GR), CORESO(BE) - Others: AIA (ES), Artelys (FR), BULL (FR), PEPITE (BE), Quinary (IT), Tractebel (BE), Technofi (FR), Imperial College (UK), INESC Porto (PT), KTH (SE), K.U.Leuven (BE), RSE (IT), DTU (DK)	
<b>Brief project description:</b> The goal of this 4 year R&D project is to develop and validate an open interoperable toolbox which will bring support, by 2015, to future operations of the pan-European electricity transmission network, thus favouring increased coordination and harmonisation of operating procedures among network operators. New concepts, methods and tools are developed to define security limits of the pan European system and to quantify the distance between an operating point and its nearest security boundary: this requires building its most likely description and developing a risk based security assessment accounting for its dynamic behaviour. The chain of resulting tools meets 3 overarching functional goals: i) To provide a risk based security assessment accounting for uncertainties around the most likely state, for probabilities of contingencies and for corresponding preventive and corrective actions, ii) to construct more realistic states of any system (taking into account its dynamics) over different time frames (real-time, intraday, day ahead, etc.), iii) to assess system security using time domain simulations (with less approximation than when implementing current standard methods/tools).	
<b>Key words:</b> Pan European coordination, Security assessment, Risk-based security analysis, System dynamic behavior, Large non convex optimization techniques	
<b>Website of the project:</b> www.itesla-project.eu	
<b>Functional objectives:</b> T7	

KÄVA2 	
<b>Project Coordinator:</b> Jarno Lamponen	<b>Company:</b> Fingrid (Finland)
<b>E-mail:</b> jarno.lamponen@aalto.fi	<b>Phone:</b> +34-91-650-20-12
<b>Address:</b> Not specified	
<b>Start/End:</b> 2007/2013	<b>Current status:</b> Ongoing
<b>Budget:</b> Not specified	<b>Funding scheme:</b> Not specified
<b>Members of the consortium:</b> - TSOs: Fingrid (FI) - Others: Aalto University (FI)	
<b>Brief project description:</b> Doctoral thesis project on power system security. The purpose is to develop probability based methods to supplement the n-1 criterion.	
<b>Key words:</b> Reliability, N-1	
<b>Website of the project:</b> None	
<b>Functional objectives:</b> T1	

KRIEGERS FLAK COMBINED GRID SOLUTION 	
<b>Project Coordinator:</b> Not specified	<b>Company:</b> Energinet.dk (Denmark)
<b>E-mail:</b> kbe@energinet.dk	<b>Phone:</b> +45-7622-4420
<b>Address:</b> Tonne Kjaersvej 65, 7000 Fredericia (Denmark)	
<b>Start/End:</b> Nov. 2009/Dec. 2016	<b>Current status:</b> Ongoing
<b>Budget:</b> Not specified	<b>Funding scheme:</b> EEPR
<b>Members of the consortium:</b> - TSOs: Energinet.dk (DK), 50Hertz Transmission (DE)	
<b>Brief project description:</b> To design the first offshore interconnected multi-terminal HVDC-HVAC and connect up to 1.800 MW offshore wind turbines.	
<b>Key words:</b> None	
<b>Website of the project:</b> None	
<b>Functional objectives:</b> T1, T3, T4, T12	

LIFE Biodiversité 	
<b>Project Coordinator:</b> Gaëlle Vervack	<b>Company:</b> Elia
<b>E-mail:</b> Gaëlle.Vervack@elia.be	<b>Phone:</b> Not specified
<b>Address:</b> Not specified	
<b>Start/End:</b> Sep. 2011/Aug. 2016	<b>Current status:</b> Ongoing
<b>Budget:</b> € 2.55 million	<b>Funding scheme:</b> LIFE Programme (DG Environment)
<b>Members of the consortium:</b> - TSOs: Elia (BE), RTE (FR) - Others: SOLON asbl (BE), CARAH asbl (FR)	
<b>Brief project description:</b> The aim of the Elia Biodiversity project is to develop innovative techniques for the creation and maintenance of corridors under overhead lines, allowing the maximisation of their potential benefits for biodiversity. The expected benefits include: the preservation of the natural beauty of the landscape; improved attractiveness to tourists, hunters and local residents; greater acceptance by the general public of line infrastructure in the landscape; and a better public image for the transmission system operator. Specifically, the project aims to restore 130 km of corridors under overhead high voltage lines in Belgium and France.	
<b>Key words:</b> biodiversity management, overhead lines, transmission	
<b>Website of the project:</b> www.life-elia.eu	
<b>Functional objectives:</b> T14	

