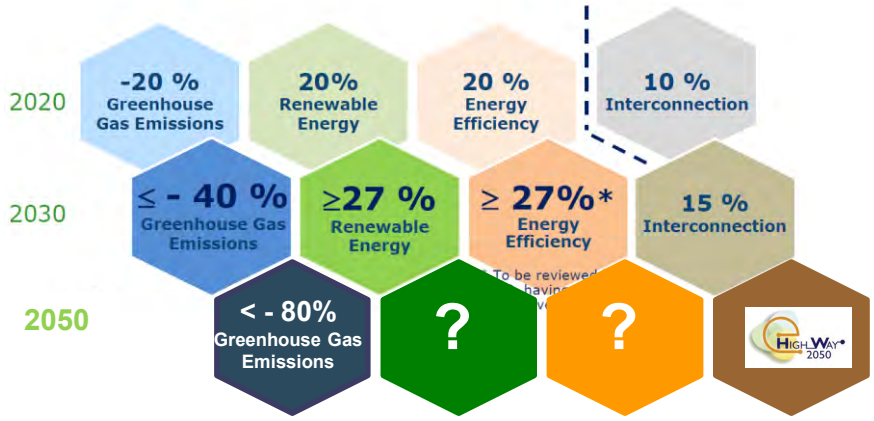
e-Highway2050
Main results

10th SEE Energy Dialogue 13-14 June 2017, Belgrade

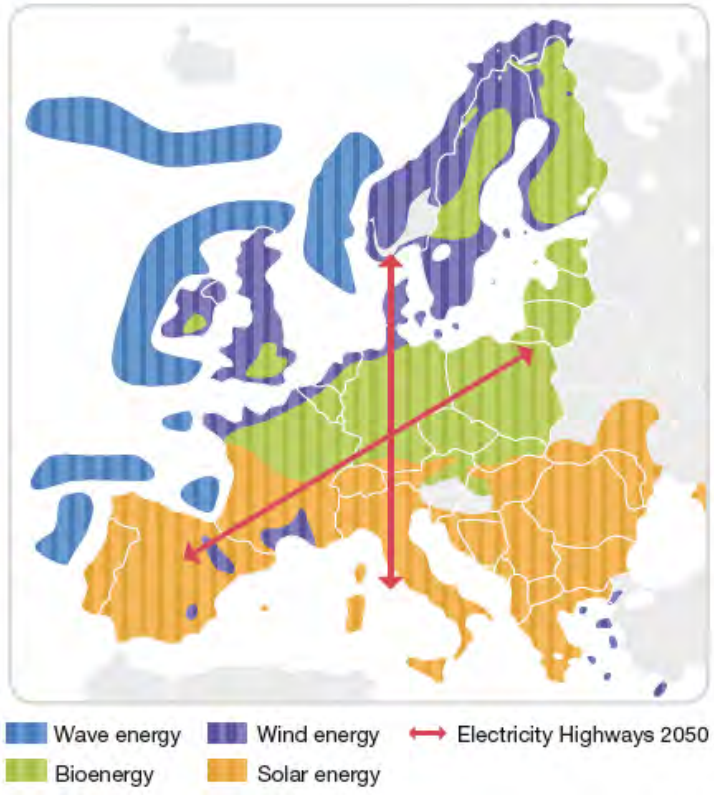
Dragana Orlic (EKC) – Grid Development Task Leader

Introduction of e-Highway2050

Background



The Energy Roadmap 2050 is the basis for developing a long-term European framework



General requirement of the project

"Planning for **European Electricity Highways** to ensure the reliable delivery of renewable electricity and **Pan-European** market integration"

A consortium of 28+8 partners

TSOs

50hertz, amprion, APG, ČEPS a.s., elia group, ELES, ENERGINET.DK, entsoe, ΑΔΜΗΕ, PSE, RED ELÉCTRICA DE ESPAÑA, REN, Rte, SVENSKA KRAFTNÄT, swissgrid, Terna, Transelectrica

Industry

eurelectric, europacable (Try life without us), EWEA, T&D europe

Research institutes

Brunel University London, Universidad Pontificia ICAI ICADE Comillas, ECN, ensiel, JEN, KU LEUVEN, RSE, SINTEF, Técnico Lisboa, Technische Universität Berlin

Experts

Collingwood Environmental Planning, dena German Energy Agency, E3G, PÖYRY, TECHNOFI

40 month project, from **September 2012 to December 2015**

HIGHWAY 2050, SEVENTH FRAMEWORK PROGRAMME, EEGI

How the issue has been processed?

Through Scenarios

What could occur with the 'present' grid?

Stakes by 2050?

- Identification of the electricity demand/generation by 2050.
- State of the electricity system, with the 'present' transmission grid.
- Highlighting the need for solutions in order to solve the congestion/spillage/energy not supplied

Which additional transmission grid by 2050?

- Which **transmission requirements** in order to solve the constraints?
- Which **technologies** should be available by 2050?
- Which **cost and benefit** of the new grid architectures?
- Are the 2050 grid architectures **operable**?

