REALISEGRID: towards a pan-European transmission network

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Presentation outline

- Challenges of the grid 2020 and beyond
- The project REALISEGRID
- “Smart” transmission technologies
- Prioritizing transmission investments
- Tackling the consensus problem
1. Challenges of the grid 2020 and beyond
Challenges for the pan-European transmission grids for 2020 and beyond

Integration of very large amounts of variable RES, while keeping network security and reliability at acceptable levels

Renewable generation exceeding local needs at a given time, requiring transport elsewhere

Aging of the present transmission grid; difficulties to get consensus for building new overhead lines

Liberalization of market inducing increased cross-border power exchanges rising uncertainties and congestion problems

Increasing role of active demand and distributed generation to relieve stress on European electricity system

European electricity grids are on the critical path to meet the EU climate change and energy policy objectives
How increasing wind penetration can affect grid congestion

- Congestion becomes a pan-European problem. Planning should be coordinated between the TSOs;
- Frequent flow changings heavily affect operation and require a coordinated approach

High wind scenarios
Low wind scenarios
European Supergrids: horizontal and vertical concepts

Growing support in Europe to the creation of supergrids, connecting many offshore wind farms in several Member States, so as to maximize the utilization of RES and reduce the impact on the transmission backbones:

- **Vertical**: creating a north-south interconnection to ease delivering RES power (around the North Sea) and the big customer centers in the central and southern part of Europe. Two approaches:
  - Expanding the current transmission backbones
  - Creating dedicated highways (concept of overlay network from the recent Energiekonzept document of the German Bundesregierung)

- **Horizontal**: interconnecting off-shore and providing a multi-point docking to the AC backbones. Some pilot projects:
  - **Kriegers Flak** connecting 1800 MW between Denmark, Sweden (now stepped-out) and Germany, €150mil. financing from EC in 2009 for pre-feasibility
  - **North Sea Offshore grid project** connecting 70 GW offshore wind among 9 Countries. In December 2009, it was decided that the ISLES project will carry out a feasibility study. Investments should amount to €30bil.
Connection or interconnection between different grids can be realized both in AC or DC with submarine or land cables. The choice of the AC or DC solution is depending on the power to be transmitted and on the length of the circuit.
Desertec SuperGrid

HVDC investment costs

Source: Desertec
The EU Energy Policy (1/2)

Support climate change mitigation:
- reducing CO₂ emissions;
- promoting green generation;
- boosting efficiency in the consumption (energy saving)

Promote competition:
- eliminating cross-border bottlenecks;
- harmonizing market regulation throughout Europe;
- promoting the creation of a common Internal Energy Market

Increase security of supply

- Communication on Strategic Energy Technology Plan (SET-Plan, 2007)
- Third Liberalization Package (2009) and Directive 2009/72/EC
- Communication “A strategy for competitive, sustainable and secure energy” (2010)

The PIP (Jan. 2007) underlined that electricity and gas networks are the “heart” of a well-functioning energy market;

The Second Strategic Energy Review (Nov. 2008) clarified that EU will never realize its objectives unless the grid will be soon significantly expanded.

Green Paper “Towards a secure, sustainable and competitive European energy network” (Nov. 2008)
TEN-E Guidelines: 32 projects labeled as “of European interest”: only 19% is completed, 5% under construction, 76% in the authorization path and/or in study. Bottom-up fixed-list aproach failed!

Communication: “A strategy for competitive, sustainable and secure energy”: defines five priorities for energy strategy, among which “building a truly integrated energy market”. To achieve it:
  - Action 2: establishing a blueprint of the European infrastructure for 2020-2030,
  - Action 3: stremlining permit procedures,
  - Action 4: providing the right financial framework.