## OPTIMATE



**Project Coordinator:** Serge Galant

**Company:** Technofi (France)

**E-mail:** sgalant@symple.eu

**Phone:** +33-4-93-65-34-44

**Address:** Atlantis 2–55, Allée Pierre Ziller, BP 22, 06901 Sophia Antipolis Cedex (France)

**JRC reference:** Not specified

**EEGI label:** Not specified

**Start/End:** Oct. 2009/Sept. 2012

**Current status:** Finished

**Budget:** € 4.2 million

**Funding scheme:** Granted by 7th Framework Programme

**Members of the consortium:**

- TSOs: RTE (FR), TransnetBW GmbH (DE), REE (ES), Elia (BE), 50 Hertz Transmission (DE)
- Others: Katholik University of Leuven (BE), Association pour la Recherche et le Développement des Méthodes et Processus Industriels, ARMINES (FR), University Comillas (ES), DTU (DK), European University Institute (IT), University of Manchester (UK)

**Brief project description:** The project aims at developing a numerical test platform to analyze and to validate new market designs which may allow integrating massive flexible generation dispersed in several regional power markets.

**Key words:** Market design, Simulation platform, Agent based, day ahead market, intra-day market, Balancing mechanism, Flow based market coupling, Intermittent generation

**Website of the project:** [www.optimate-platform.eu](http://www.optimate-platform.eu)

**Functional objectives:** T10, T11, T12

## PEGASE



**Project Coordinator:** Stephane Rapoport

**Company:** Tractebel engineering (Belgium)

**E-mail:** stephane.raoport@gdfsuez.com

**Phone:** +32-27-73-78-99

**Address:** Avenue Ariane 7, 1200 Brussels (Belgium)

**Start/End:** June 2008/June 2012

**Current status:** Ongoing

**Budget:** € 13.6 million

**Funding scheme:** Granted by 7th Framework Programme

**Members of the consortium:**


- TSOs: RTE (FR), REE (ES), Litgrid (LT), Transelectrica (RO), REN (PT), SO UPS (RUS), HEP (HR), TEIAS (TU) and Elia (BE)
- Others: TRACTEBEL (BE), DELING DOO (BA), DIGITEO (FR), CRSA-ECP (FR), AICIA (ES), FGH (DE), University Of Liege (BE), University Of Duisburg (DE), University Of Manchester (UK), University Eindhoven (NL) RTU (LT), Energosetproject (RUS) and NUCLEO (ES)


**Brief project description:** Define the most appropriate state estimation, optimization and simulation frameworks, their performances and the requested data flows. Relieve the technical barriers that prevent European-wide real-time state estimation and off-line and on-line simulations to be run. Develop methodologies for building and validating static and dynamic models (including renewable energy sources, power electronics, etc.). Study the architecture of a pan-European real-time state estimation, simulation and training.


**Key words:** State Estimation, Optimal Power Flow, Dynamic Simulation, Model, Dispatcher Training Simulator, Pan-European

**Website of the project:** <http://fp7-pegase.eu/>

**Functional objectives:** T6, T7, T8

PoStaWind 	
<b>Project Coordinator:</b> Nayeem Ullah	<b>Company:</b> STRI AB (Sweden)
<b>E-mail:</b> nayeem.ullah@stri.se	<b>Phone:</b> +46-0-2-40-79-575
<b>Address:</b> Regnbagsgatan 8B, 41755 Gothenburg (Sweden)	
<b>Start/End:</b> July 2011/Oct. 2012	<b>Current status:</b> Ongoing
<b>Budget:</b> € 0.19 million	<b>Funding scheme:</b> Vindforsk III
<b>Members of the consortium:</b>	
- TSOs: Svenska Kraftnät (SE), Fingrid (FIN), Statnett (NO)	
- Others: STRI AB (SE), Statkraft (SE), Vattenfall (SE), E.ON Elnät Sverige AB (SE)	
<b>Brief project description:</b> Effects of large scale wind power integration on power system stability: angle, voltage and frequency stability.	
<b>Key words:</b> Wind power, stability.	
<b>Website of the project:</b> <a href="http://www.elforsk.se/Programomraden/EI--Varme/Vindforsk/projekt1/projekt_VFIII/projects_area_4/V-369-PoStaWind/">http://www.elforsk.se/Programomraden/EI--Varme/Vindforsk/projekt1/projekt_VFIII/projects_area_4/V-369-PoStaWind/</a>	
<b>Functional objectives:</b> T10	

