

# e-Highway 2050

## Modular Development Plan of the pan-European Transmission System for 2050

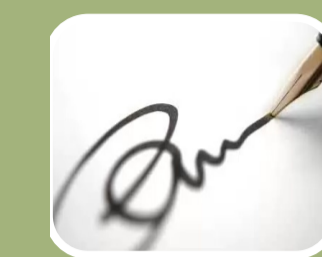
Interim Results are methods, grid architectures and recommendations:



Top-down methodology organized in modular blocks



Validated pan-European grid architectures at 2050



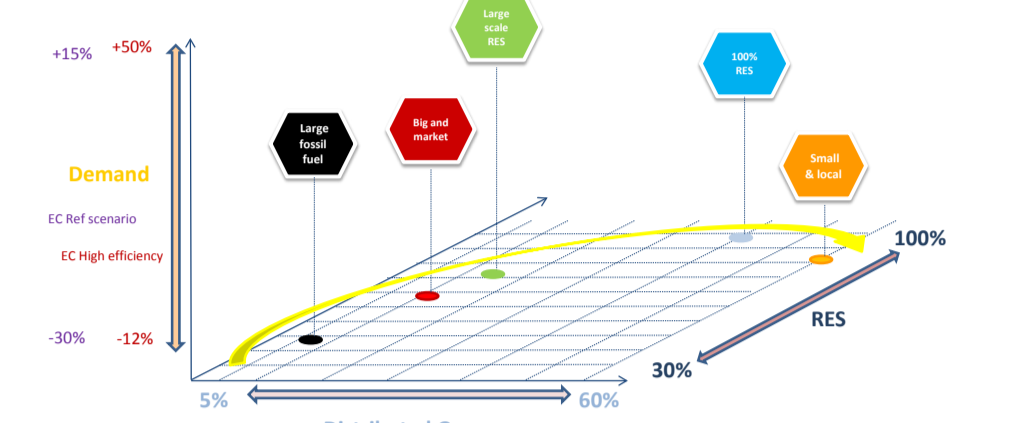
Recommendations towards stakeholders

ENERGY SCENARIOS AT 2050

### Energy scenarios by 2050 are built upon a systematic methodology:

- Possible 2050 energy scenarios as a combination of 6 strategies (endogenous options upon which decision makers have control) and 5 futures (exogenous uncertainties)
- Selection of energy scenarios as most challenging for the grid

➔ Five «extreme but realistic» energy scenarios at 2050

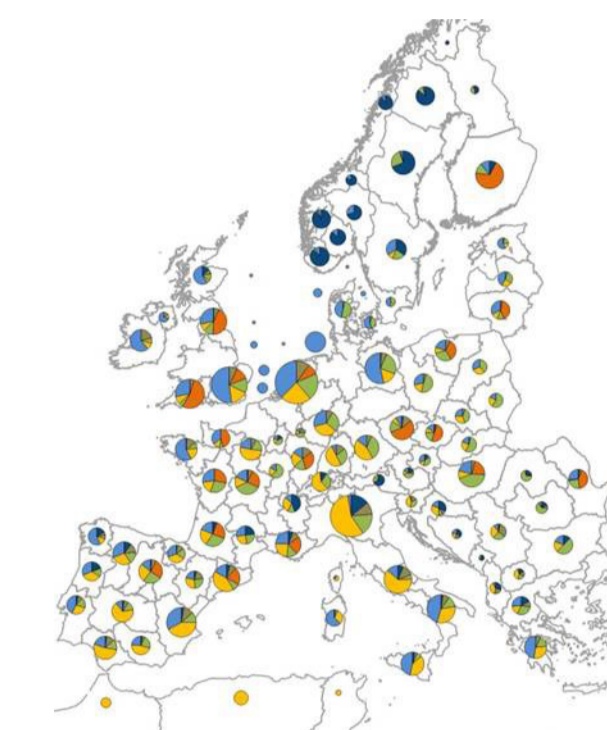


GENERATION AND DEMAND AT CLUSTER LEVEL

### A simplified pan-European grid is constructed so as to enable system simulations



Equivalent pan-European grid model of a hundred clusters, calculated from the 2020 full description of the grid



