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Identifying challenges and research priorities for grid integration of wind energy in Europe

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Agenda

1. A short project introduction
2. Challenges for the grid integration of wind energy
 1. Grid management timeframe
 2. Planning timeframe
 3. Market operation timeframe
3. Definition of research priorities
4. Discussion: What do we need to ensure (almost) full wind integration in the future?

A short project introduction (1/2)

- > **Objective of this action:** Support the European Commission in evaluating (...) technology development and demonstration options for wind energy, with a short- to mid-term focus on reduction of costs for both onshore and offshore wind electricity and on its integration
- > **Cost competitive targets** of the European Wind Initiative (EWI):
 - Make onshore wind power fully competitive by 2020
 - Make offshore wind power fully competitive by 2030
 - Achieve a 20% reduction in the cost of wind energy by 2020 (in comparison to 2009)
 - Enable a 20% share of wind energy in the final EU electricity consumption by 2020
- > Relevant research projects are supported under the key frameworks **FP7** (2007–2013; 76 projects; EC share 436 mill. EUR out of 733 mill. EUR) and **Intelligent Energy Europe** (2003–2013; 35; 30 out of 45 mill. EUR).

A short project introduction (2/2)

Outline of the project:

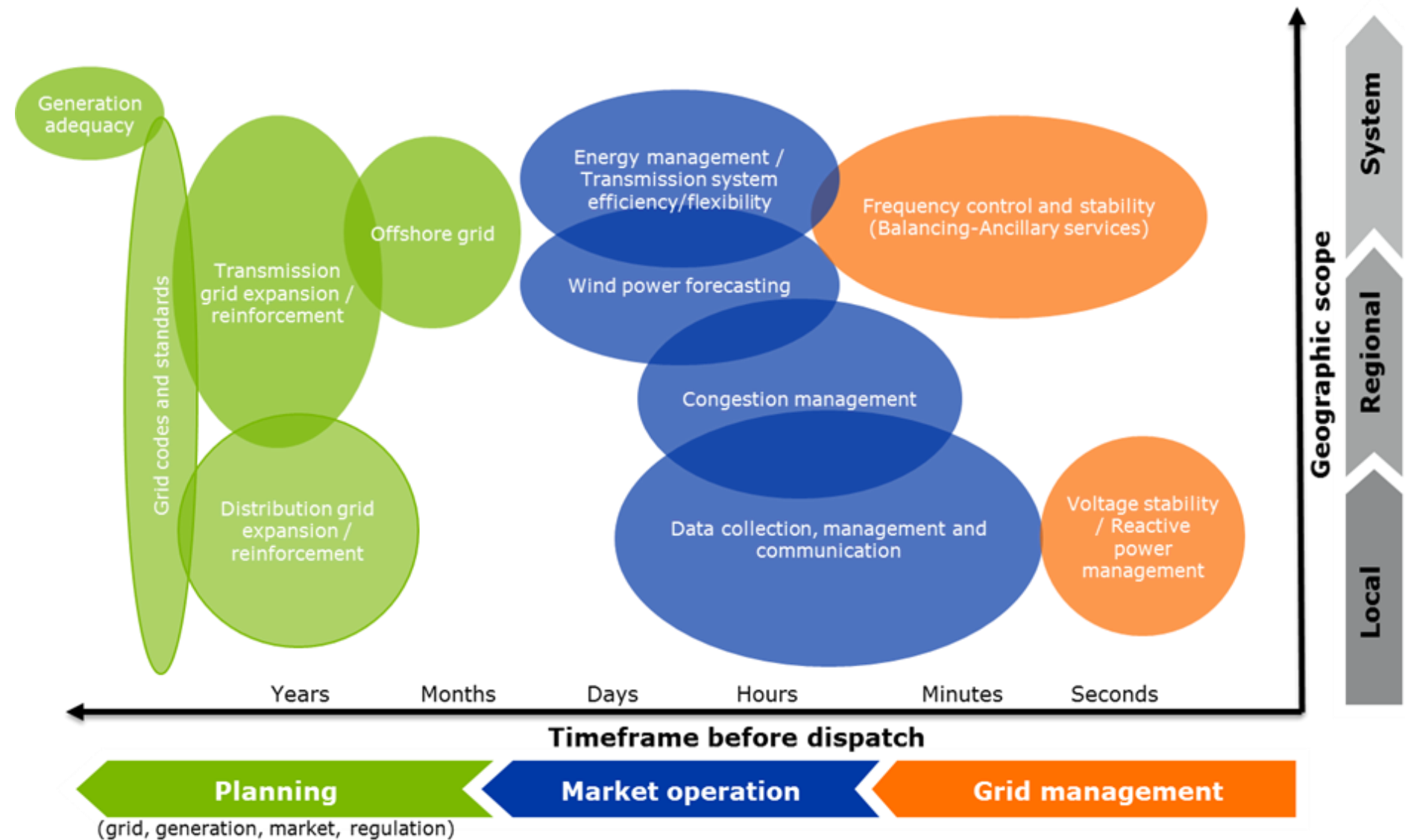
1. Evaluation of current challenges in the grid integration of wind energy
2. Interviews with project leaders and activity mapping
3. Interviews with experts from the wind industry
4. Research funding allocation analysis
5. Gap analysis and research priorities