Communication “Energy infrastructure priorities for 2020 and beyond”: new methodology not based on bottom-up contributes of the TSOs but on a shared methodology for prioritizing projects on the basis of European priorities at 2020 (four corridors for electricity, three for gas) and a long-term perspective of a smart-supergrids continental interconnection. Improvement permitting and consensus. Set up of new financial instruments.
Need to invest in the transmission grid

- The last years: demand increase vs reduced grid development
- It is generally agreed that new investments are needed, motivated on the basis of a technical–economical evaluation comparing costs with benefits for the system (market competitiveness, interests of consumers and other market players)
2. The Project REALISEGRID
The project REALISEGRID (http://realisegrid.erre-web.it)

The ultimate objective of REALISEGRID is to develop a set of criteria, metrics, methods 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 EU.

Research centers and universities
- RSE (I), Coord & WP3
- Politecnico di Torino (I), WP2
- Technische Universiteit Delft (NL)
- Universität Dortmund (D)
- Technische Universität Dresden (D)
- EC Joint Research Centre - Inst. Energy
- Univerza v Ljubljani (SL)
- The University of Manchester (UK)
- Observatoire Méditerranéen Energie (F)
- R&D Center for Power Engineering (RU)
- Vienna University of Technology, EEG (A)

TSOs
- RTE (F)
- Verbund-APG (A)
- Terna (I)
- TenneT (NL)

Industry
- Technofi (F), WP1
- ASATREM (I)
- KANLO (F)
- Prysmian (I)
- RIECADO (A)
Activities of REALISEGRID

- Identification of technical performances, economic benefits and costs of novel *technologies* aimed at increasing capacity, reliability and flexibility of the transmission infrastructure.

- Definition of long term *scenarios* for the European power sector, characterized by different evolutions of demand and supply, such as the integration of a large amount of intermittent renewable energy sources (e.g. wind power), meeting specific targets concerning security of supply and sustainability.

- Implementation of a framework to facilitate harmonisation of pan-European approaches to electricity infrastructure evolution and to evaluate benefits of *transmission investments*. 
Work Package 3 “Transmission investments”

Planning Practice

WP3.1 Analyzing current practice and developing a robust set of criteria for improved transmission planning in presence of a large penetration of RES-E generation

WP3.2 Evaluate bottlenecks and investment needs in cross-border capacities in the European Electricity markets

WP3.3 Set up a methodology and a supporting tool to carry out multi-criteria cost-benefit analysis supporting the development of trans-European transmission infrastructure

Testing Bed

WP3.5 Validation of the cost-benefit methodology set up in WP3.3 on a real case concerning the TEN-E priority axis EL2

WP3.6 analyzing the impact of regulation and incentive mechanisms on transmission investment

Regulation

WP3.7 deriving a benefit-based approach to improve consensus on new infrastructures

Modeling tools

WP3.4 Creation of a tool to support coordinated investment in electricity and gas infrastructure
3. “Smart” transmission technologies
Identifying “smart” transmission technologies

Inclusion principle: technologies potentially helpful for TSOs and possibly interacting with the transmission planning

A 2030 roadmap is in preparation, to be published before the end of the year
Smart transmission VS distribution technologies

Cost of “smart” technologies and components to be implemented on distribution grid level [€ / MW_{DGinst}]

- Towards fully active and smart distribution grid
- Status quo of transmission grid
- Moderate transmission grid expansion
- Significant transmission grid expansion
- Transmission grid expansion
- DG penetration in an electricity system [MW_{DGinst}]

- Fully autonomous and intelligent “cells” on distribution grid level
- Bidirectional load flow management devices
- New information, communication, control and data management systems
4. Prioritizing transmission investments
Transmission planning process

Scenarios development

Security analysis

Security criteria met?

Identification of first, broad group of solutions

Techno-economic assessment

Identification of second, restricted group of solutions

Environmental/social assessment

Final ranking of solutions

Decision making

No expansion

REALISEGRID proposed approach

Cost-benefit analysis

Traditional approach
Cost-benefit analysis: (main) benefits tree

Transmission expansion benefits

- Competitiveness
  - Congestions reduction
  - Market competitiveness increase

- Security of energy supply
  - Reliability increase
  - Losses reduction

- Environmental sustainability
  - Emissions savings
  - RES exploitation
  - Fossil fuel costs reduction
  - External costs reduction