Top-down quantification to estimate the generation mix and demand at cluster level for each scenario

➔ Description of the system (generation, demand and grid) for a hundred clusters for the 5 scenarios

CONGESTION CONSTRAINTS

### Detection of congestion constraints results from system simulations

- System simulations of 100 Monte-Carlo years with a time resolution of one hour for each scenario
- Identification of constraints based upon the level of unsupplied energy, spilled energy and thermal redispatching
- Reinforcement options to remove the constraints

➔ Transmission reinforcements for each of the 5 scenarios

POWER TECH DATA 2050

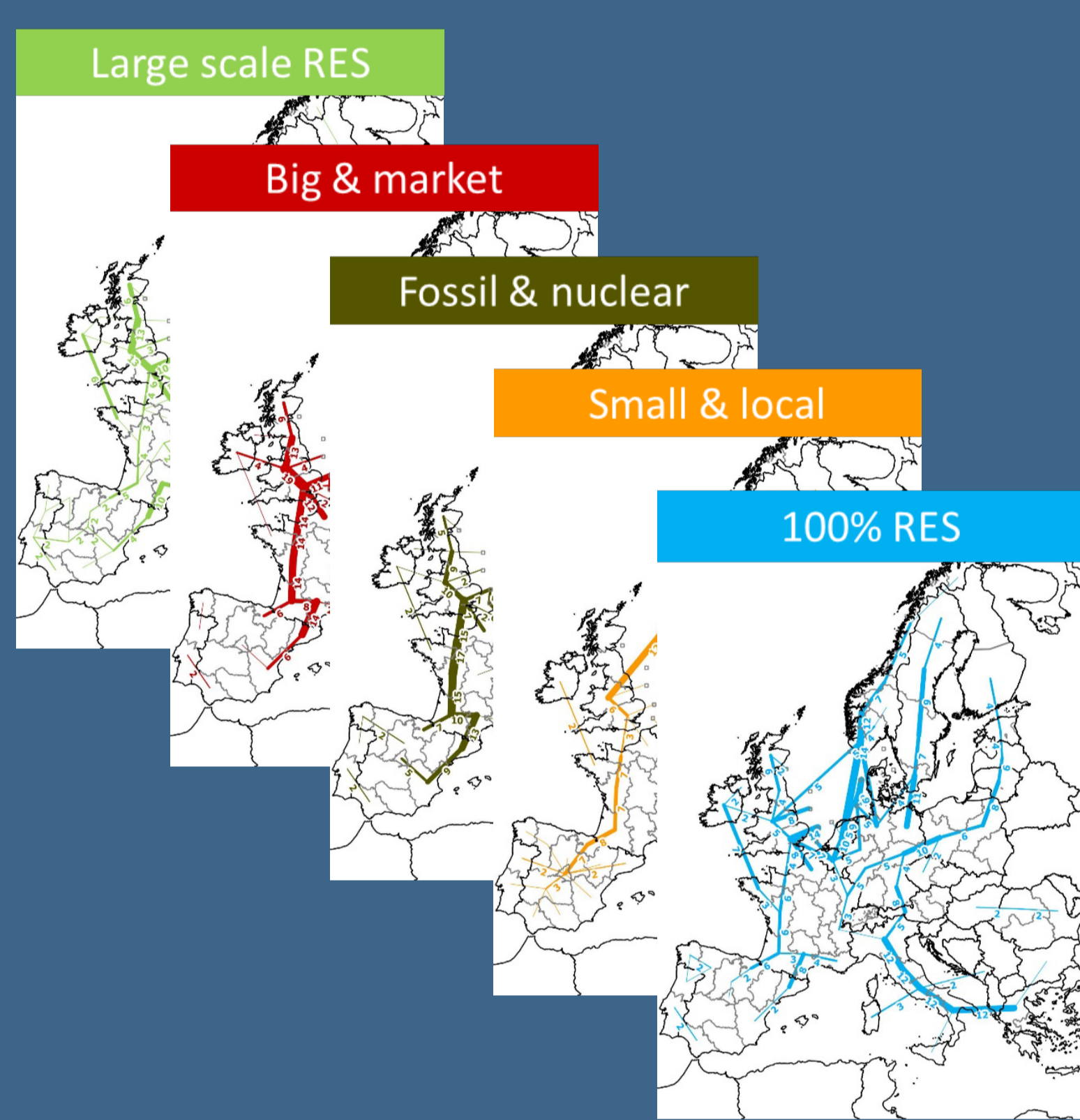
### Costs and performances of technologies impact grid architecture studies at 2050