A short project introduction (2/2)

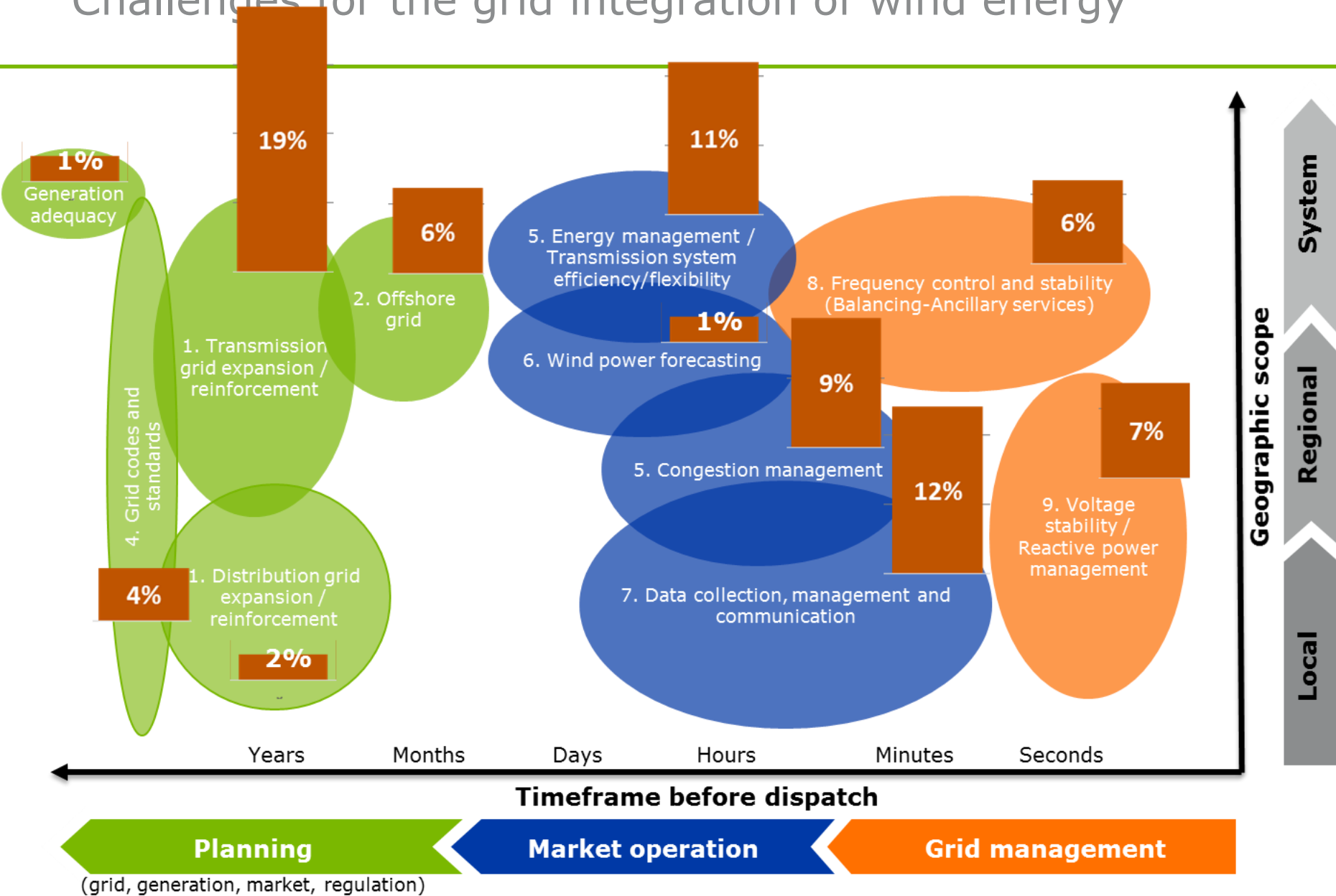
Outline of the project:

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5. **Gap analysis and research priorities**

Challenges for the grid integration of wind energy



Challenges for the grid integration of wind energy



Wind integration challenges in the grid management timeframe

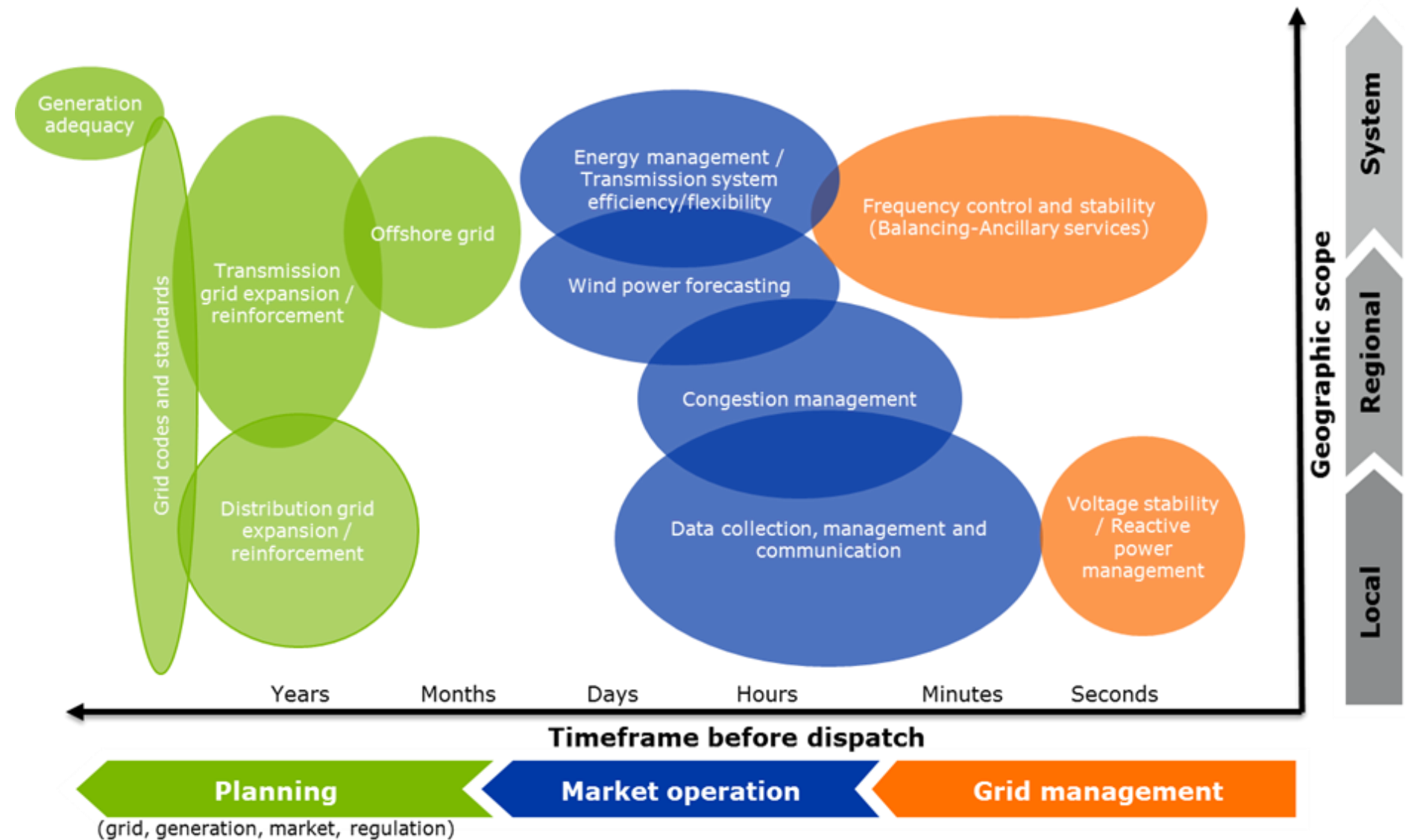
> **Frequency control & stability (Balancing-ancillary services)**