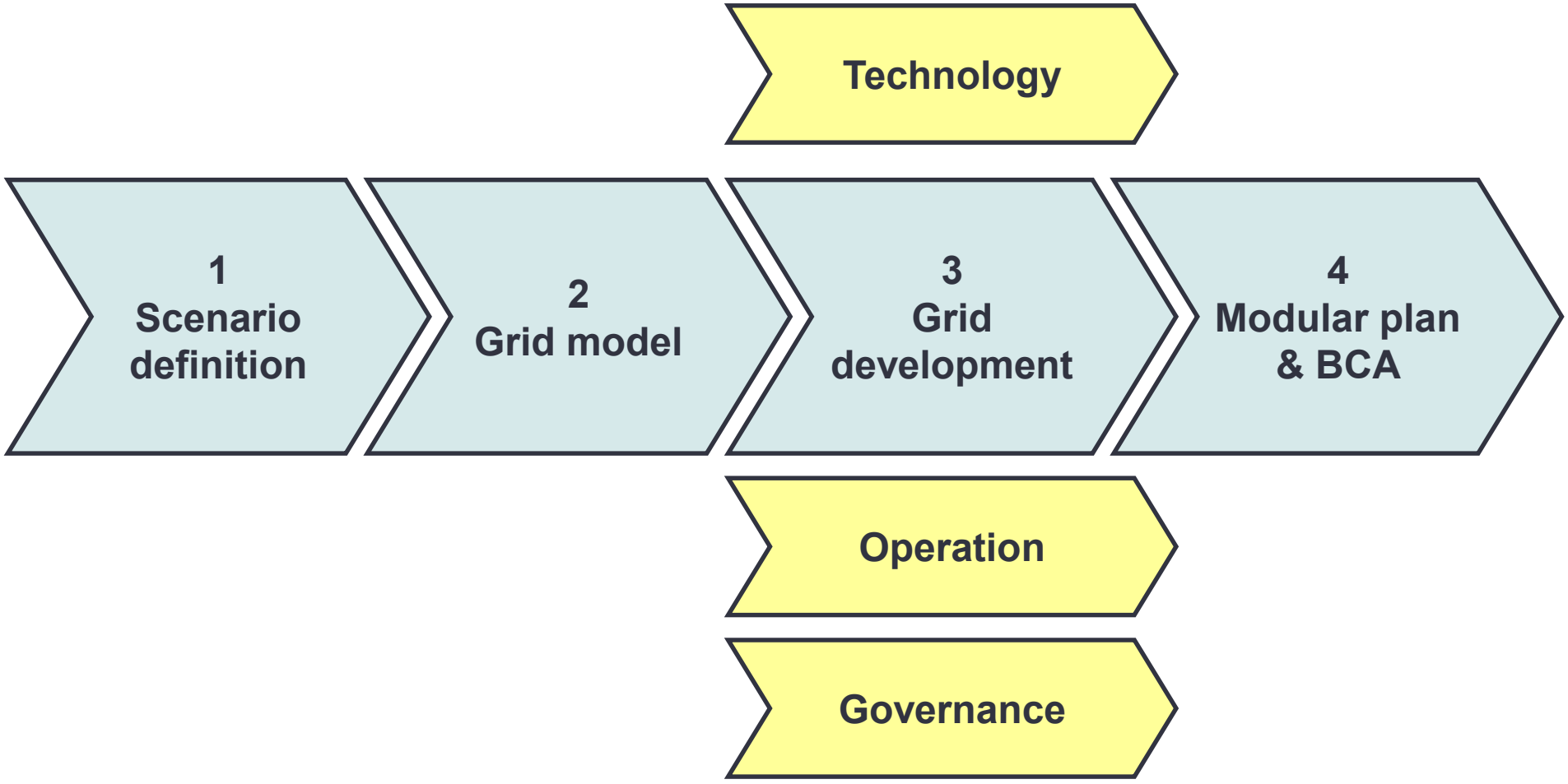
Roadmap 2030-2050

How to develop the transmission grid from now up t 2050?

Which **intermediate architectures** in order to reach the 2050 grid architectures?

Which **governance** for a pan-European transmission grid?