PROBA 	
<b>Project Coordinator:</b> Vanessa De Wilde	<b>Company:</b> Elia
<b>E-mail:</b> vanessa.dewilde@elia.be	<b>Phone:</b> Not specified
<b>Address:</b> Not specified	
<b>Start/End:</b> Feb. 2012/Dec. 2014	<b>Current status:</b> Ongoing
<b>Budget:</b> € 0.25 million	<b>Funding scheme:</b> Financed 100 % by Elia
<b>Members of the consortium:</b>	
- TSOs: Elia (BE)	
- Others: Université libre de Bruxelles (BE)	
<b>Brief project description:</b> The project focuses on the development of a methodology (using a probabilistic approach) to assess via relevant risk indices (e.g. risk/cost of curtailment) the risk(s) of accepting the connection of a new DG unit.	
<b>Key words:</b> risk-based reliability assessment, distribute generation, connection	
<b>Website of the project:</b> None	
<b>Functional objectives:</b> TD1	

REALISEGRID 	
<b>Project Coordinator:</b> Gianluigi Migliavacca	<b>Company:</b> RSE (Italy)
<b>E-mail:</b> Gianluigi.Migliavacca@rse-web.it	<b>Phone:</b> +39-02-3992-5489
<b>Address:</b> Via Rubattino 54, 20134 Milano (Italy)	
<b>Start/End:</b> Sept. 2008/May 2011	<b>Current status:</b> Completed
<b>Budget:</b> € 4.2 million	<b>Funding scheme:</b> Granted by 7th Framework Programme (FP7 ENERGY.2007.7.3.4)

**Members of the consortium:**

- TSOs: APG (AT), RTE International (FR), TenneT (NL), TERNA (IT)
- Others: RSE (IT), EC JRC (BE), OME (FR), EEG TU Wien (AT), TU Delft (NL), TU Dortmund (DE), Politecnico di Torino (IT), Technofi S.A. (FR), R&D Center for Power Engineering (RU), Prysmian Powerlink S.r.l. (IT), Kanlo Consultants SARL (FR), RIECADO GmbH (AT), TU Dresden (DE), Univerza v Ljubljani (SI), ASATREM (IT), The University of Manchester (UK)

**Brief project description:** The REALISEGRID project aims at developing a set of criteria, metrics, methodologies and tools to assess how the transmission infrastructure should be optimally developed to support the achievement of a reliable, competitive and sustainable electricity supply in the European Union (EU). REALISEGRID includes three main areas of activities:

- 1) identification of performances and costs of new grid technologies aimed at increasing capacity, reliability and flexibility of the transmission infrastructure;
- 2) definition of long term scenarios for the EU power sector, characterised by different evolutions of demand and supply;
- 3) implementation of methods and tools to assess the different benefits of transmission expansion investments.

Main outputs of REALISEGRID activities are:

- roadmap for the incorporation of new transmission technologies (including WAMS, FACTS, HVDC) into the electricity networks;
- analysis of the impact of different scenarios on the future electricity exchanges between European countries;
- evaluation of the benefits provided to the pan-European power system by the development of transmission infrastructure;
- testing of such cost-benefit analysis to specific transmission projects, namely, nine electricity projects of European interest concerning the Trans European Network priority axis EL.2.

**Key words:** Transmission planning, RES integration, Cost-benefit analysis, Infrastructure package, Innovative technologies

**Website of the project:** <http://realisegrid.rse-web.it>

**Functional objectives:** T1, T2

**REAL-SMART**

**Project Coordinator:** Nina Thornhill

**Company:** Imperial College of Science, Technology and Medicine (United Kingdom)

**E-mail:** [n.thornhill@imperial.ac.uk](mailto:n.thornhill@imperial.ac.uk)

**Phone:** +44-0-20-7594-6622

**Address:** South Kensington Campus, Imperial College of Science (United Kingdom)

**Start/End:** Sept. 2010/Aug. 2014

**Current status:** Ongoing

**Budget:** € 1.09 million (funding)

**Funding scheme:** FP7-PEOPLE-2009, Marie Curie IAPP transfer of knowledge programme

**Members of the consortium:**

- TSOs: Statnett (NO), Fingrid (FIN)
- Others: ABB (NO, CH, PL), General Electric (GER), Aalto-Korkeakoulusaatio (FI), Technische Universität Graz (AUT), Imperial College of Science, Technology and Medicine (UK), National Grid (UK)

