e-Highway2050 project

Tomorrow's grid for low-carbon energy in Europe

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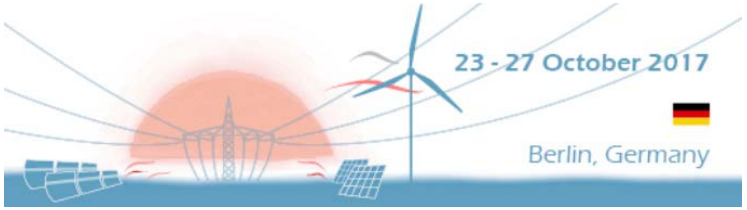
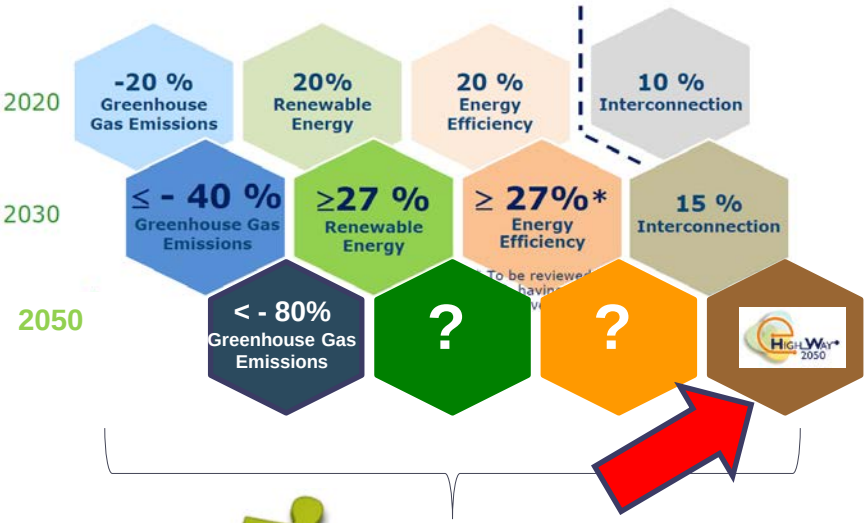
Coordinator of e-Highway2050 project

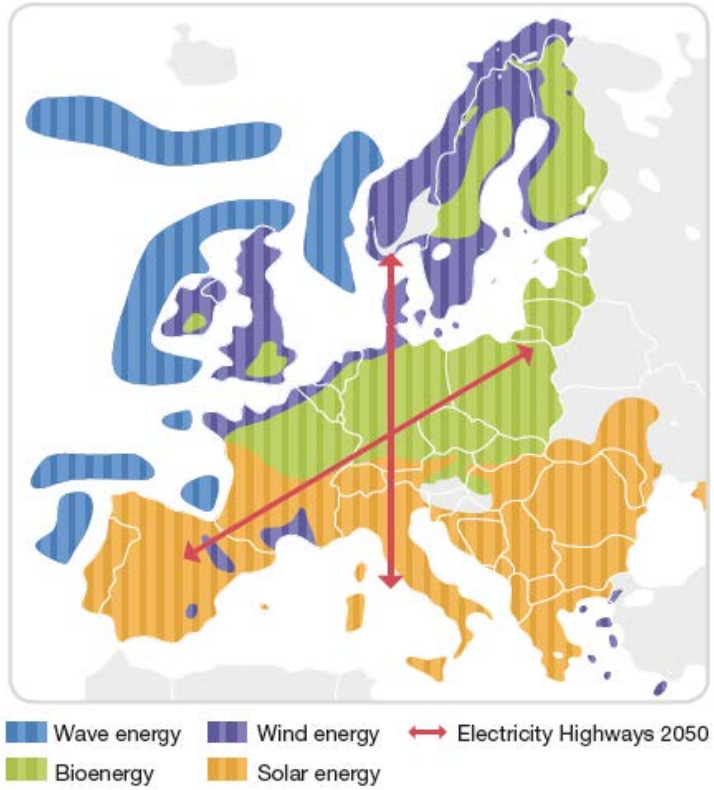


Introduction of e-Highway2050

Background



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



< - 80% Greenhouse Gas Emissions

General requirement of the project

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

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

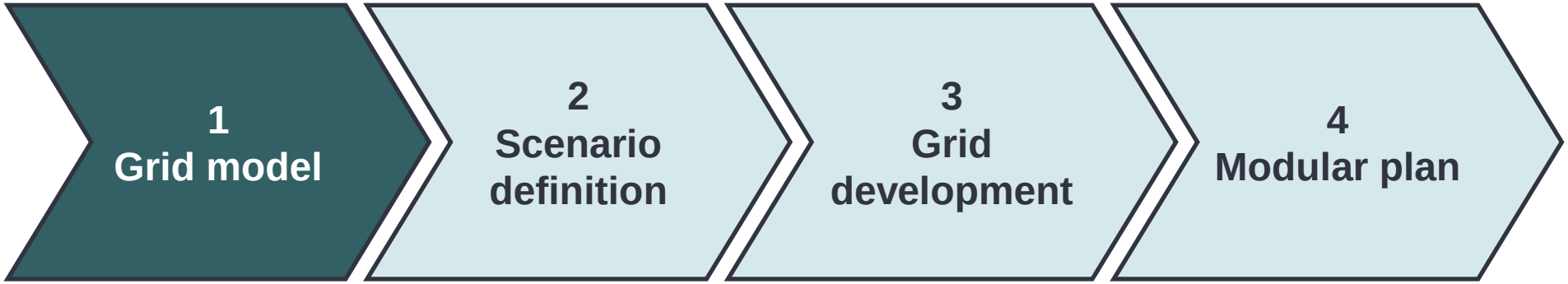
How to develop the transmission grid from now up to 2050?