- Main problem: Replacement of inertia of thermal power plants
- Budget: 6%
- Challenges: Reassess system's requirements for frequency stability, develop concepts of synthetic inertia, provide technical and institutional conditions

> **Voltage stability / Reactive power management**

- Main challenge: Wind turbines must contribute to voltage stability
- Budget: 7%
- Challenge: Controlled reactive power dispatch, cost allocation, transient voltage stability

Challenges for the grid integration of wind energy



Wind integration challenges in the planning timeframe

> **Transmission / Distribution Grid Expansion**

- Main problem: Discrepancy in project lead time and efficiency of traditional power system design and operation methods call for robust grid planning incorporating flexibility options
- Budget: 19% (transmission) and 2% (distribution)
- Challenges: Definition of robust grid expansion strategies, incorporation of new technical solutions, soft issues (transmission); consideration of flexibility for sizing, development of new market rules, integrate distribution grid into global optimization, data collection (distribution)

> **Offshore grid**

- Main problem: Efficient set-up of an offshore grid
- Budget: 6%
- Challenges: HVDC in meshed grids, grid topology (radial vs. coordinated (meshed) grid), regulatory issues

Wind integration challenges in the planning timeframe

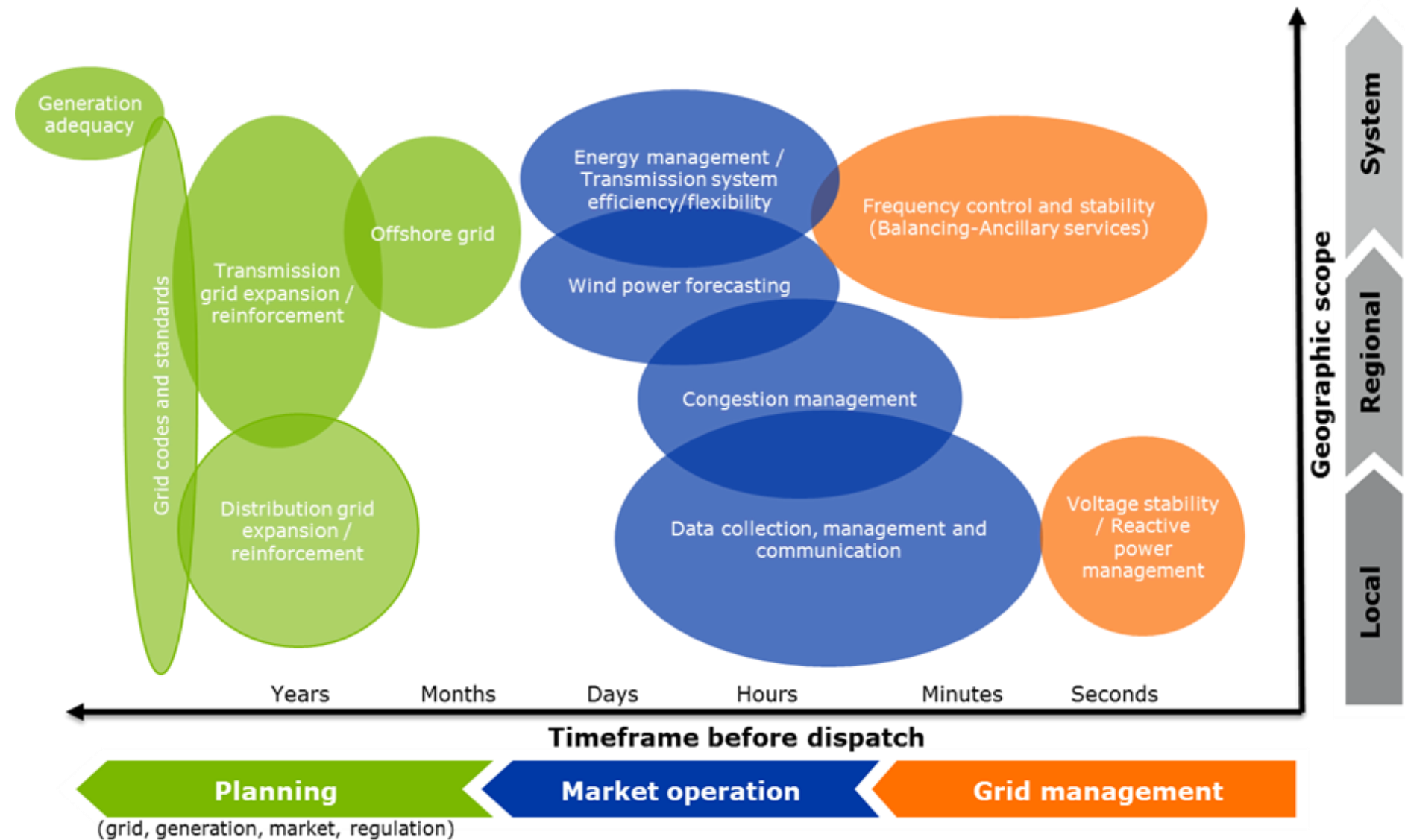
> **Generation adequacy**

- Main problem: Adequate consideration of renewable energy contribution to generation adequacy
- Budget: 1%
- Challenges: Consideration of wind for generation adequacy studies, harmonization of evaluation methods across Europe, consideration of demand flexibility

> **Grid Codes/standards**

- Main problem: Optimal design of grid codes on system operation and requirements for generators
- Budget: 4 %
- Challenges: Harmonization across Europe, consideration of future technical challenges while facing long asset life cycles