The whole process



Steps of grid architecture development

Scenario definition

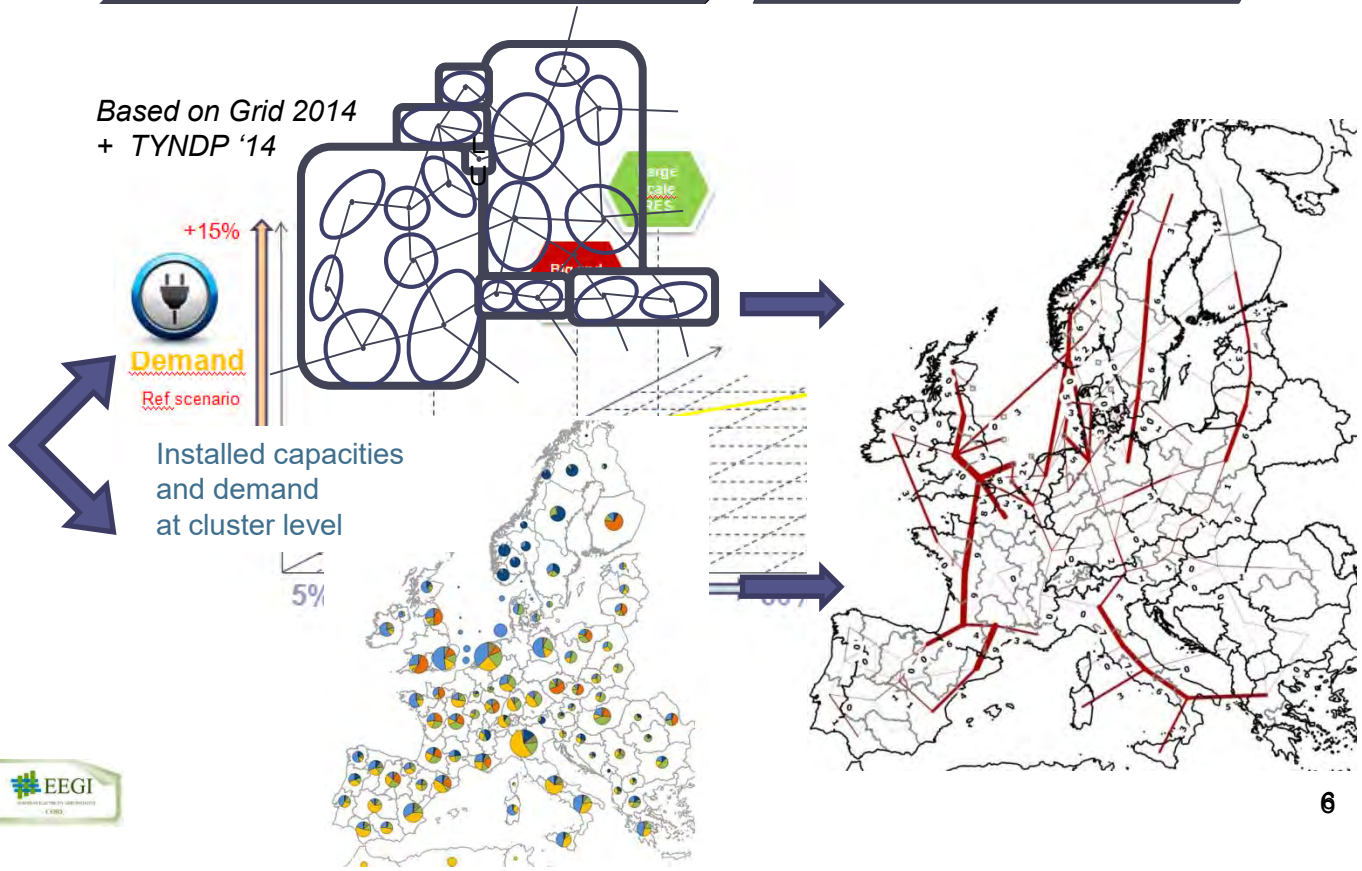
European grid model

Scenarios quantification

Grid development

Five scenarios

Based on Grid 2014
+ TYNDP '14



Summary of the main assumptions for grid development

- Only the inter-clusters transmission requirements are assessed
- Focus is on the major ones, some smaller could be profitable as well
- The 2030 grid from TYNDP2014 is the starting point, major projects like HVDC in Germany are thus already assumed
- The detailed routes and connection points are unknown
- Each transmission requirement could be realized through many parallel reinforcements
- For each scenario, a complete set of reinforcements for Europe is suggested, the reinforcements are not assessed independently.
- The time horizon is 2050 : the profitability of the reinforcements is not proven before.

System simulations

System simulations are done with Antares..

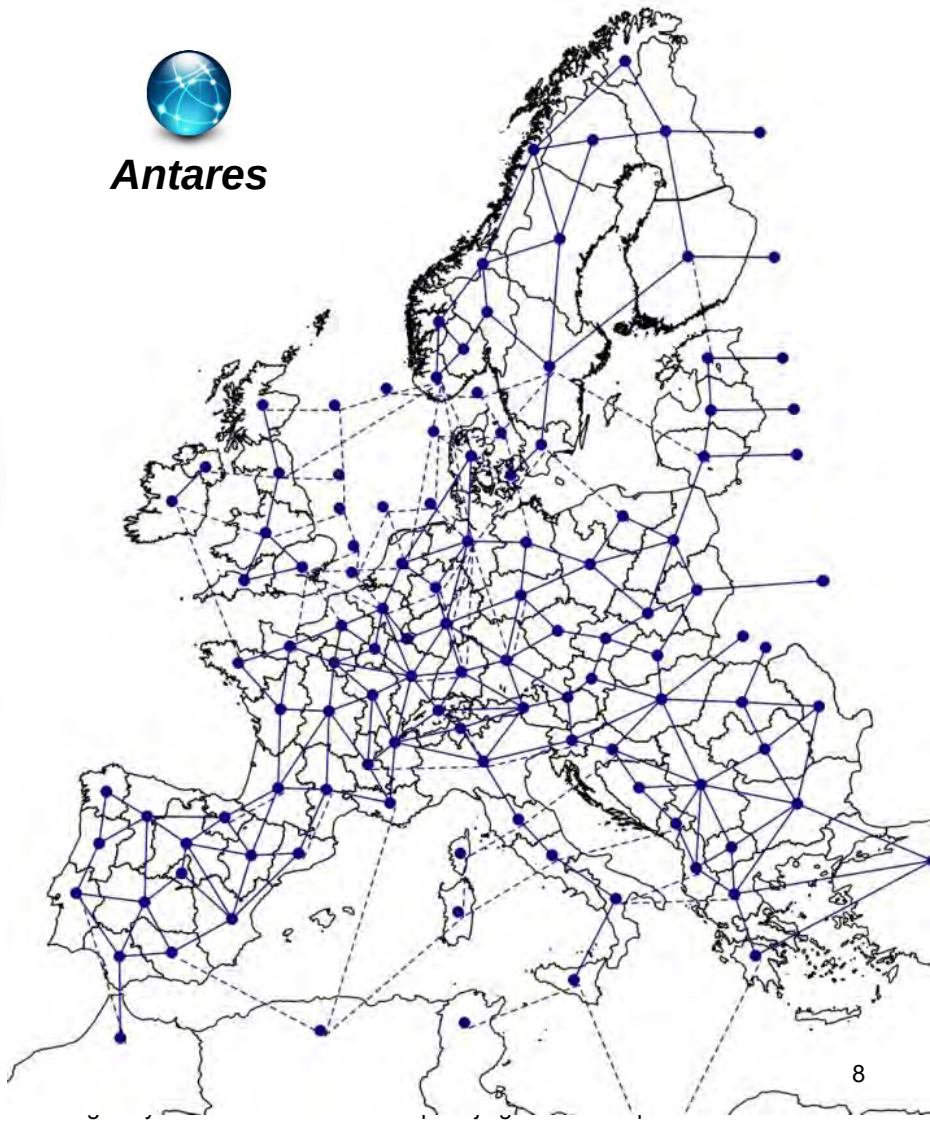
… a **stochastic tool** (Monte-Carlo scheme : Wind, Solar generation and load … weather conditions)