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

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

The main results

The grid model of e-Highway2050



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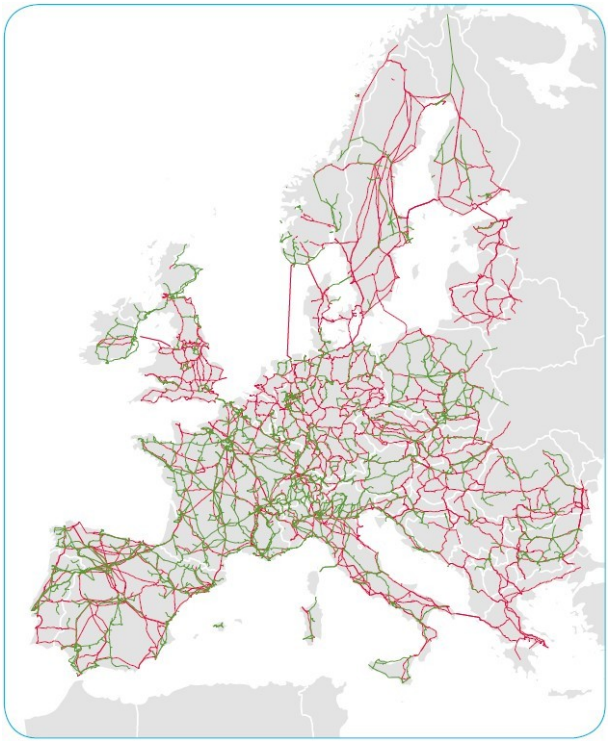
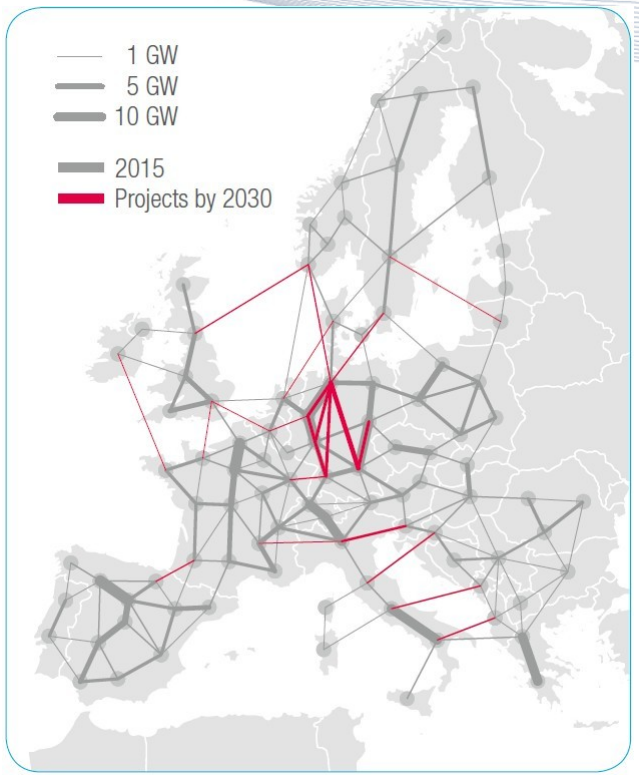