- Database for all power system technologies (generation/ storage/ demand/ transmission) up to 2050, updated with the support of manufacturers
- Management of uncertainties in predicting cost and performance trajectories of technologies

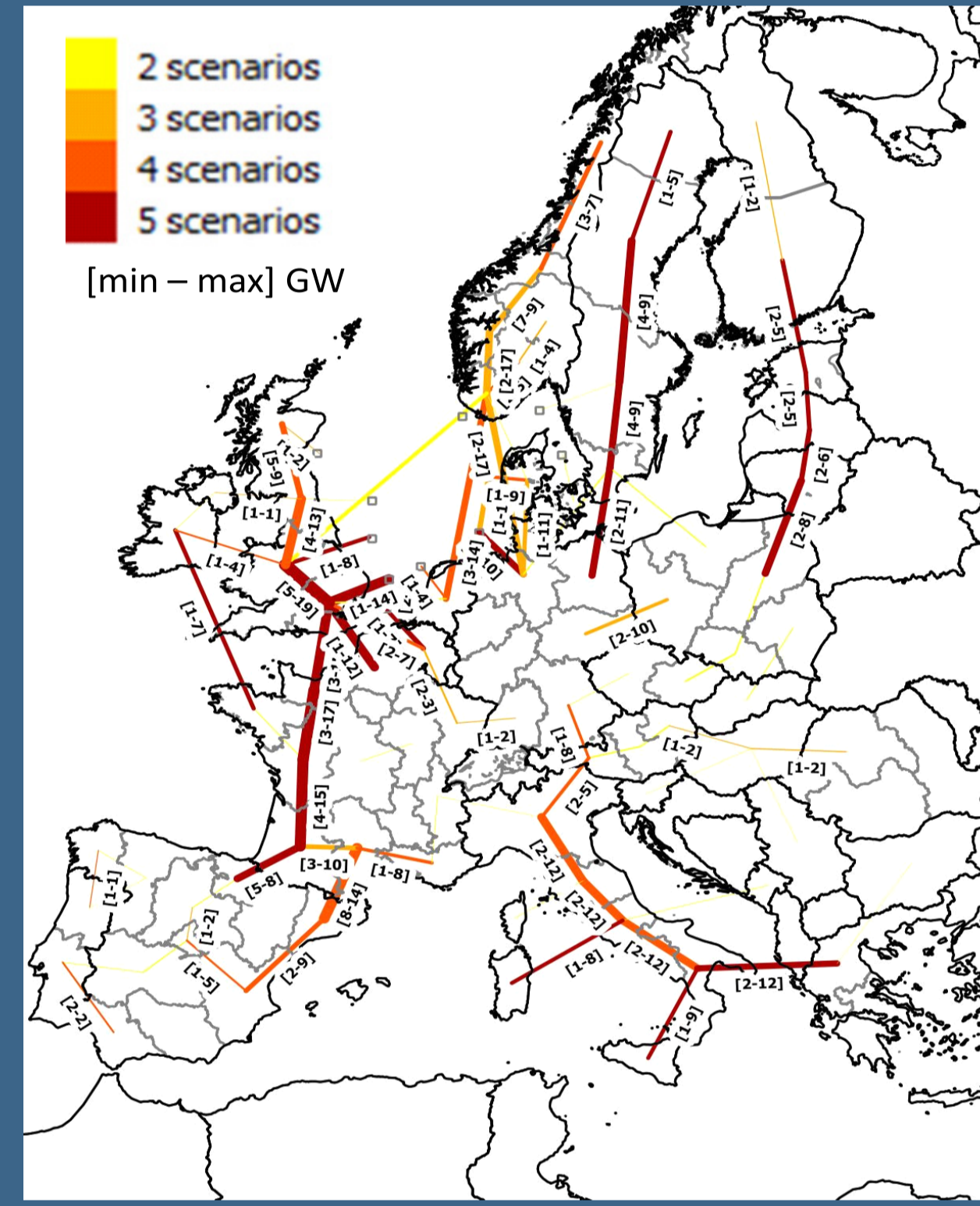
➔ A cost and performance database for 50 power system technologies