… optimize **generation of dispatchable** units (merit order) to satisfy net demand

… taking into account **grid constraints** (DC approximation : Kirchhoff laws)

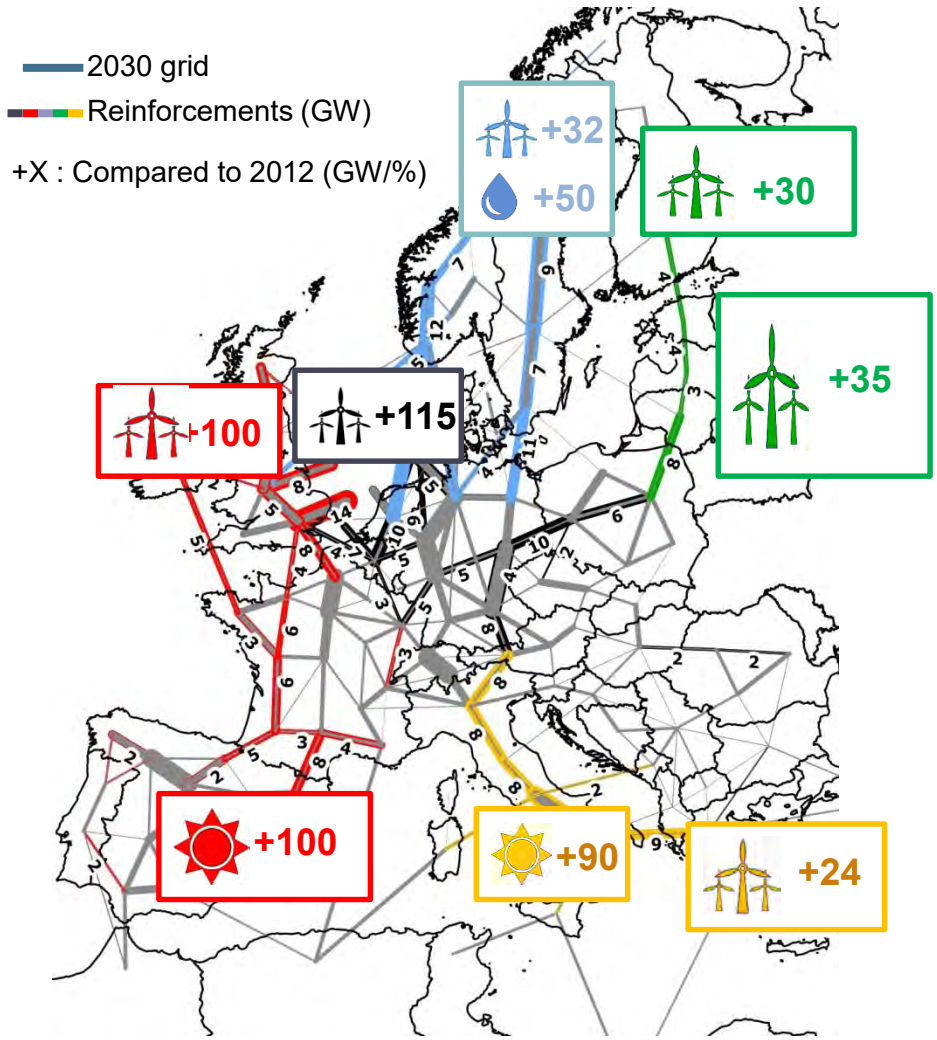
… time step resolution of **one hour …** for a period covering **one year.**

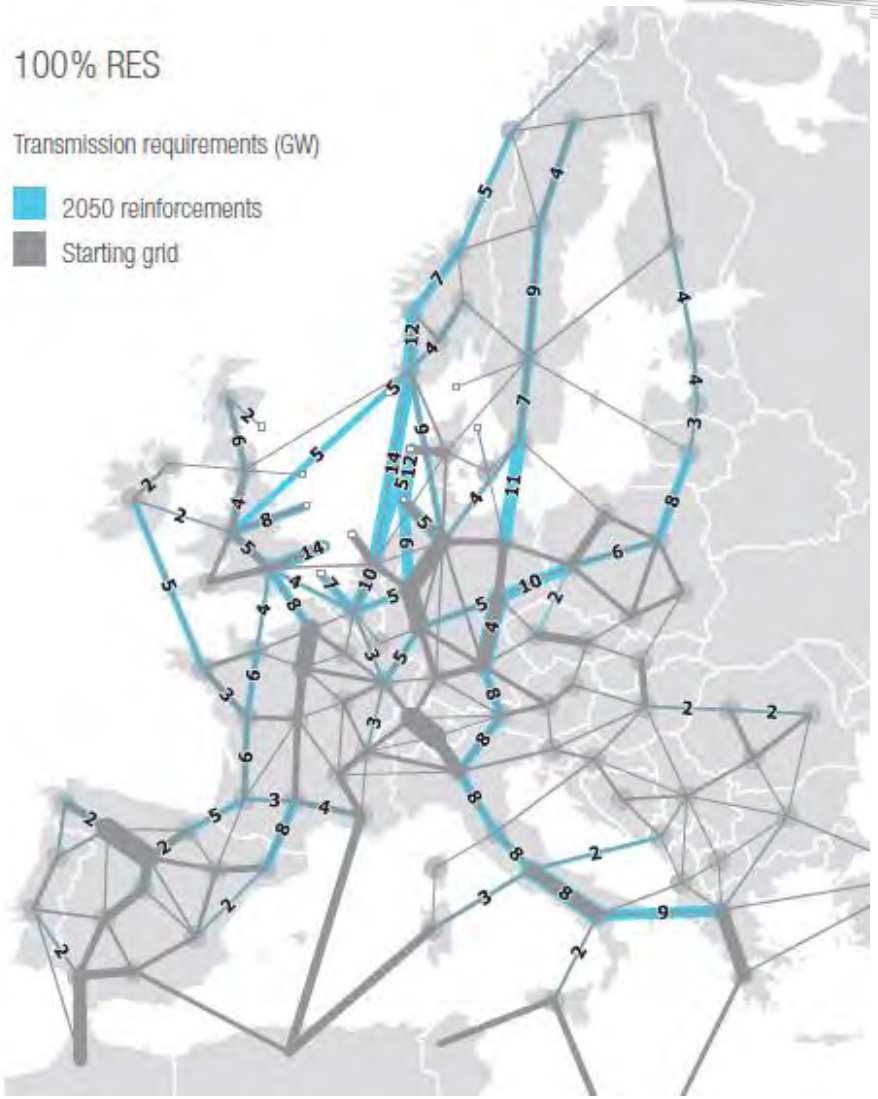
Optimization of **whole European** system in one shot (minimization of the generation cost)