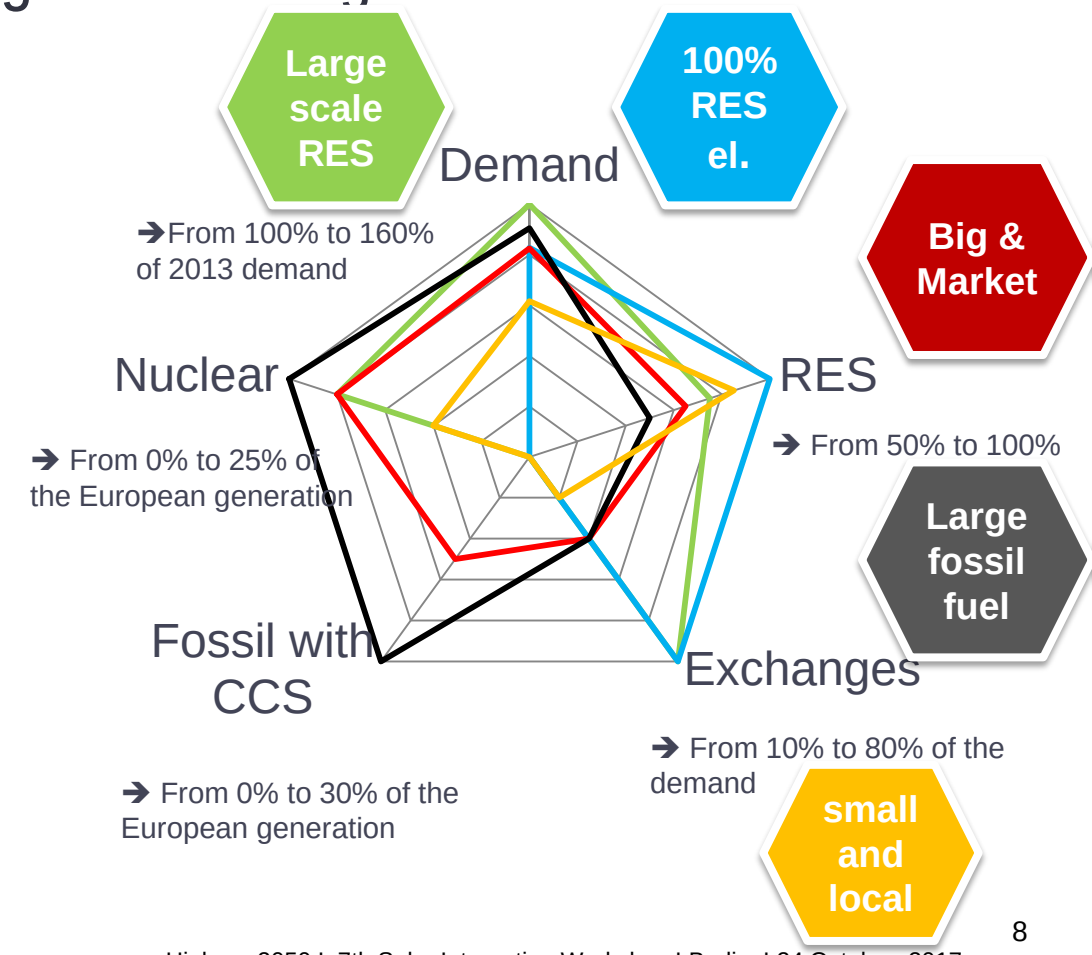


- Not the real grid (> 8000 electrical nodes), but a model with 100 clusters (electrical nodes).
- The starting grid is grid foreseen until 2030, and included in the TYNDP (ENTSO-E).

