Accelerating the Energy Transition: **The Role that Direct Current (DC) Grids can Play – Summary Slides**

8th December 2020

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AGENDA

Welcome & Introduction by John Fitzgerald, Vice-Chair of currENT | CEO, SuperNode

Keynote Address from Joachim Balke, Head of Network and Regional Initiatives, DG ENER

- **Arnoldus Van Wingerde**, Chief Scientist, Fraunhofer Institute for Wind Energy Systems IWES
- **Jochen Kreusel**, Deputy President, T&D Europe
- **Cornelis Plet**, Principal Consultant Offshore Power Systems, DNV GL
- **Wolfgang Reiser,** Managing Director, VESC and President of ivSupra
- **Dirk Van Hertem**, Electrical Energy Systems and Applications (ELECTA), University of Leuven

Panel discussion and Q&A session, moderated by John Fitzgerald.

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Our vision is a European power network that is the recognised world leader in enabling decarbonisation through the efficient use of modern grid technology.

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Ampacimon
Smart solutions for a dynamic grid

SMART WIRES

OTLM
KNILL GRUPPE

amsc

HEIMDALL POWER

LINEVISION

SuperNode

- SuperNode is developing superconducting electrical cable systems.
- Recently achieved statement of feasibility on its offshore offering.
- For more information, contact Rob at robert.oconnor@supernode.energy

https://renews.biz/64936/superconducting-cable-wins-feasibility-statement/

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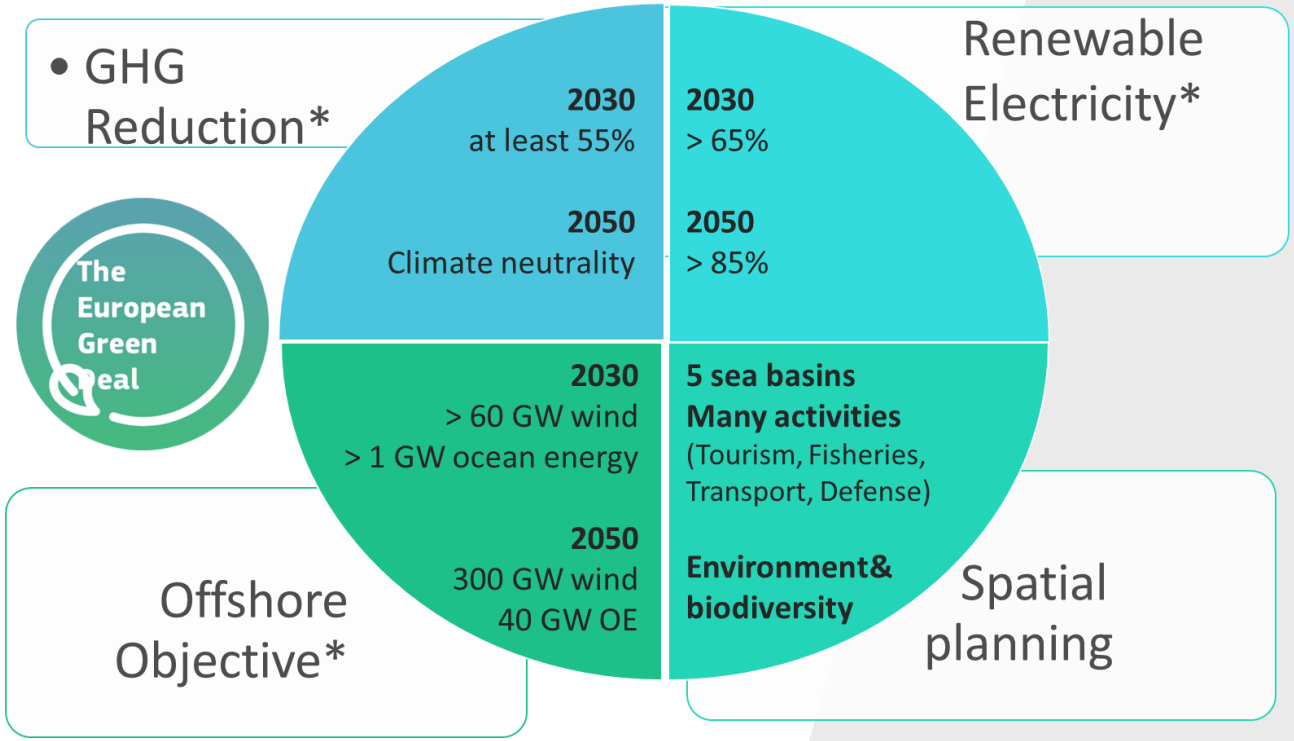
Joachim Balke, Head of Network & Regional Initiatives, DG Energy