Results: scenario *100% RES*

100% RES





Results: scenario *100% RES*

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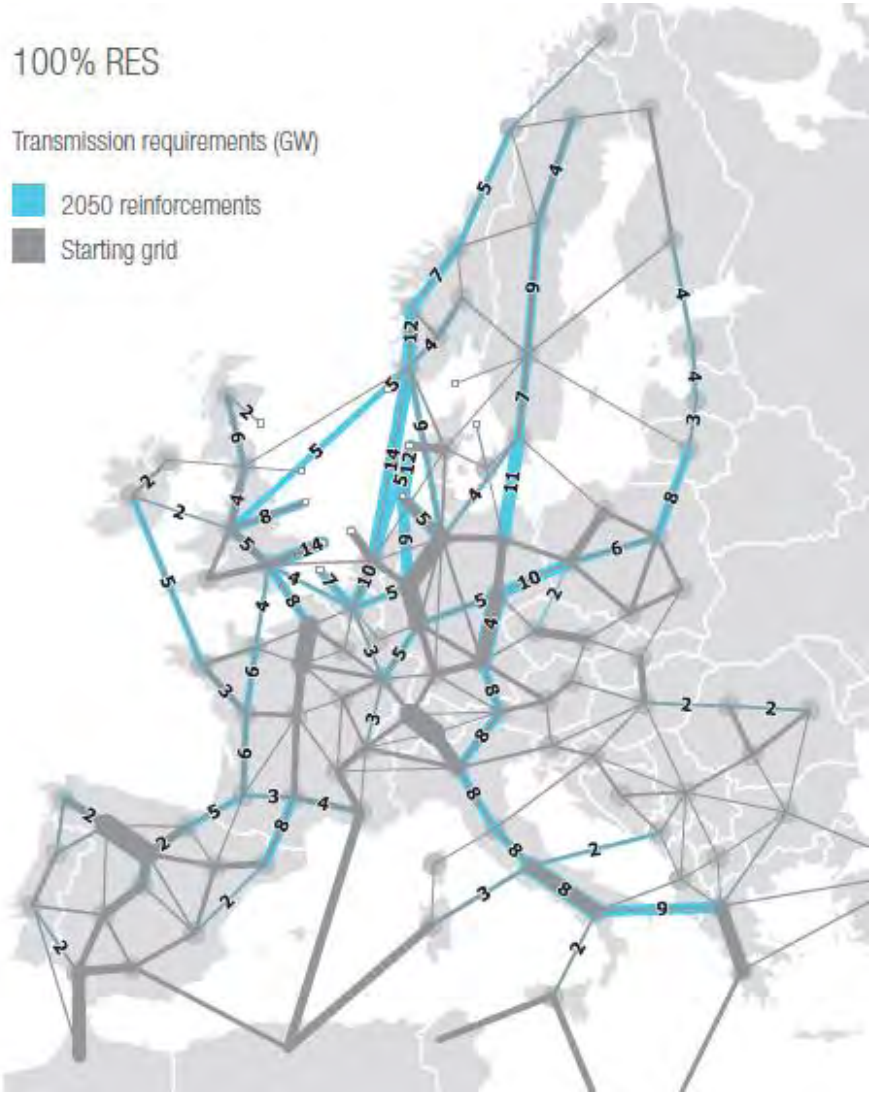
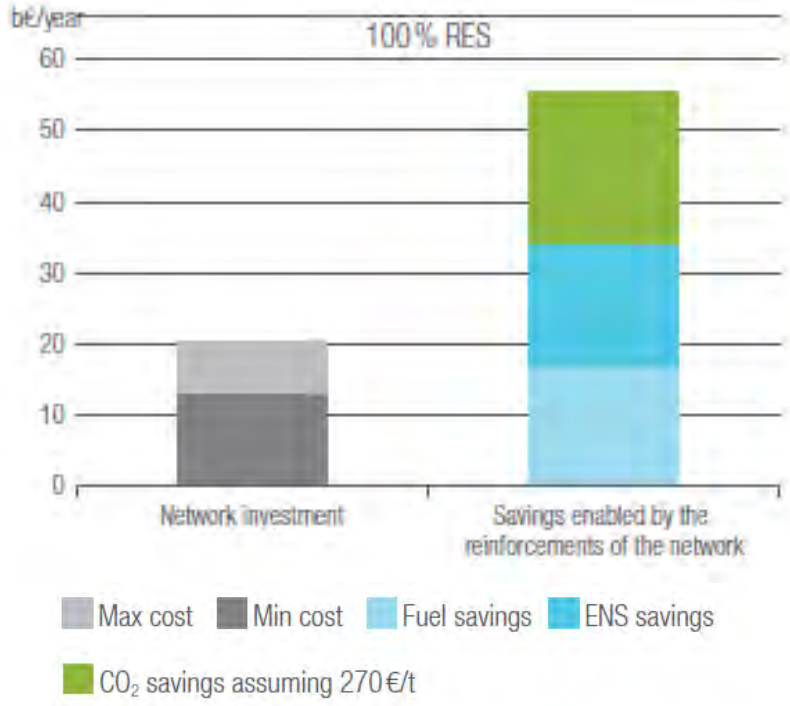