Scenario definition

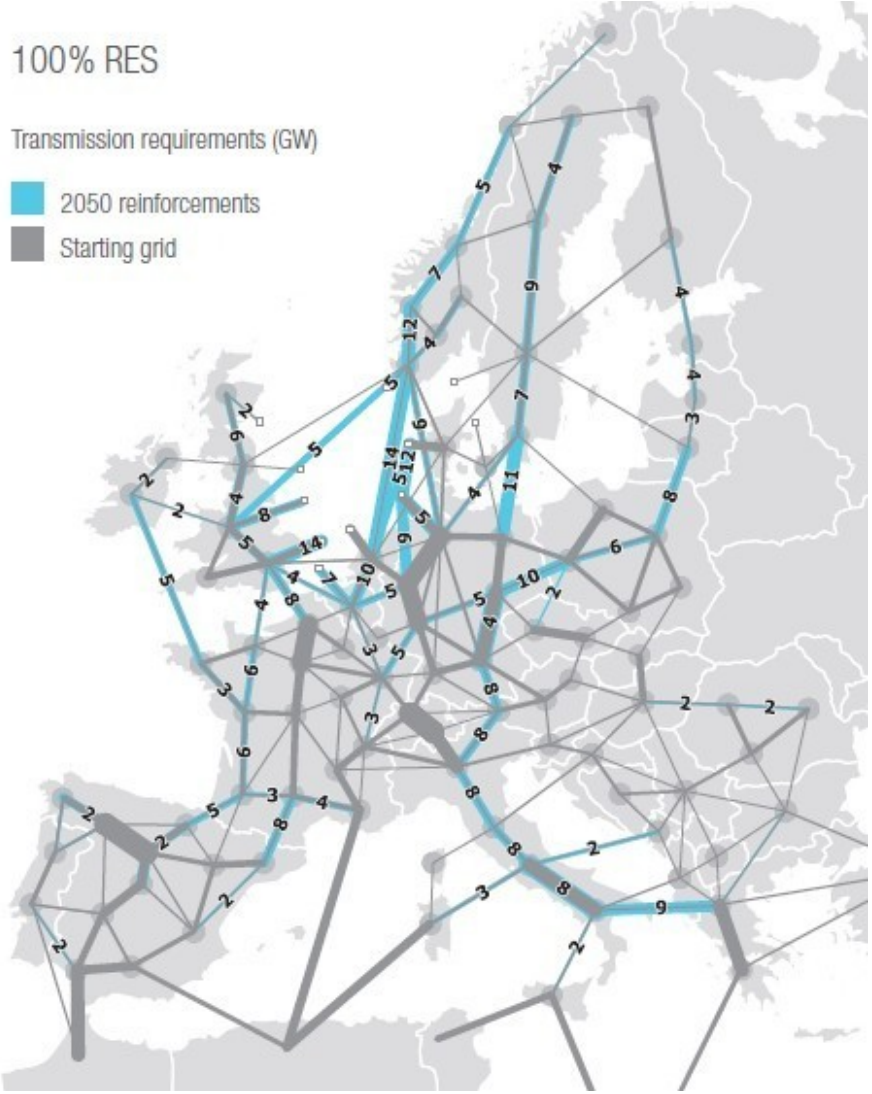
5 “extreme but realistic” scenarios

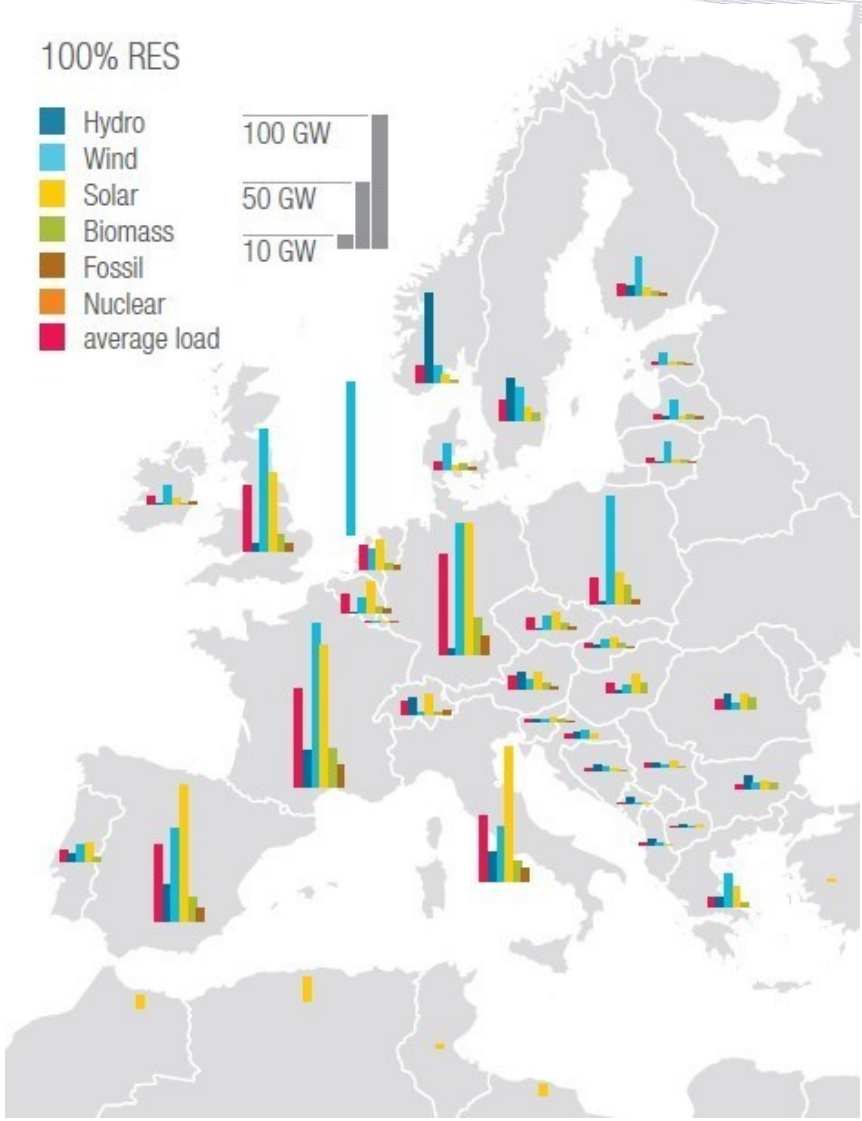
- Target : reduce by 95% the CO2 emissions
- 5 European scenarios were selected to encompass a wide range of possibilities at 2050 regarding the following criteria :