THE 2050 GRID REINFORCEMENTS

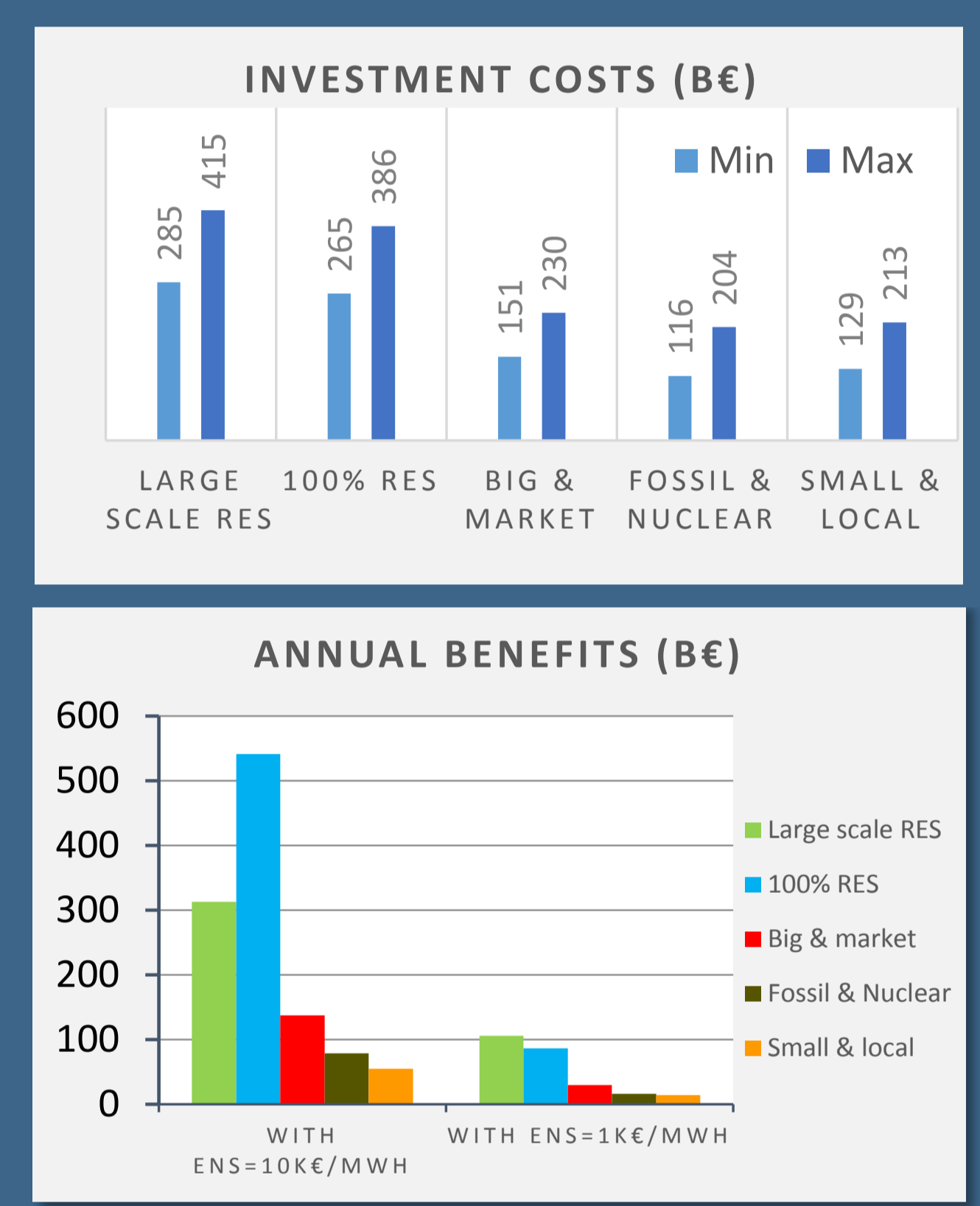
### 2050 reinforcement needs



### Common reinforcements (Nb. of appearances in scenarios)



### Benefit Cost Analysis



ENVIRONMENTAL ASSESSMENT

### Methodology for environmental impact assessment of grid reinforcements at 2050

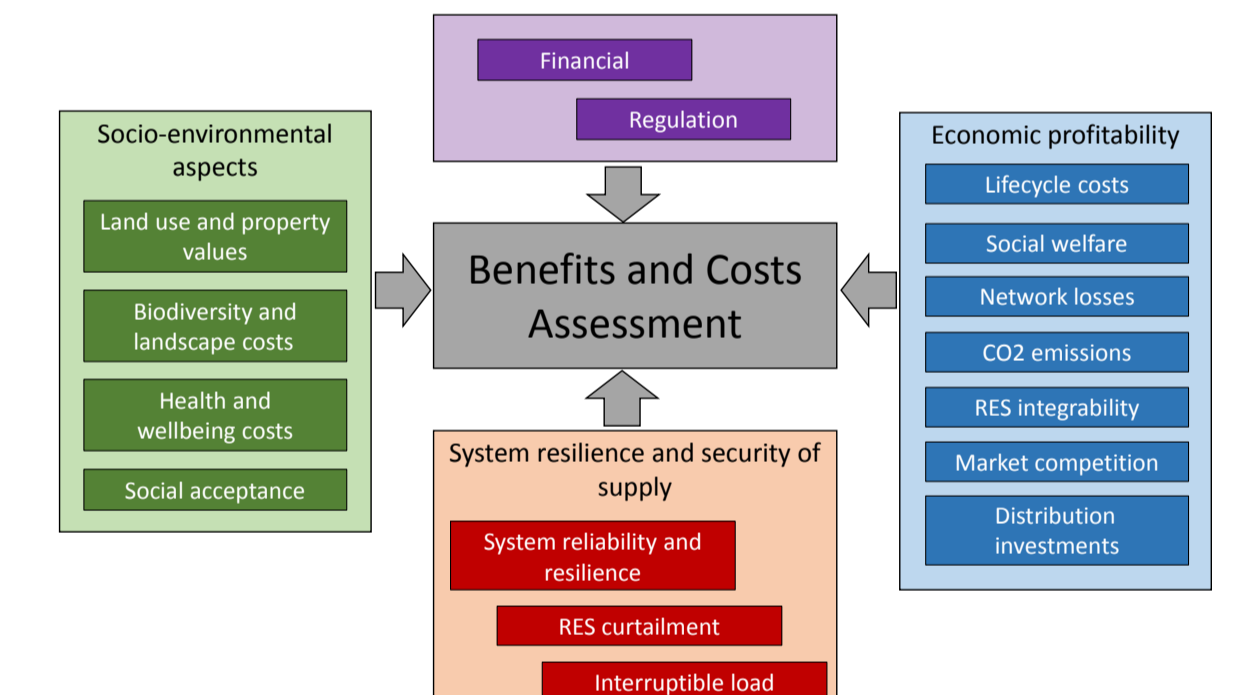
- 16 Strategic Options inherent to e-Highway2050 scenarios, organized into 4 strategic themes: Generation and regional balance, Storage, Transmission, and International strategy
- 4 Critical Decision Factors: Social acceptance and acceptability, Energy security and energy technologies, Geo-political economy and regional equity, and European regional governance

