

The challenges and opportunities of a smart grid for the European TSO

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entsoe
Reliable Sustainable Connected

Represents 42 TSOs from 34 countries

525 million citizens served

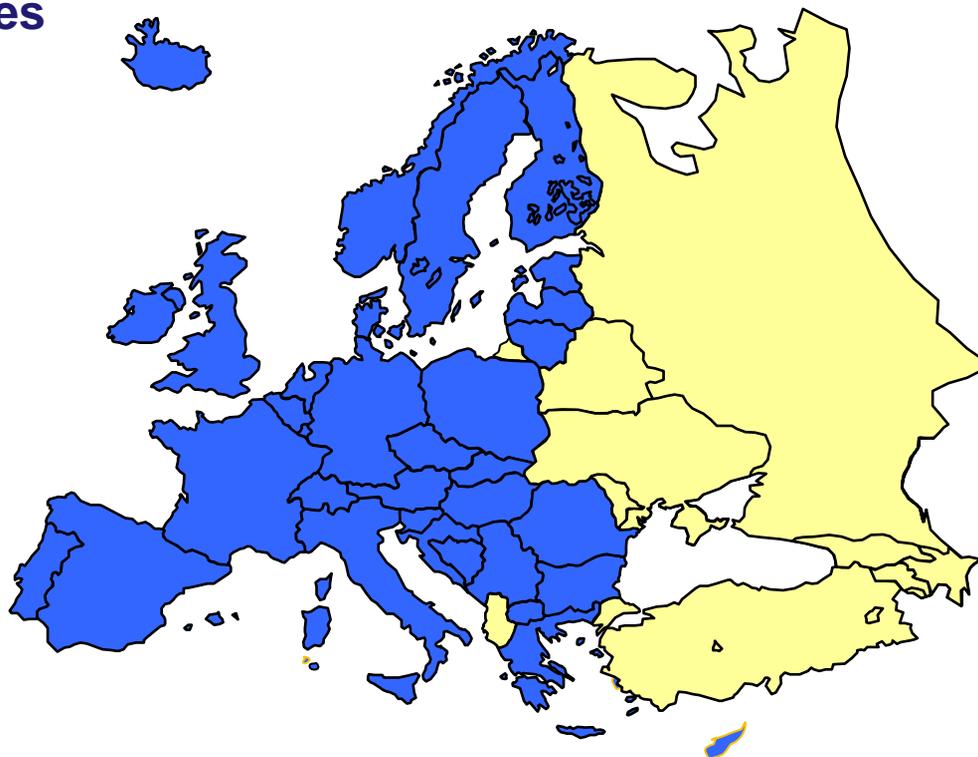
828 GW generation

305,000 km of transmission lines
managed by the TSOs

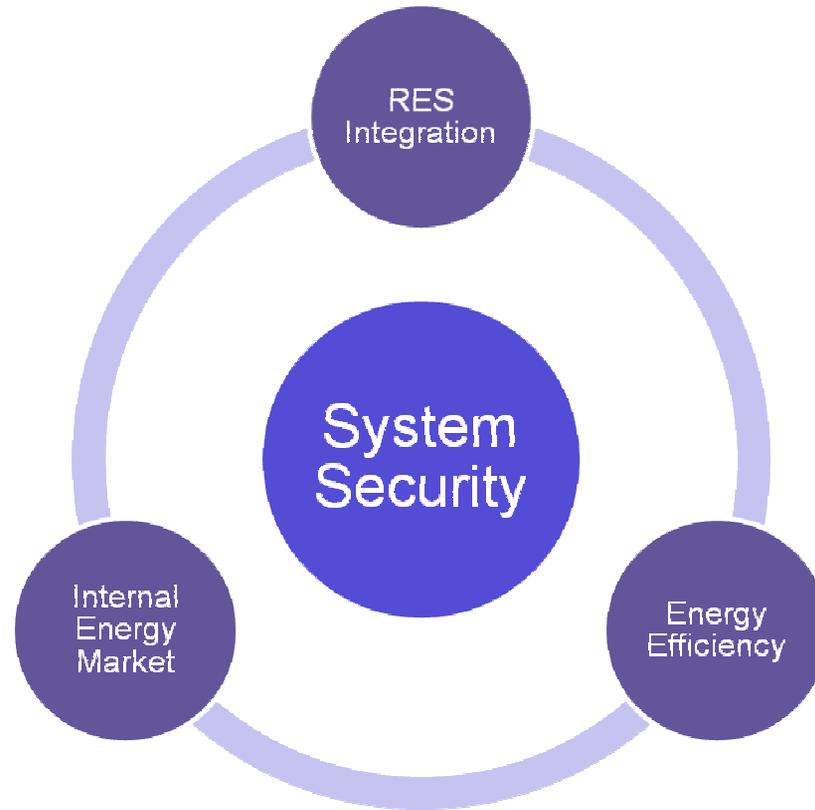
3,400 TWh/year demand:

400 TWh/year exchanges:

Replaces former TSO organisations:
ATSOI, BALTSO, ETSO, NORDEL, UCTE,
UKTSOA



Where are we coming from?





“Smart Grid” is the process “to transform the functionality of the present electricity transmission and distribution grids so that they are able to provide a user-oriented service, enabling the achievement of the energy policy targets (2020 and beyond) and guaranteeing, in an electricity market environment, high security, quality and economic efficiency of electricity supply”.

“Smartness” is not an objective itself, it is a set of tools for supporting the achievement of the 20/20/20 targets.



Challenges

- Balancing intermittent generation
- Idle generation for peak demand
- System losses

Smart Grid

- Customers in the centre
- Demand response
- Enhance monitoring
- Distributed control
- Resilience

How

- Communication
- Especially between DSOs and TSOs
- IT infrastructure
- New power system applications

Bulk of the costs in distribution, but much of the benefits in TSO-level, European intraday and balancing markets

**ENTSO-E R&D
PROGRAM**



Required by the 3rd Energy Package both in Directive EC/72/09 and in Regulation 714/09.

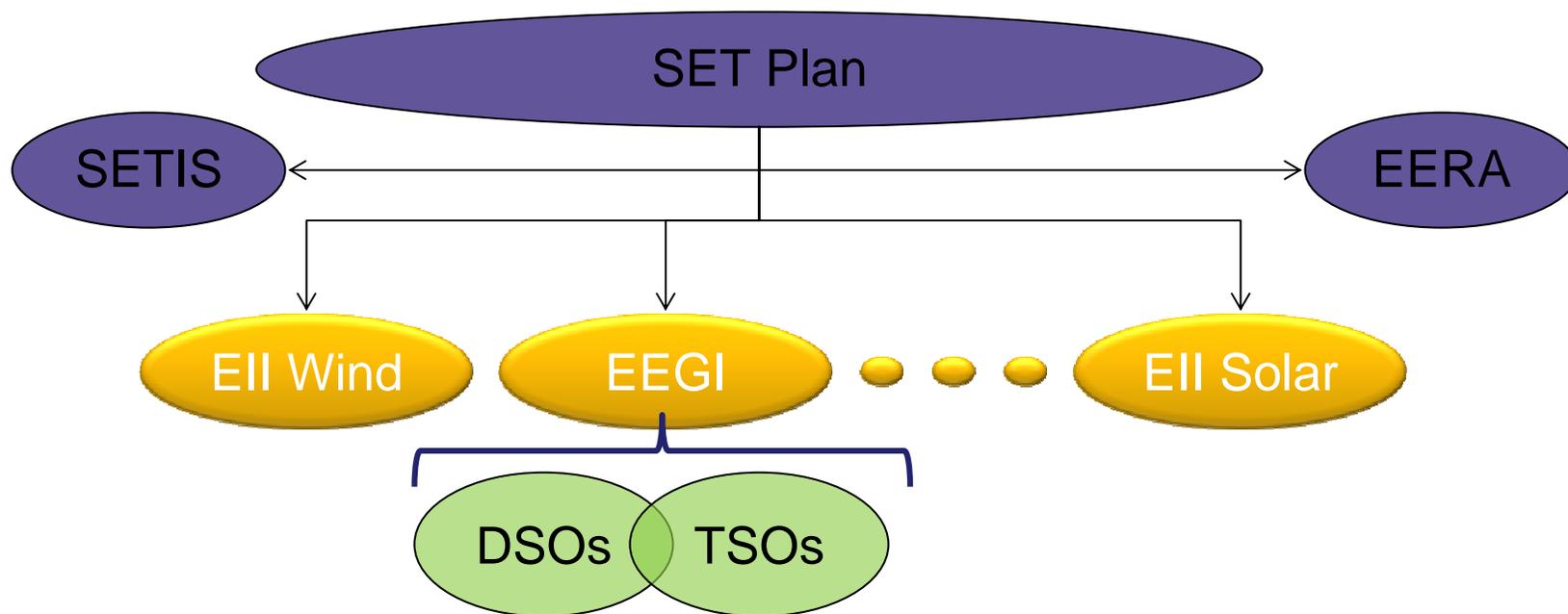
ENTSO-E shall adopt a R&D plan for common network operation.