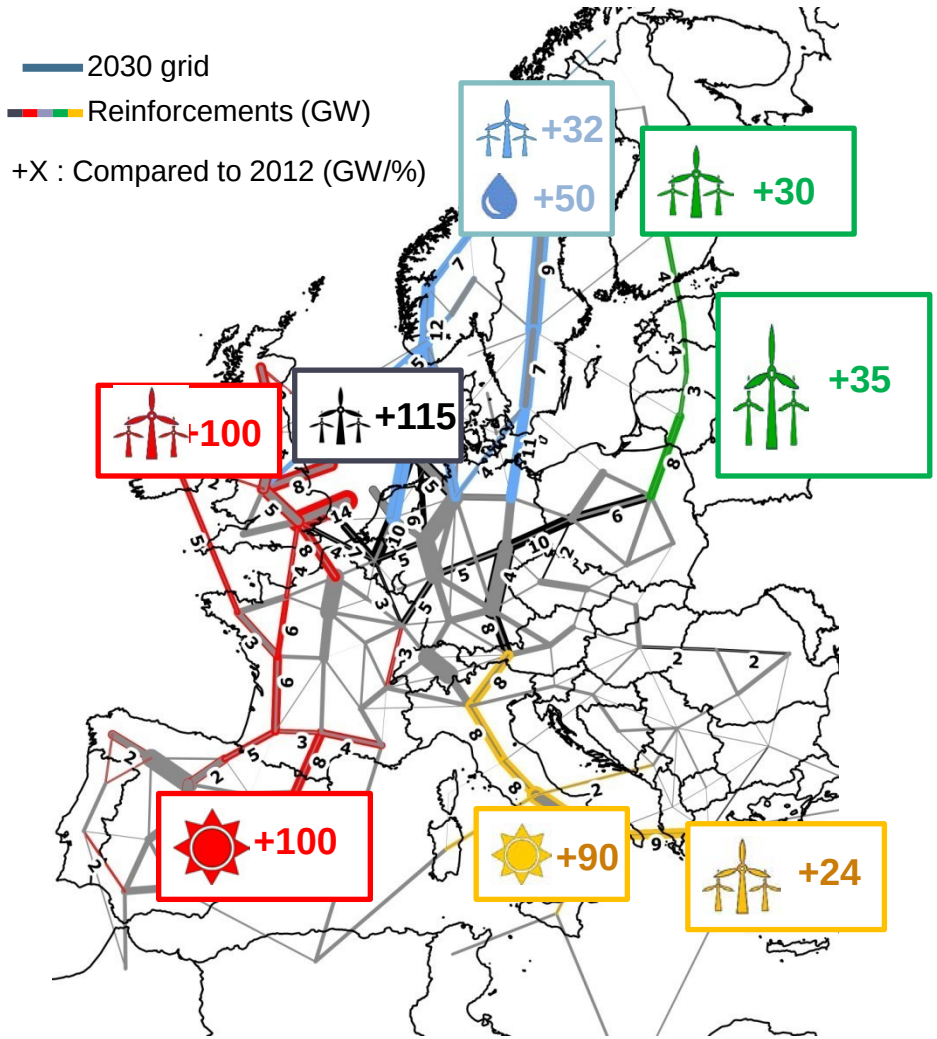
Grid development

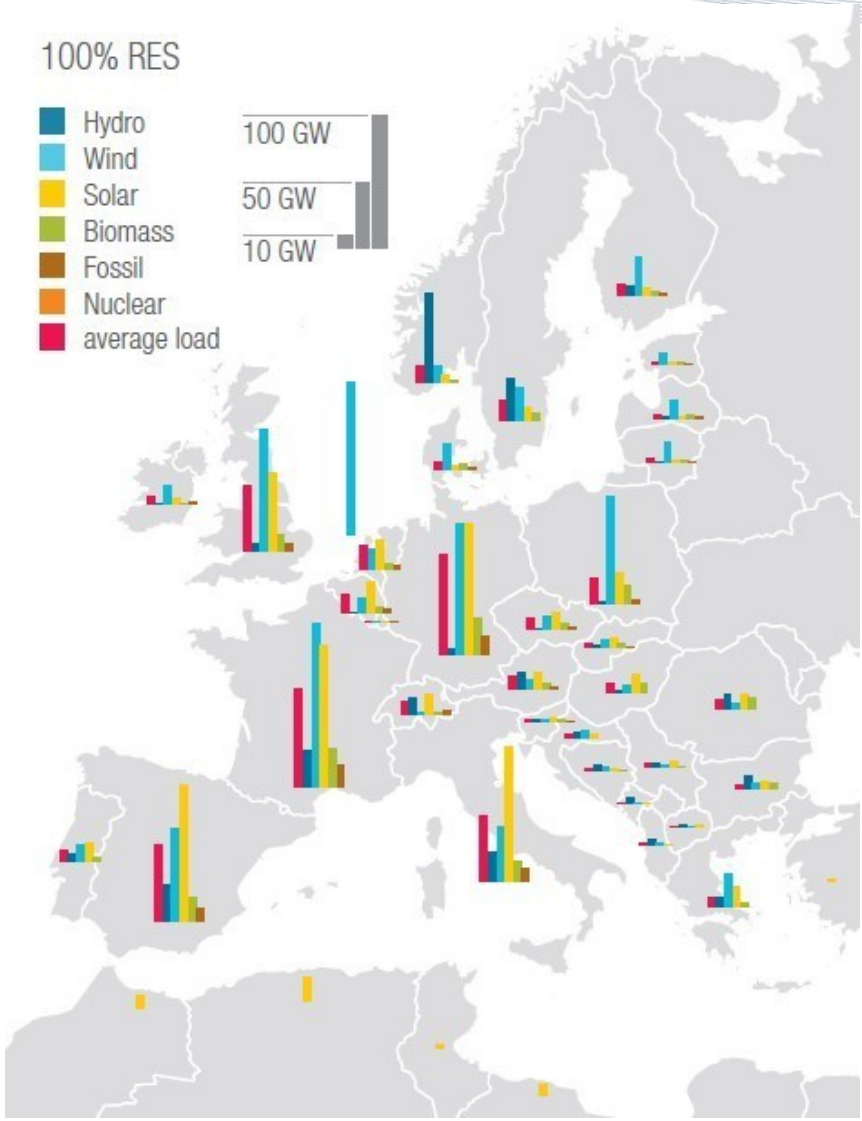
Results: scenario 100% RES





Results: scenario 100% RES