➔ Risks and opportunities based on environmental and sustainability conditions

BENEFIT COST ASSESSMENT

### A new multi-criteria benefit-cost methodology to compare new transmission investments

- Existing Benefit Cost Assessment (BCA) approaches extended so as to account for social-environmental factors, financial and regulatory aspects



➔ A BCA toolbox to compare different grid architecture options for the 2050 time horizon

GOVERNANCE MODELS

### Target governance models emerge from transnational infrastructures experiences

- Initial analysis of 11 existing governance models from various contexts: European, non-European and Worldwide Electricity, Other Energy Infrastructure and Non-Energy models
- Selected governance models for in-depth analysis according to 5 building blocks:

	Design	Ownership	Financing	Cost Allocation	Operation
1 <sup>st</sup> ranked	Central America	Brazil	Germany	USA	USA (PJM)
2 <sup>nd</sup> ranked	Germany	USA (PJM)	Nordic	Brazil	Germany
3 <sup>rd</sup> ranked	Brazil	Germany	UK	Central America	Argentina

➔ A set of recommendations for the e-Highway2050 regulatory framework

ENHANCED TRANSMISSION EXPANSION PLANNING

### Optimization methods for long-term grid planning at pan-European level raise challenges

- Traditional Transmission Expansion Planning (TEP) methods are based on knowledge of experts and simulation tools. The increasing complexity - stochastic behaviour of RES and advanced controls (HVDC, PST, DSM, ...) - requires new tools to help planners
- An approach optimizing multi-step investments was developed ensuring system reliability while using a realistic modeling of RES and advanced controls taking advantage of High Performance Computing

➔ An optimization methodology: approach for better and more efficient TEP decisions

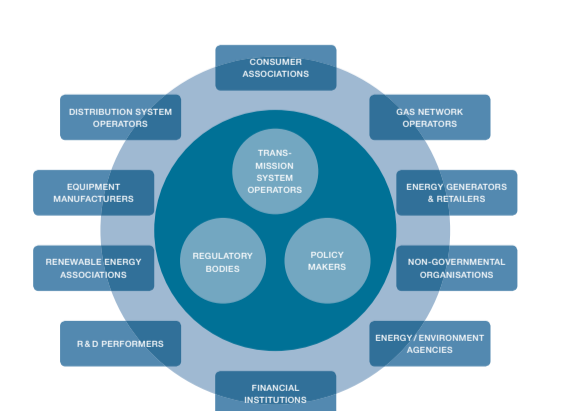
RECOMMENDATIONS TO...

### Recommendations from a continuous dialogue with the electricity value chain stakeholders

Stakeholder Group	Recommendations
TSOs	<ul style="list-style-type: none"> <li>Transmission planning methods, grid architectures and possible reinforcement needs at 2050</li> <li>Potential solutions for optimizing long-term transmission expansion planning</li> </ul>
Policy makers	<ul style="list-style-type: none"> <li>Recommendations to implement suggested reinforcements and target governance models</li> </ul>
Academia	<ul style="list-style-type: none"> <li>Further research needs</li> </ul>
Manufacturers, Associations, NGOs	<ul style="list-style-type: none"> <li>Innovative grid transmission technologies and standardization needs</li> <li>Strategic Environmental and Sustainability Assessment and Benefit Cost Analysis approaches</li> </ul>

### Stakeholder involvement and communication

- Results discussed and validated through stakeholder workshops and consultations: a framework for a continuous dialogue with stakeholders has been set up
- Results to be disseminated through the e-Highway2050 website and [www.gridinnovation-on-line.eu](http://www.gridinnovation-on-line.eu), the European Electricity Grid Initiative (EEGI) Knowledge Sharing Platform dedicated to smartgrids
- Save the date to attend the Final International Conference:



“Electricity Highways, the Backbone for Secure and Sustainable Energy in Europe”

Radisson Blu Royal Hotel, Rue du Fossé-aux-Loups 47, 1000 Brussels

3-4 Nov. 2015  
Brussels

Contact : [info@e-highway2050.eu](mailto:info@e-highway2050.eu) Web: [www.e-highway2050.eu](http://www.e-highway2050.eu) Twitter: @e\_Highway2050