**Brief project description:** Power transmission in Europe is entering a period of significant renewal and technological change because the electrical transmission grids face increases in new and variable energy sources, especially from large scale wind power generators. They therefore face future challenges of operation and control. Changes happening in the process industries will also have an impact on electrical supply because electric motors are taking over from traditional gas turbine drivers for large-scale process equipment such as compressors. On the other hand, new measurement and data acquisition methods such as phasor measurement units are allowing greatly improved observation of the transmission grid. The REAL-SMART proposal presents a balanced programme of applied R&D to address measurement-based monitoring and management of the high voltage transmission grid. The REAL-SMART consortium is interdisciplinary with experts in electrical power systems, modelling, instrumentation, signal analysis, equipment condition monitoring, and automation of oil & gas processes. The consortium will conduct research and undertake secondments to transfer experience and knowledge both ways between academia and industry. The project integrates in-depth understanding of the power system operational issues with analysis of state-of-the-art measurements and first-principles physical knowledge. It will invent and develop state-of-the-art tools that will be deployed by the transmission system operators, and will produce trained and experienced personnel. We aim to take a pivotal role in the creation of technology for intelligent operation of the wide-area transmission grids of the future.

**Key words:** Smart Grid, wind power, WAMS

**Website of the project:** <http://cordis.europa.eu>

**Functional objectives:** T2, T5, T6, T10, TD3

## SAFEWIND



**Project Coordinator:** Mathieu Reboul

**Company:** Association pour la recherche et le développement des méthodes et processus industriels – Armines (France)

**E-mail:** georges.kariniotakis@mines-paristech.fr  
mathieu.reboul@armines.ensmp.fr

**Phone:** +33-140519478

**Address:** Boulevard Saint-Michel 60, Paris (France)

**Start/End:** Sept. 2008/Aug. 2012

**Current status:** Not specified

**Budget:** € 5.6 million

**Funding scheme:** Granted by 7th Framework Programme

### Members of the consortium:

- TSOs: RTE (FR), Energinet.dk (DK)
- Others: Acciona Energia S.A. (ES), Institute Of Communication And Computer Systems (GR), Fundacion Gener-Ciemat (ES), Carl Von Ossietzky Universität Oldenburg (DE), Meteo-France France (FR), Universidad Carlos Iii De Madrid (ES), The Energy And Resources Institute India Public Power Corporation S.A. (GR), Overspeed Gmbh & Co. Kg (DE), System Operator For Northern Ireland (GB), Eirgrid Plc (IE), Energy & Meteo Systems Gmbh (DE), Danmarks Tekniske Universitet (DK), Electricite De France S.A. (FR), The Chancellor, Masters And Scholars Of The University of Oxford (GB), European Centre For Medium-Range Weather Forecasts (GB), Universidad Complutense De Madrid (ES)

**Brief project description:** The project will develop: New forecasting methods for wind generation focusing on uncertainty and challenging situations/extremes.

- Models for “alarming”: providing information for the level of predictability in the (very) short-term.
- Models for “warning”: providing information for the level of predictability in the medium-term (next day(s)).

**Key words:** Renewable energy, Short-term forecasting, Uncertainty, Ramps forecasting, Alarming, Warning, Weather forecasts, Remote sensing, Weather extremes, Meteorology

**Website of the project:** [www.safewind.eu](http://www.safewind.eu)

**Functional objectives:** T6, TD1

## SAMREL



**Project Coordinator:** Gjerde Oddbjörn

**Company:** Sintef Energy Research AS (Norway)

**E-mail:** Oddbjorn.Gjerde@sintef.no

**Phone:** +45-76-22-44-33

**Address:** ostboks 4761 Sluppen, 7465 Trondheim (Norway)

**Start/End:** Jan. 2010/Dec. 2013

**Current status:** Ongoing

**Budget:** € 1.9 million

**Funding scheme:** Granted by Research Council of Norway

### Members of the consortium:

- TSOs: Energinet.dk (DK), Fingrid (FI), Statnett (NO)
- Others: Det Norske Veritas AS (NO), Norwegian University of Science and Technology (NO), Norwegian Water Resource and Energy Directorate (NO)


**Brief project description:** Integration of methods and tools for security of electricity supply analysis. The primary goal is to establish a comprehensive methodology for security of electricity supply analysis, by the integration of power system reliability analysis with the electricity market analysis.