- 55% GHG reductions needs > 60GW of OSW
- 2050 RES-E >85%
- Encourage public and private investment in new infrastructure and research
- Promote Regional Cooperation to achieve energy objectives
- TEN-E revision, National Maritime Spatial Planning and Renewable Directive all due in 2021



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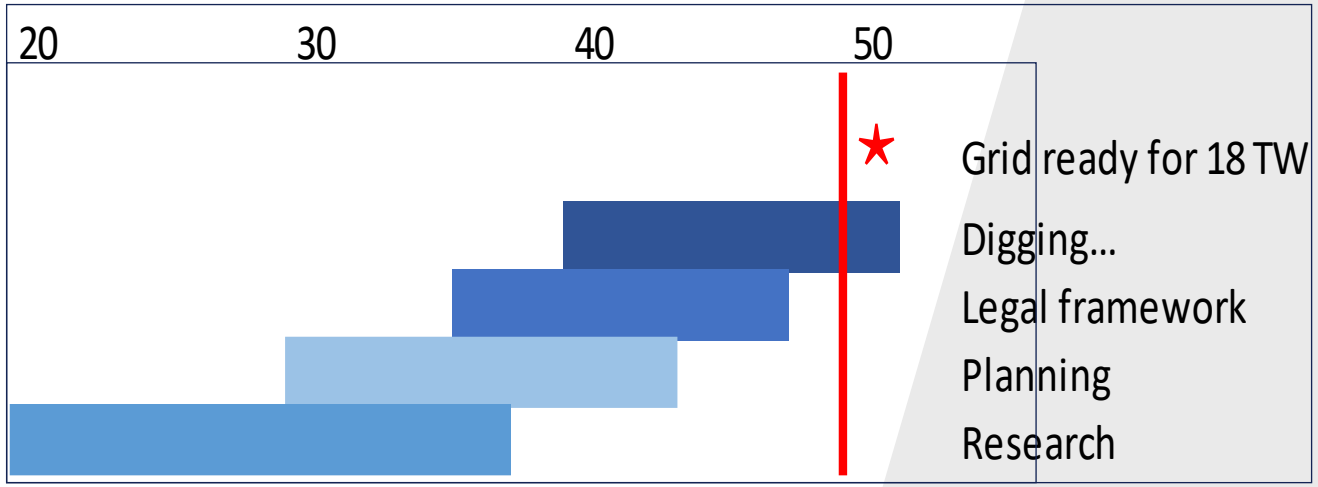
Arnoldus Van Wingerde, Chief Scientist, Fraunhofer Institute for Wind Energy Systems IWES

- In order to achieve this in a timely manner, a reversed Gantt chart is a useful tool:
  - ❖ Clear message to politicians that talking about 2050 does not absolve them from implementing the first steps today.
- Developing a grid for the future requires an approach that sees no borders – Europe cannot use a nationalistic approach
- The technology is ready, the understanding of market dynamics is there, but the political electoral cycle is too short term in focus.
- In order to be successful a wide-ranging grid is necessary, capable of transferring vast loads between countries and even continents.