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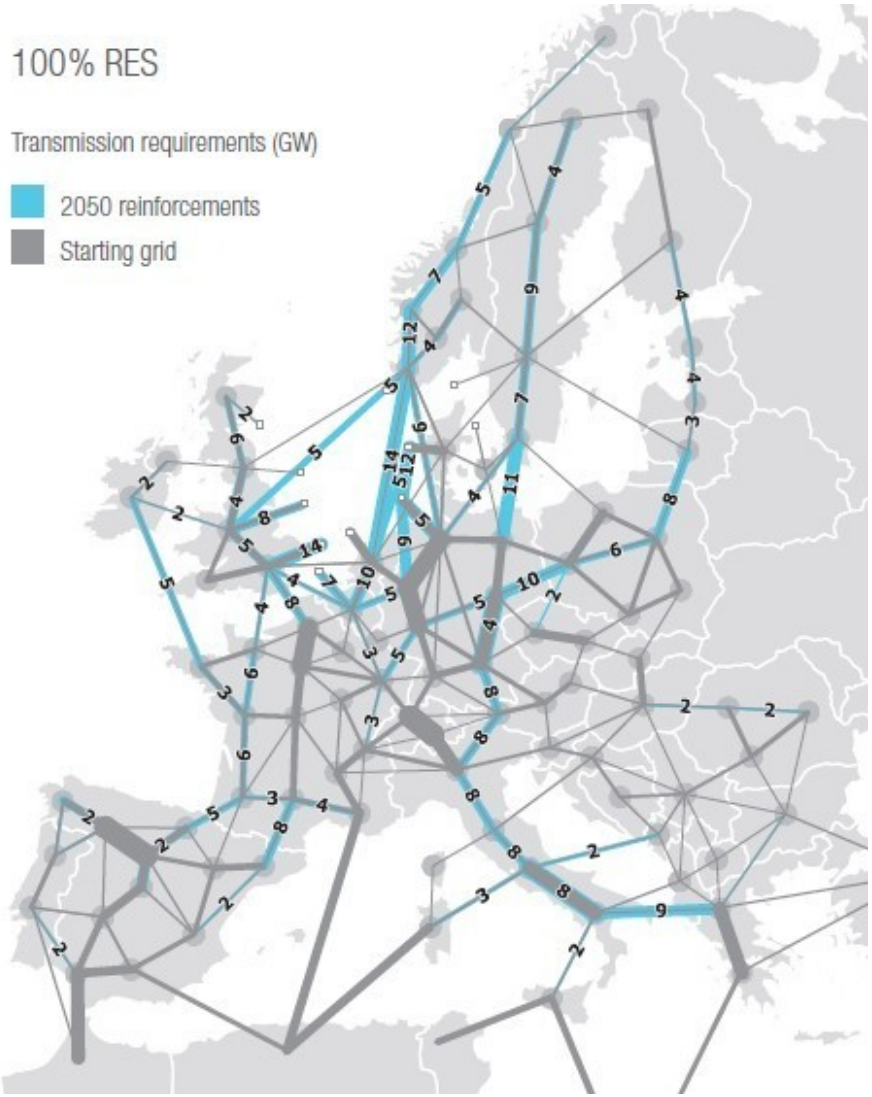
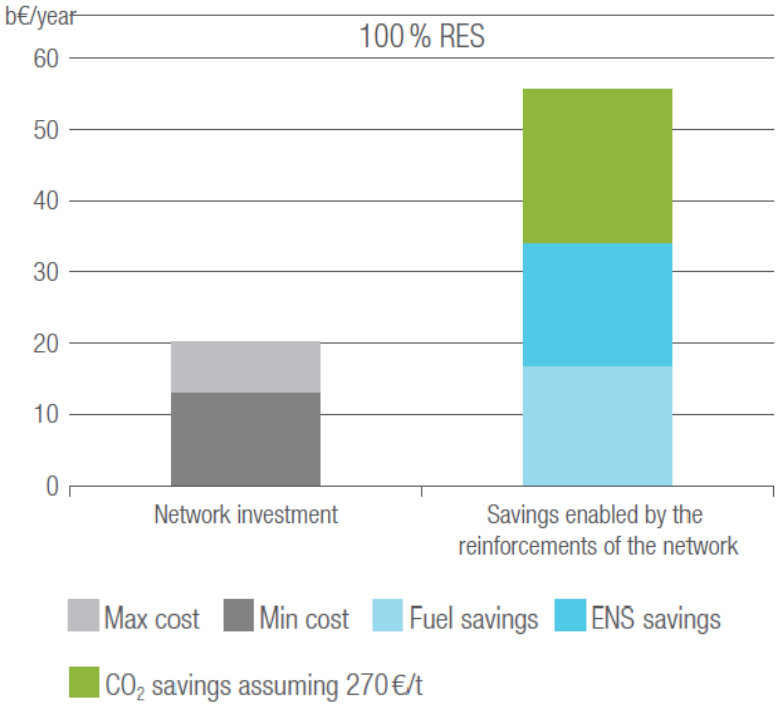
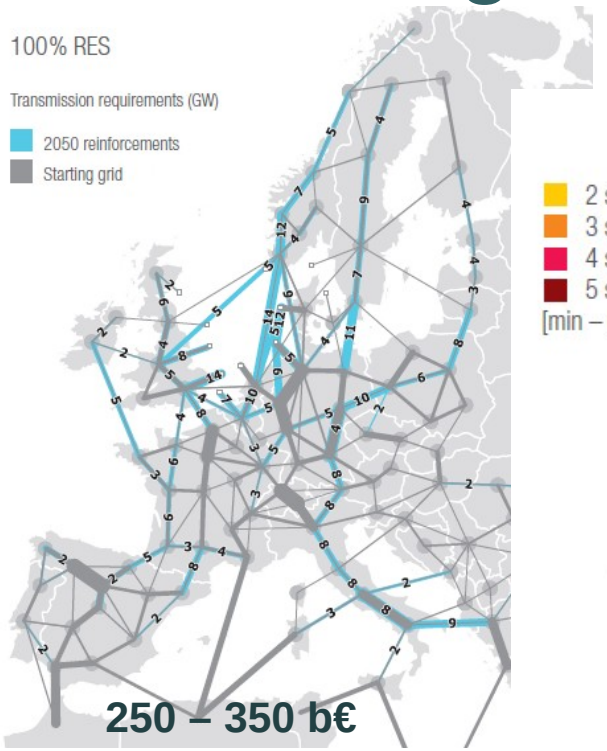