**Key words:** Simulation tool, System security, Reliability

**Website of the project:** None

**Functional objectives:** T9



SUMO 	
<b>Project Coordinator:</b> Jan Kostevc	<b>Company:</b> ELES (Slovenia)
<b>E-mail:</b> jan.kostevc@eles.si	<b>Phone:</b> +386-1-474-2105
<b>Address:</b> ELES, d.o.o. Hajdrihova 2, 1000 Ljubljana (Slovenia)	
<b>Start/End:</b> 2011/2014	<b>Current status:</b> Ongoing
<b>Budget:</b> € 2.0 million	<b>Funding scheme:</b> Financed 100 % by ELES
<b>Members of the consortium:</b>	
- TSOs: ELES (SI)	
- Others: EIMV (Milan Vidmar Electric Power Research Institute)	
<b>Brief project description:</b> Dynamic thermal rating will be incorporated in SCADA/EMS environment. Network analyses will use near real time system capabilities. Calculation of element ratings will use ambient parameters from relevant geographical areas.	
<b>Key words:</b> Dynamic thermal rating	
<b>Website of the project:</b> None	
<b>Functional objectives:</b> T3	

TWENTIES 	
<b>Project Coordinator:</b> Vicente González	<b>Company:</b> Red Eléctrica de España (Spain)
<b>E-mail:</b> vgonzalez@ree.es	<b>Phone:</b> +34-91-650-20-12
<b>Address:</b> Conde de los Gaitanes, 177 – 28109 Alcobendas (Madrid, Spain)	
<b>Start/End:</b> Apr. 2010/Apr. 2013	<b>Current status:</b> Finished
<b>Budget:</b> € 56.8 million	<b>Funding scheme:</b> Granted by 7th Framework Programme
<b>Members of the consortium:</b>	
- TSOs: REE (ES), Elia (BE), Energinet.dk (DK), RTE (FR), 50Hertz Transmission GmbH (DE), Tennet TSO (NL)	
- Others: DONG (DK), IBR (ES), RISØ.DTU (DK), EDF (FR), ALSTOM (UK), Comillas-IIT (ES), Fraunhofer IWES (DE), SINTEF (NO), GAMESA (ES), Siemens (DE), EWEA (BE), CORESO (BE), ABB (ES), INESC-PORTO (PO), UCD (EI), RSE (IT), Strathclyde (UK), ULG (BE), KUL (BE), ULB (BE)	
<b>Brief project description:</b> Project aims to demonstrate through real-life, large-scale demonstrations, the benefits and impact of several critical types of technology required to improve the European transmission network, thus giving Europe the ability to increase the share of renewable in its energy mix by 2020 and beyond, while keeping its present reliability.	
<b>Key words:</b> Wind power integration, DC grid management, AC grid flexibility, WAMS, DLR, FACTS, VPP, Wind farms services provider	
<b>Website of the project:</b> www.twenties-project.eu	
<b>Functional objectives:</b> T2, T3, T4, T5, T6	

## UMBRELLA



**Project Coordinator:** Helmut Paeschke

**Company:** TenneT TSO GmbH (Germany)

**E-mail:** Helmut.Paeschke@tennet.eu

**Phone:** Not specified

**Address:** TenneT TSO GmbH, Rosswachtstr. 40, 85221 Dachau (Germany)

**JRC reference:** Not specified

**EEGI label:** TSO Core

**Start/End:** 2012/2016

**Current status:** Ongoing

**Budget:** € 5.0 million (€ 3.8 million granted)

**Funding scheme:** Granted by 7th Framework Programme

**Members of the consortium:**

- TSOs: TenneT TSO GmbH (DE), Amprion GmbH (DE), ČEPS, a.s.(CZ), Elektro-Slovenija, d.o.o (SI), TransnetBW GmbH (DE), PSE Operator S.A.(PL), swissgrid ag (CH), TenneT TSO B.V. (NL), Austrian Power Grid AG (AT)
- Others: ABB Delft University of Technology (NL), ETH Zurich (CH), Graz University of Technology (AT), RWTH Aachen (DE), University Duisburg-Essen (DE), FGH e.V. (DE)

**Brief project description:** To develop a dedicated innovative toolbox to support a coordinated decentralised grid security approach for TSOs. To demonstrate the enhancement of existing and current procedures by the utilization of the developed toolbox. To provide a scientifically sound basis to support common TSO decisions. Cooperation with iTesla in order to achieve a common use case at the beginning of both of the projects and recommendations to converging operational rules to ENTSO-E at the end of both of the projects.