Needed in order to find efficient solutions to face the new challenge of replacement aged assets and of integration renewable resources.

First ENTSO-E R&D Plan released after public consultation in May 2010.

The basis for the ENTSO-E contribution to the Strategic Energy Technology Plan (SET-Plan).

In the context of the SET Plan European Electricity Grid Initiative (EEGI) as a common platform for industry, grid operators, administrations and other relevant stakeholders.





BY 2020

TSOs and DSOs

Actively **integrate efficient new generation and consumption models**, in particular:

- ✓ Integrate **new variable renewable resources** at the different voltage levels
- ✓ Enable and integrate **active demand** from end users
- ✓ Enable and integrate new electricity uses, in particular recharging infrastructure for **electric vehicles** and increasing electric heating (**heat pumps**)
- ✓ Support and enable **energy efficiency** by end users.
- ✓ Enable new **business opportunities** and innovations for market players



BY 2020

TSOs and DSOs

Coordinate planning and operation of the whole electricity network

- ✓ for the pan European transmission network through ENTSO-E

- ✓ between transmission and distribution networks

with dedicated solutions developed in the EEGI program

Study and **propose new market rules** to maximize European welfare both at national and European level.



SMART GRIDS MODEL

Level 1: Smart pan-European

Cluster 1: Pan-European Grid architecture
Novel approaches to develop a pan-European Grid

Cluster 2: Power technologies
Affordable technologies to make the transmission system more clever and flexible

Cluster 3: Network management and control
Critical building blocks to operate the interconnected transmission system in real-time and reliably

Cluster 4: Market rules
Market simulation techniques to develop a single European electricity market

SMART GRIDS
Functional level

Functional projects

- T1. A toolbox for new network architecture assessment
- T2. Tools to analyze the pan-European network expansion options
- T14. Innovative approaches to improve the public acceptance of overhead lines
- T3. Demonstrations of power technologies for more network flexibility
- T4. Demonstrations of power technologies for new architectures
- T5. Demonstrations of renewable integration
- T6. Tools for pan-European network observability
- T7. Tools for coordinated operations with stability margin evaluation
- T8. Improved training tools for improved coordination
- T9. Tools for pan-European network reliability assessment
- T10. Tools for pan-European balancing markets
- T11. Advanced tools for congestion management
- T12. Tools for renewable market integration of active demand
- T13. Tools to study market integration of active demand

R&D Plan Time Schedule



Year									
2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tool box for new network architecture assessment									
INTEGRINET									
S.I.T.R.E.N.									
Tools to analyze the pan European expansion options									
Almacena Project									
REALISEGRID									
Demonstrations on power technologies for a more network flexibility									
220 kV SSSC for power flow control									
Demonstrations on power technologies for a novel network architectures									
COBRA									
Demonstrations for renewable integration									
TWENTIES Project									
KriegersFlak									
SAFEWIND									
SUSPLAN									
ANEMOS.PLUS									
IS-P.									
Innovative tools for a pan European network observability									
Sub-station 61850									
PEGASE									
Innovative tools for coordinated operations with stability margin evaluation									
Training tools for improved coordination									
Tools for pan European network reliability assessment									
Advanced tools for pan European balancing markets									
Advanced tools for congestion management									
Tools for renewable market integration									
OPTIMATE Project									
Tools for market integration of active demand									
EcoGrid Europe									
ADDRESS									
Environmental impact and social acceptance of transmission facilities									
Social acceptance of overhead lines									
2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Base workstream									
Already identified sub-projects									
Other relevant on-going projects									