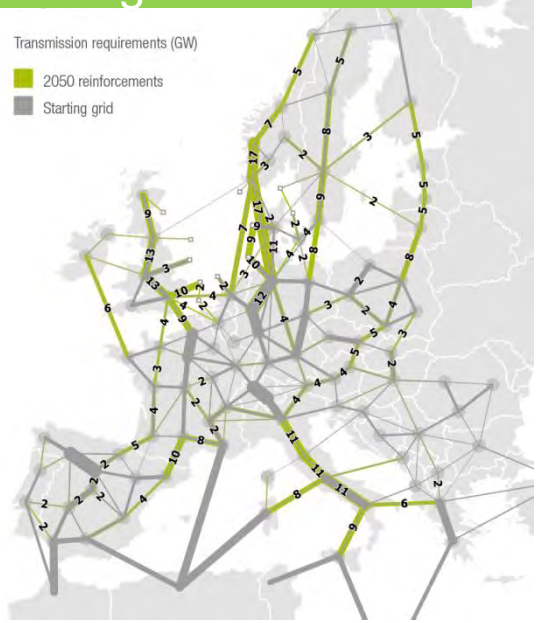
- 51 TWh of ENS avoided /year
- 465 TWh of spillage avoided /year
- 55 b€ of annual savings

Total investment cost : 245-345 b€

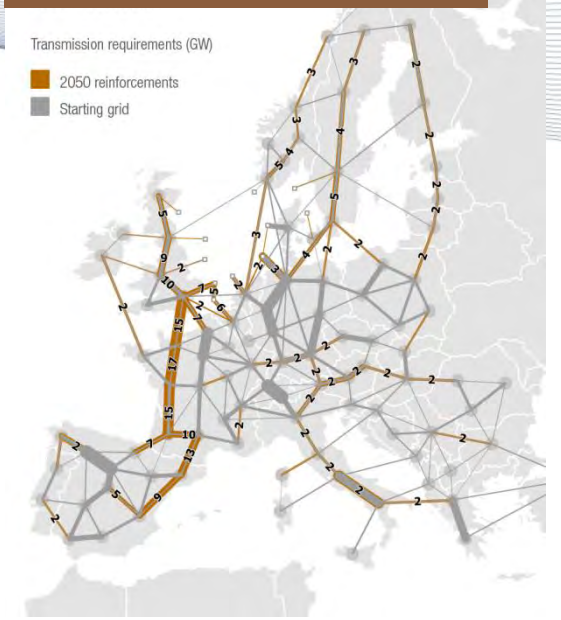


Comparison of the final architectures

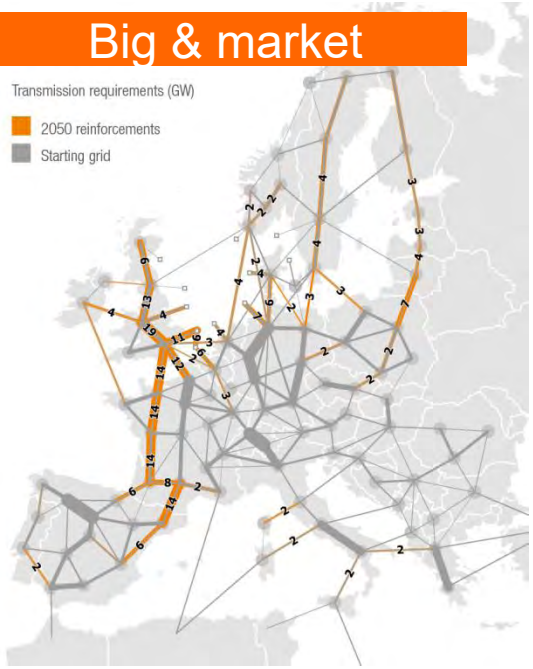
Large scale RES



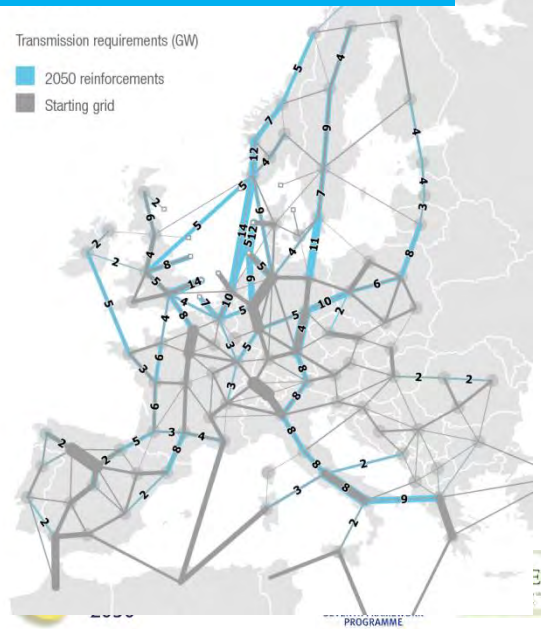
Fossil & nuclear



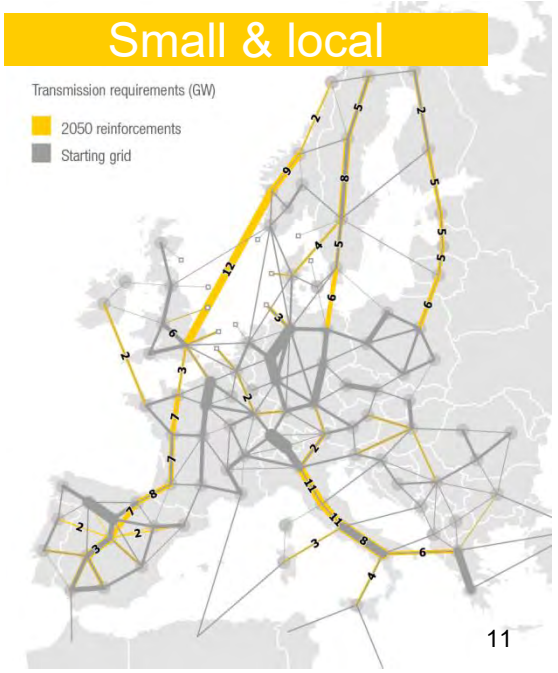
Big & market



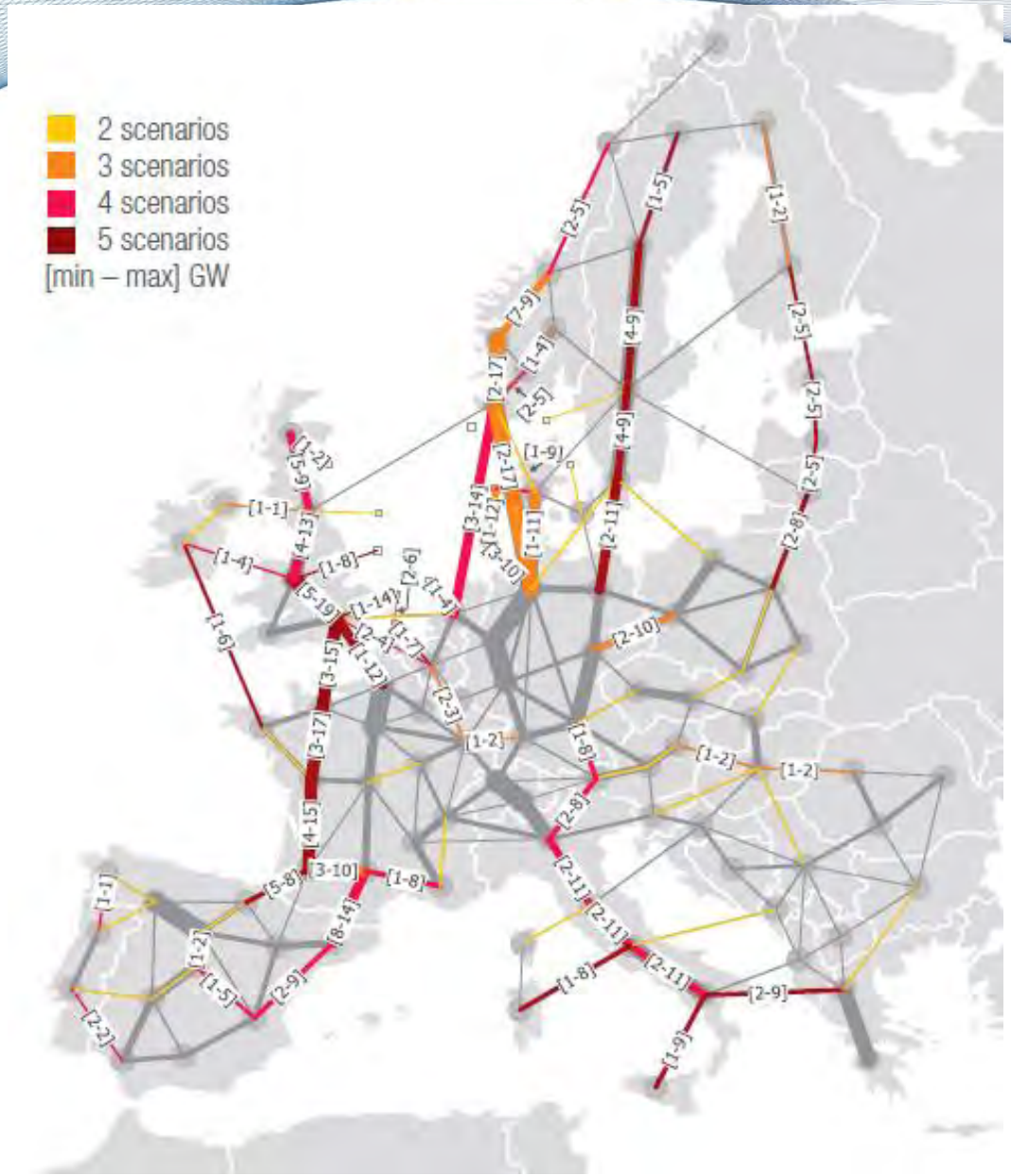
100% RES



Small & local

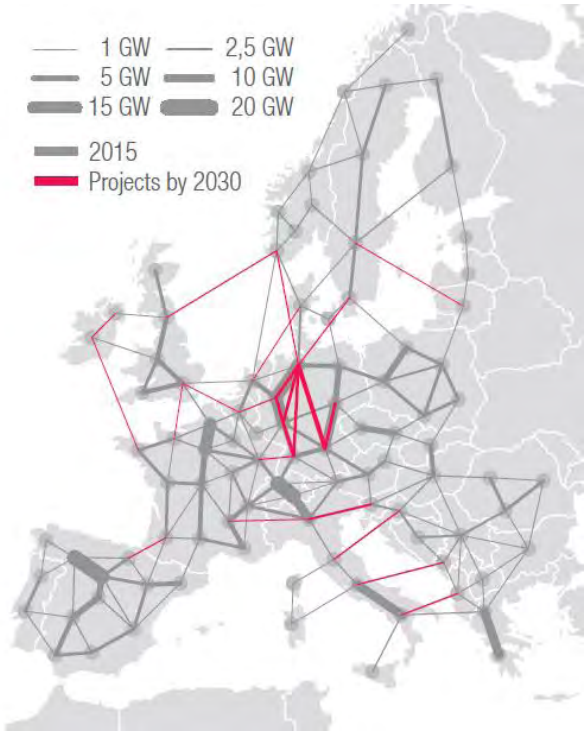


The 2050 grid architectures

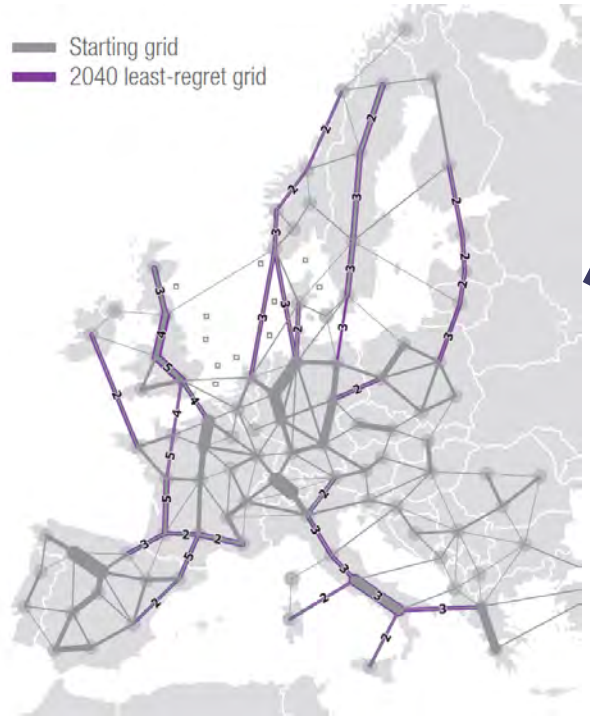


- An invariant set of new lines and reinforcements has been identified