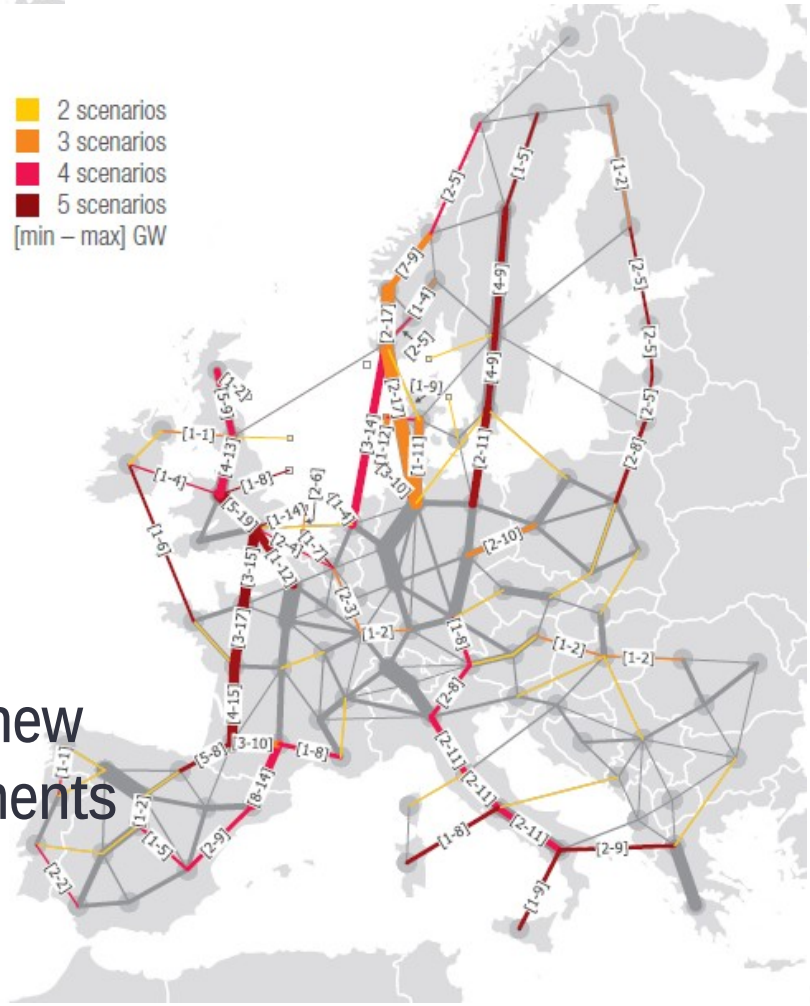
- 51 TWh of ENS avoided /year
- 465 TWh of spillage avoided /year
- 39 b€ of annual savings in operating costs