**Key words:** Operational system security, Risk assessment, Enhanced optimal power flow, Forecasting, optimization tools, Integration of renewables, Innovative operational tools, Corrective actions, Grid flexibility, Transmission capacity

**Website of the project:** [www.e-umbrella.eu](http://www.e-umbrella.eu)

**Functional objectives:** T6, T7, T9

## WAMPAC

**Project Coordinator:** Belén Díaz-Guerra

**Company:** Red Eléctrica de España (Spain)

**E-mail:** bdguerra@ree.es

**Phone:** +34-91-650-20-12

**Address:** Conde de los Gaitanes, 177 – 28109 Alcobendas (Madrid, Spain)

**Start/End:** 2009/2013

**Current status:** Ongoing

**Budget:** € 4.0 million

**Funding scheme:** Presented to EU FEDER

**Members of the consortium:**

- TSOs: Elering
- Others: Tallinn University of Technology (EE)

**Brief project description:** Not specified

**Key words:** WAMPAC

**Website of the project:** None

**Functional objectives:** T3, T6, T7

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## ABBREVIATIONS

<b>AC</b>	Alternating current	<b>OPEX</b>	Operating expense (Operating expenditure?)
<b>CAPEX</b>	Capital expenditure	<b>PMU</b>	Phasor Measurement Units
<b>DC</b>	Direct Current	<b>PV</b>	Photovoltaic
<b>DER</b>	Distributed Energy Resources	<b>R&amp;D</b>	Research and Development
<b>DLR</b>	Dynamic line rating	<b>RDC</b>	Research and Development Committee
<b>DRT</b>	Demand Response Technology	<b>RES</b>	Renewable Energy Sources
<b>DSO</b>	Distribution System Operator	<b>SCADA</b>	Supervisory Control And Data Acquisition
<b>EEGI</b>	European Electricity Grid Initiative	<b>SSSC</b>	Static Synchronous Series Compensator
<b>EMS</b>	Energy Management System	<b>ST</b>	Specific Tasks
<b>ENTSO-E</b>	European Network of Transmission System Operators for Electricity	<b>TSO</b>	Transmission System Operator
<b>FACTS</b>	Flexible AC Transmission System	<b>TYNDP</b>	Ten Year Network Development Plan
<b>FO</b>	Functional Objectives	<b>VAR</b>	Volt-Ampere Reactive
<b>HV</b>	High Voltage	<b>VPP</b>	Virtual Power Plant
<b>HVAC</b>	High Voltage Alternating Current	<b>VSC</b>	Voltage Source Converter
<b>HVDC</b>	High Voltage Direct Current	<b>WAMPAC</b>	Wide Area Monitoring Protection and Control
<b>ICT</b>	Information And Communication Technology	<b>WAMS</b>	Wide-Area Monitoring Systems
<b>IEC</b>	International Electrotechnical Commission	<b>WG MKS</b>	Working Group Monitoring and Knowledge Sharing
<b>LV</b>	Low Voltage		
<b>MV</b>	Medium Voltage		

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## IMPRINT

### PUBLISHER:

ENTSO-E aisbl  
Avenue de Cortenberg 100  
1000 Brussels – Belgium

### DESIGN & LAYOUT:

DreiDreizehn Werbeagentur, [www.313.de](http://www.313.de)

### PHOTOS:

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Publishing date: January 2014

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# NOTE

R&D Monitoring Report 2013 is an annual publication that assesses the research and development (R&D) work performed in various capacities throughout the European electricity sector within the overarching R&D Roadmap 2013–2022.

## Contact

ENTSO-E AISBL

Avenue de Cortenbergh 100  
1000 Brussels – Belgium

Tel +32 2 741 09 50

Fax +32 2 741 09 51

[info@entsoe.eu](mailto:info@entsoe.eu)

[www.entsoe.eu](http://www.entsoe.eu)



European Network of  
Transmission System Operators  
for Electricity