- Robust to face large uncertainties
- Good candidates for mid-term grid investments

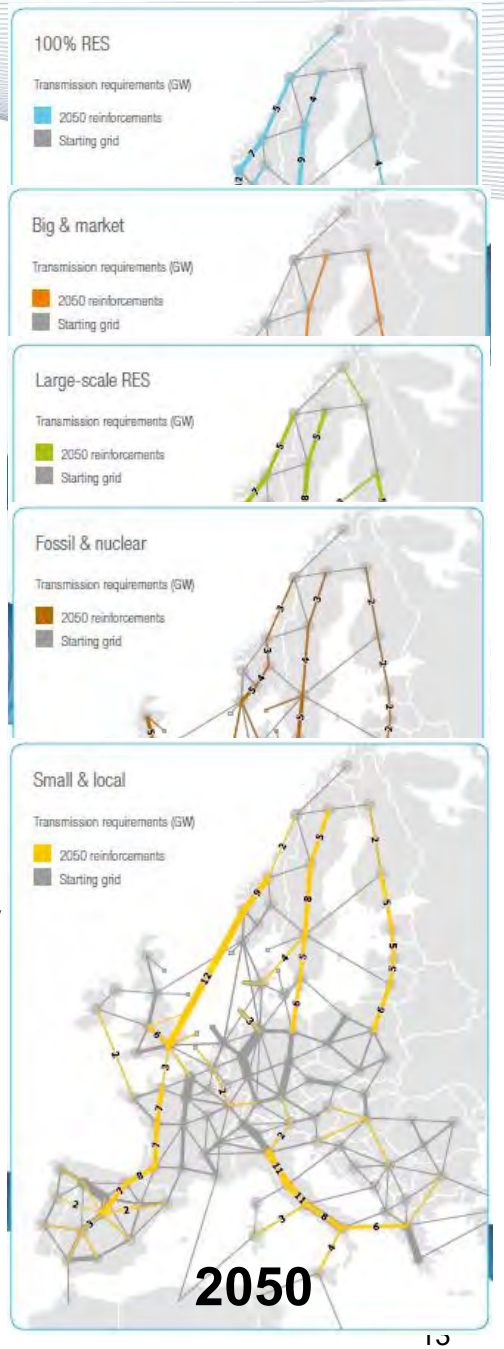
From 2030 towards 2050



2030



2040



2050

Key messages *(1/2)*

- ✓ An invariant set of transmission requirements has been identified in consistency, and in continuity with the Ten-Year Network Development Plan conducted by ENTSO-E. Their benefits for the European system, resulting from the optimal use of energy sources, largely exceed their costs.
- ✓ No needs for a new separate 'layer' within this existing grid
- ✓ New methodologies for the development of the European transmission grid have been developed, enabling to:
  - ✓ Address long term horizons,
  - ✓ Cover the whole Europe,
  - ✓ Cope with the European low carbon objectives, translated at national, and local levels, while building global grid architectures

Key messages *(2/2)*

- Technology:
  - Needs for the improvement
    - of the present technology on the transmission capacities,
    - and their use (e.g submarine in depth, DC technology).

- Governance:
  - Need for the improvement of the regulatory framework in order to realize the grid architectures proposed

- System Operation:
  - The consequences of high penetration of RES and HVDC in the power system should be further investigated

Thank you for your attention!

Web: www.e-highway2050.eu

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