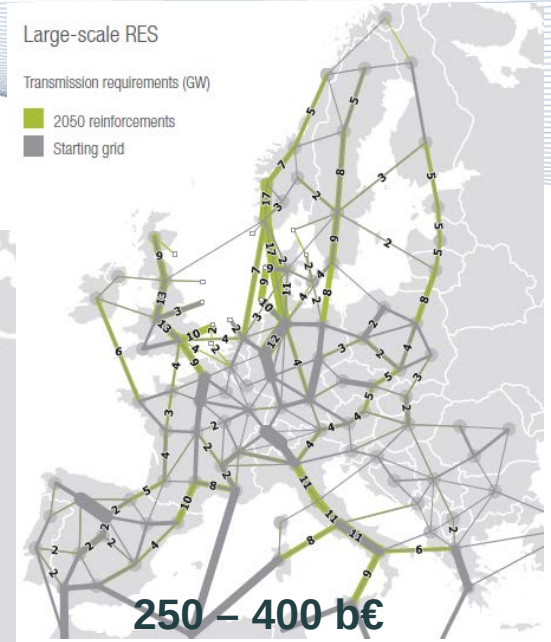
Total investment cost : 245-345 b€

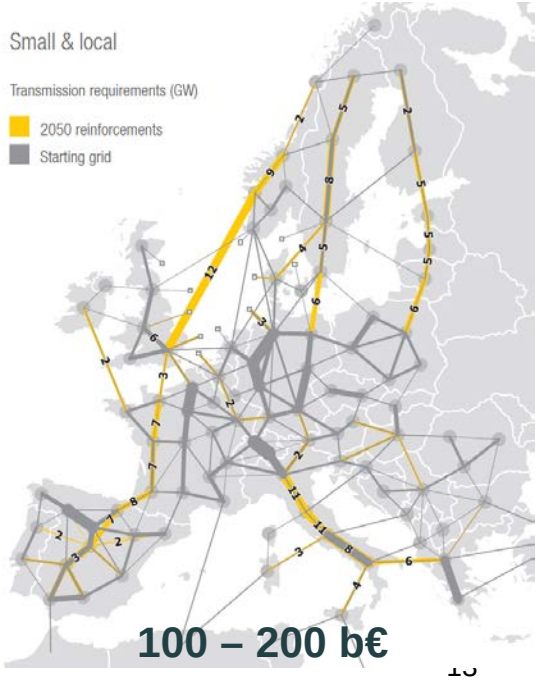


The 2050 grid architectures



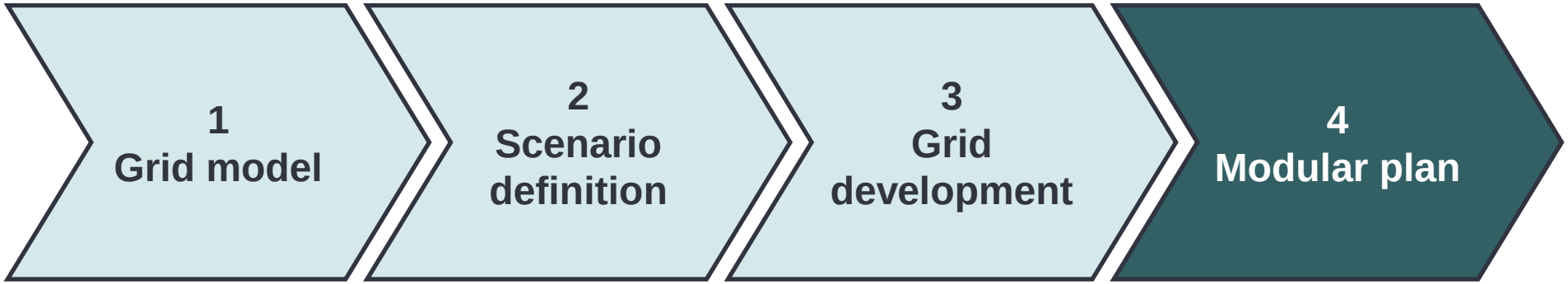




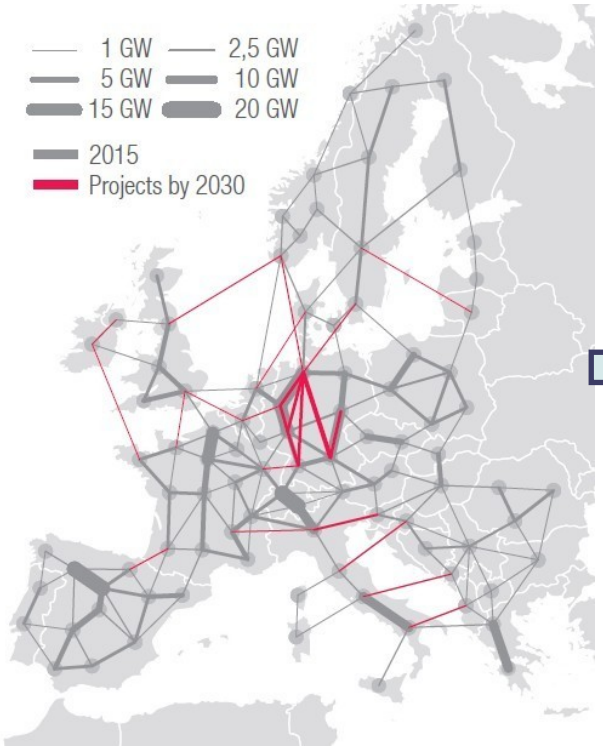


- An invariant set of new lines and reinforcements has been identified.

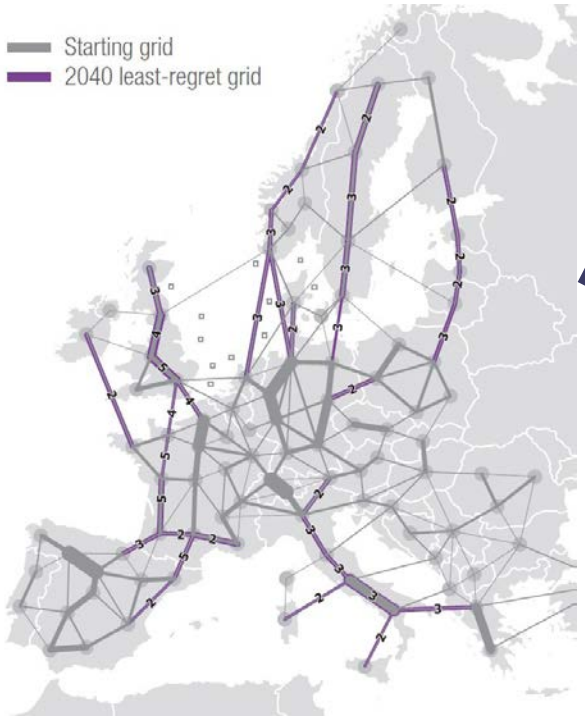
Modular plan



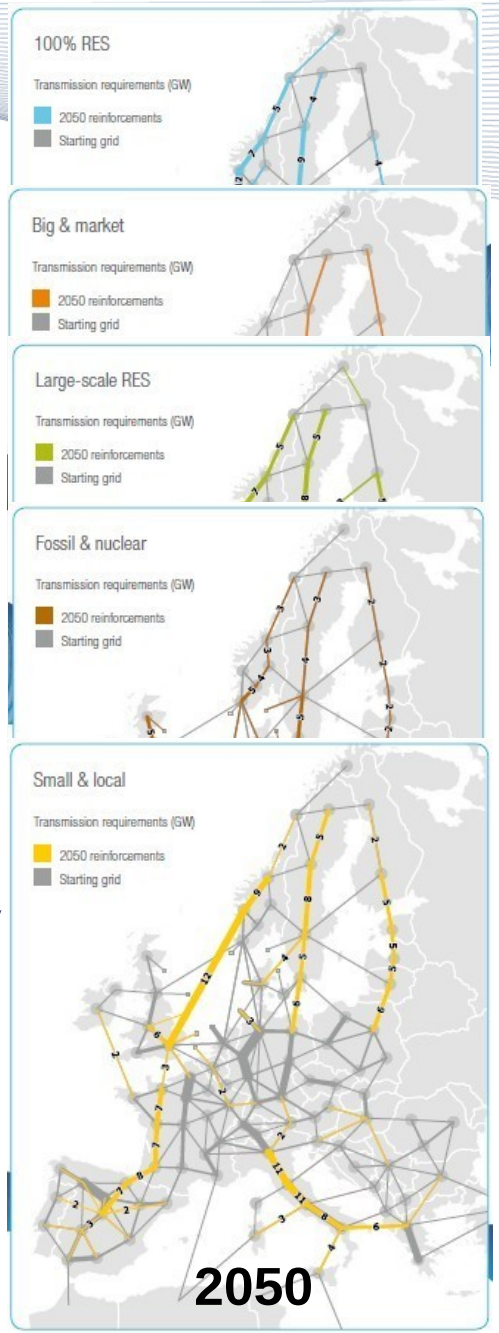
From 2030 towards 2050



2030



2040



2050

In conclusion

Key messages *(1/2)*

- Main findings of the project
  - The ‘present network’ should be not sufficient to face a future with low carbon economy.
    - Especially, huge volumes of RES would be curtailed and compensated by expensive thermal generation emitting CO2.
  - To tackle these issues, transmission grid architectures have been developed by the project, with **an invariant set of transmission** requirements.
  - The costs of investment in grid expansion lie between 100 and 400 billions €, but saving up to 500 TWh of RES curtailment, and 200 mega tons of CO2 emissions.

Key messages *(2/2)*

- Grid Structure
  - no needs for a new separate ‘layer’ within this existing grid.

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

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

Thank you for your attention!

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