The TSOs' remuneration in many EU countries does not foresee any component dedicated to recover costs for developing innovative activities. This point is crucial to have effective deployment of "Smart Grid" solutions.

Adequate regulatory scheme needed for "Smart Grids" solutions, with a relevant sharing of costs and benefits between stakeholders.

Harmonisation of regulatory rules (incl. support of RD&D) at European level is an essential condition for optimal design/operation of the future pan-European grid.



Equally important is going to be the capacity of the regulators for reacting to changes in the environment in a timely and uniform manner.

Regulatory Authorities should support the new developments needed by giving the TSOs the funds for RD&D and for realising pilot projects to test the new technologies that might be part of the transmission backbone in the future.

A fair compensation for the services provided to the system is needed. Innovation/RD&D is part of needed services and needs to be compensated.



Smart Grids a major component of ENTSO-E R&D Plan

Collaborative research via joint activities

ENTSO-E to package and disseminate the new knowledge

Long-term perspective on funding

Tariffs

Public spending in the short term

ENTSO-E to play a relevant role in the EEGI governance structure



OPTIMATE - FP7 Project (September 2009 – August 2012)

Involved partners:

Five TSOs: ELIA (BE), EnBW (DE), REE (ES), RTE (FR) and 50Hertz (DE).

Other: ARMINES (FR) , K.U.Leuven (BE), DTU-RISOE (DK), Univ. of Comillas (ES), Univ. of Manchester (GB), SEAES -University of Paris (FR) and TECHNOFI

Objectives:

To develop an open simulation platform able to mimic existing and future intra-day and balancing markets involving classical and intermittent generation.

To demonstrate that the above platform can help TSOs compare new market rules and tools capable of integrating massive intermittent generation into electricity markets, while keeping the European power system secure.



TWENTIES - FP7 Project

(April 2010 – March 2013) www.twenties-project.eu



Involved partners:

SixTSOs: Elia (BE), Energinet.dk (DK), RTE (FR), 50Hertz (DE), Tennet TSO (NL) and REE (ES).

Other: DONG (DK), IBR (ES), RISØ (DK), EDF (FR), AREVA (UK), ITT (ES), Fraunhofer IWES (DE), SINTEF (NO), GAMESA (ES), SIEMENS (DE), EWEA (BE), CORESO (BE), ABB (ES), INESC-PORTO (P), UCD (EI), ERSE (IT), STRATHCLYDE (UK), ULG (BE), KUL (BE), ULB (BE).

Objectives:

To demonstrate by early 2014 through real-life, large-scale demonstrations, the benefits and impact of several critical types of technology required to improve the pan-European transmission network, thus giving Europe the ability to respond to the increasing share of renewables in its energy mix by 2020 and beyond, while keeping its present level of performance reliability.



EcoGrid EU - FP7 Project (Proposal under evaluation) www.eu-ecogrid.net



Involved partners:

TSOs: Energinet.dk (DK), Elia (BE).

Other: Østkraft (DK), IBM Zurich (CH), IBM Benelux (NL), Siemens (DE), DTU-CET (DK), Sintef (NO), EANDES (BE), EnCT (DE), AIT (AT), TUT (EE); ORES (BE) and Labein (ES)

Objectives:

To develop and demonstrate a full-scale generally applicable concept for a smart electricity distribution network with high penetration of renewable energy sources and active user participation based on real-time price signals enabling small and medium-size distributed energy resources to contribute actively to system balancing and enabling optimized operation and control of the distribution grid. The integration of more than 50 per cent RES in the power system – mainly coming from fluctuation RES production like wind power and PV – requires participation from all distributed resources and demand response (Prosumers).