Challenges for the grid integration of wind energy



Wind integration challenges in the market operation timeframe

> **Wind power forecasting**

- Main problem: Forecast accuracy in time and place
- Budget: 1%
- Challenges: Establishment of European weather forecast platform, methods for extreme weather events, joint forecasting of RES, forecasts on provision of ancillary services, provision of production schemes

> **Data collection, management and communication**

- Main problem: Inhomogeneous data availability and quality across Europe
- Budget: 12%
- Challenges: Full usage of SCADA data, regulation on data provision, standardization of protocols, European harmonization, enhance communication system reliability

> **Congestion management / Energy management/ Transmission system efficiency/flexibility**

- Main problem: Maintaining system stability, bottlenecks in grid infrastructure lead to curtailment of renewables
- Budget: 20%
- Challenges: Market design, technical rules, upscaling of pilots, alternative technical solutions

Definition of research priorities

- > To get an impression on how the EC should set priorities, we will ask experts and project owners to evaluate the sub-challenges with regard to the following **categories/KPIs**:
 - Cost / Benefit
 - LCoE reduction potential
 - Required RTD investment
 - RTD risk
 - Contribution to fostering scientific advancement
 - European impact of RTD
 - Appropriateness and impact for RTD funding

Discussion

- > Where, in your opinion, is research needed most urgently in order to pave the way to full grid integration of wind?
- > How do you consider the maturity of the following research topics?
 - Grid expansion; offshore grids; grid codes; generation adequacy; wind forecasts; energy and congestion management; data collection; frequency control; voltage control
- > In your opinion, which criteria should be evaluated to prioritize research activities?

For Comments – Feedback:



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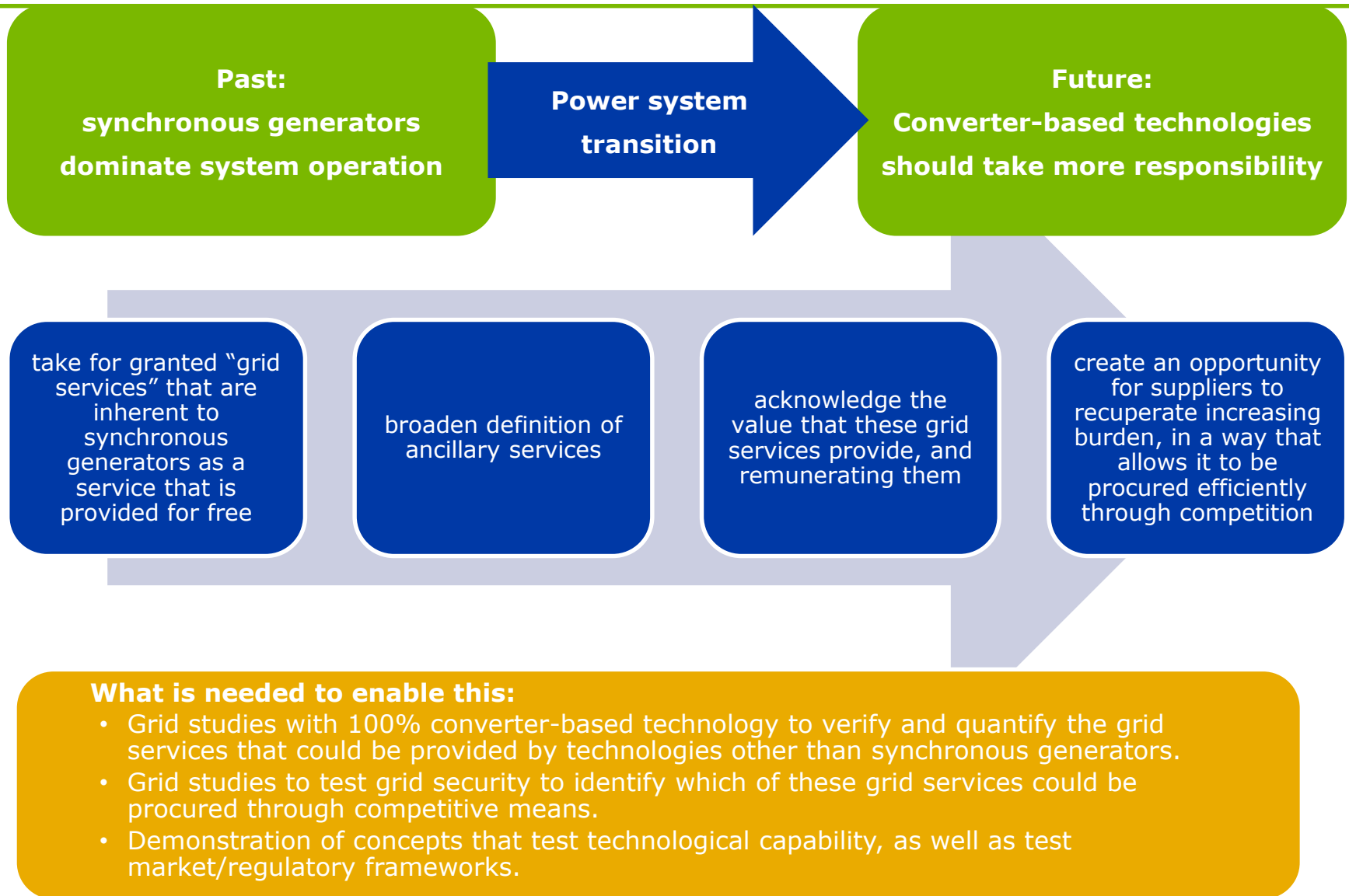
Content and Methodology

- > 1. Inventory of technical challenges
 - 11 key challenges in three main thematic areas identified
 - **Grid management → Market operation → Planning**

- > 2. Mapping of activities related to grid integration
 - identify, review, and summarise current technical grid integration activities
 - EU-funded projects from the last 5 years (i.e., FP7, IEE)
 - Expert interviews

- > 3. Gap analysis
 - contact project coordinators to obtain information on budget allocation to the 11 challenges
 - analyse how budget was spent within each project and which challenges were covered
 - present a matrix showing budgets spent in each project on each of the technical challenges.

Results: Key messages obtained from expert interviews



EU-funded projects analysis

- > For the EU funded projects in the last 5 years related to wind grid integration, project coordinators were asked to assign the project budget allocated on the 11 challenges. Preliminary result is shown on next slide for part of the following projects.
 - FP7: 76 projects, 733 Million EUR (EC share 436 Million EUR)
 - Intelligent Energy Europe: 35 projects, 45 Million EUR (EC share 30 Million EUR)

- > This information reveals how much budget was spent on each challenge and enables us to analyse how budget was spent on each project and which challenges were covered. This gives a quantitative indication of which challenges are not yet covered by the EU.