Utility function → translation into monetary terms

Weighted sum → translation a mono-dimensional ranking

Solution A

Solution B

Solution C

Sensitivity analysis on weighing factors needed
Cost-benefit analysis: temporal perspective

- **Authorization phase**
- **Building phase**
- **Amortization phase**

Variables:
- $\Delta B_{1,t1}$
- $\Delta B_{2,t1}$
- $\ldots$
- $\Delta B_{1,t2}$
- $\Delta B_{2,t2}$
- $\ldots$
- $\Delta B_{1,tn}$
- $\Delta B_{2,tn}$
- $\ldots$

NPV$_0$
REALISEGRID is going to use the new methodology to carry out a cost/benefits classification of the most important projects belonging to Trans European Network priority axis "EL.2. Borders of Italy with France, Austria, Slovenia and Switzerland: increasing electricity interconnection capacities". This region is one of the most interesting ones to assess the impact and the benefits of future cross-border transmission projects.

- Lienz (AT) - Cordignano (IT) line
- New interconnection between Italy and Slovenia
- Udine Ovest (IT) - Okroglo (SI) line
- S. Fiorano (IT) - Nave (IT) - Gorlago (IT) line [reinforcements completed]
- S. Fiorano (IT) - Robbia (CH) line [completed]
- Venezia Nord (IT) - Cordignano (IT) line
- St. Peter (AT) - Tauern (AT) line
- Südburgenland (AT) - Kainachtal (AT) line
- Austria - Italy (Thaur-Brixen) interconnection through the Brenner rail tunnel.
5. Tackling the consensus problem
The de-bottlenecking problem: a wide view

1. Build-up new infrastructure
2. Anticipate needs in the planning
3. Speed up and harmonize legal procedures (top-down)
4. Facilitate merchant investment wherever convenient
5. Refurbish the existing infrastructure
6. Reform the electricity market
7. Act on public opinion and on compensation policy (bottom-up)
8. Boost TSO investment optimality
Consensus: the position of REALISEGRID

- The complexity of authorization procedures and to get consensus for new infrastructures is a key problem to cope with the future challenges.

- In order to obtain support by public opinion, two synergic actions have to be combined:
  
  - a good information flow to the population (bottom-up approach). This information has to account for all costs and benefits and clearly show the cost of inaction. The ground points are:
    - Provide a clear vision of benefits and costs bound with the new infrastructure. Clearly state the cost for the society deriving form inaction or sub-optimal actions;
    - Promote a cultural action, meeting all the points of the perception of a new line. Clarify the relationship between RES integration and grid development. Clarify the relationship between costs and different technical solutions (e.g. cabling).
    - Promote a thorough evaluation of property value, so as to bring about a fair compensation value that can be agreed by all the parties.

  - a clear regulatory approach (top-down approach) harmonized throughout Europe:
    - Act on the legal framework: simplify, harmonize, set time limits and rationalize the procedure (number of entities, number of phases, etc)
    - Create, especially for the most important projects an “arbiter” to promote compromises and managing the entire procedure in trans-national cases.
How to speed-up grid development and increase consensus?

**Problems**

- Social acceptance
- Duration of authorization procedures
- Lag between transmission and generation development times
- Choice of innovative technologies
- Lack of harmonized legal framework

**Actions**

- “serious” information to the public opinion
- Clear information of inaction costs
- Reflect on compensation policies
- Institute a “facilitator” (ENTSO-E, ACER)
- Streamline role of all institutions in approval
- Introduce maximum time for approval
- Make a binding pre-approval possible
- Entice TSOs to anticipate on the basis of a cost-benefit analysis
- Discourage generators from initiating procedure if not sure this will be realized
- Favor merchant investment if convenient
- Mature technologies should be used to:
  - Extend usage existing infrastructure
  - Reduce impact and realization time
- Harmonizing legal framework in Europe
- Incentivize transited TSOs

This analysis has been specifically carried out in support of the creation of the Infrastructure package by EC. The Interim Report created by REALISEGRID is downloadable from the project web.
Thank you for your attention...

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