the Reversed Gantt Chart



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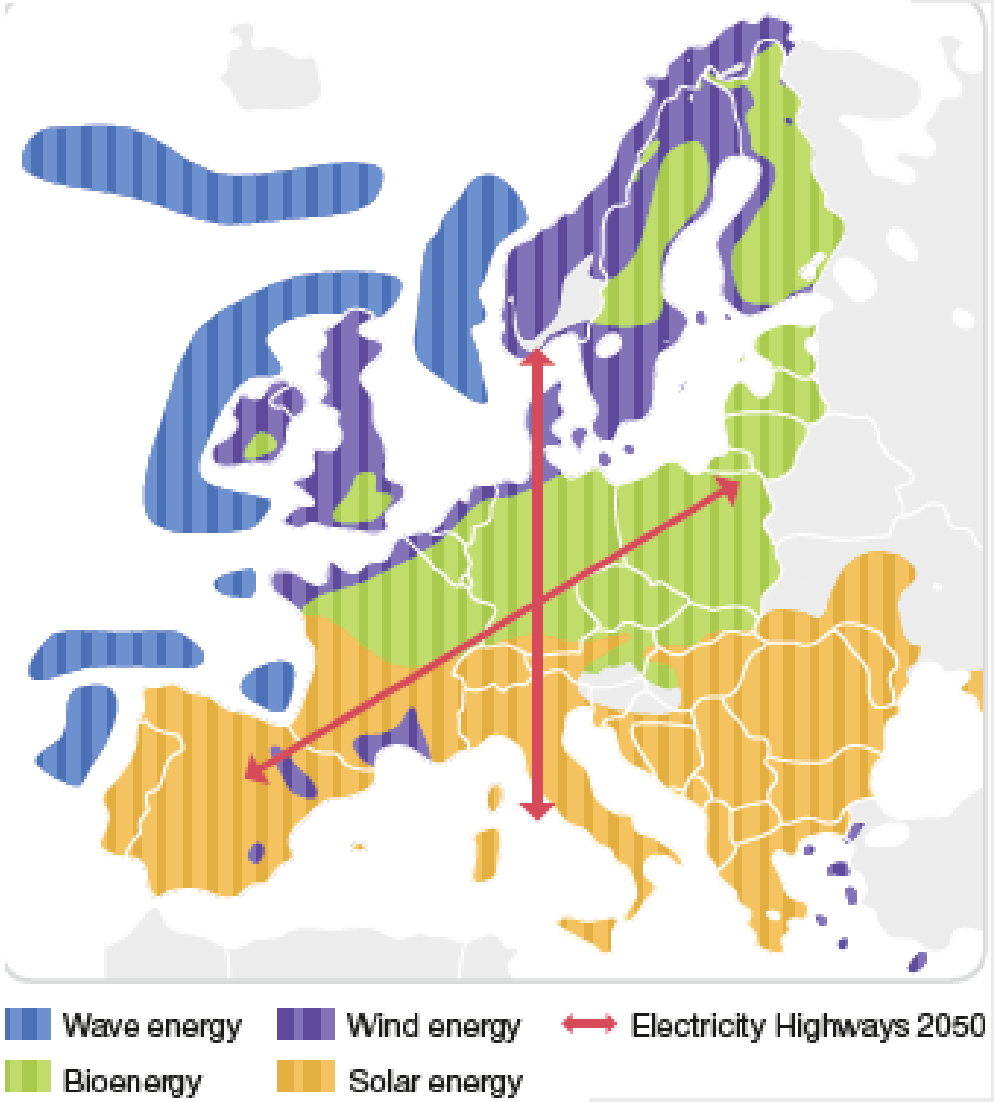
Jochen Kreusel, Deputy President, T&D Europe

- Europe needs a moon-shot to integrate the levels of renewables required in Europe
- AC and DC both have advantages and a role to play
- DC is important for the integration of variable renewable sources - both from distributed resources and from bulk clusters
- Europe has conducted a vast amount of successful research projects – the time is now to develop a successful real-life full-scale and fully functional demonstration project.



e-highways 2050

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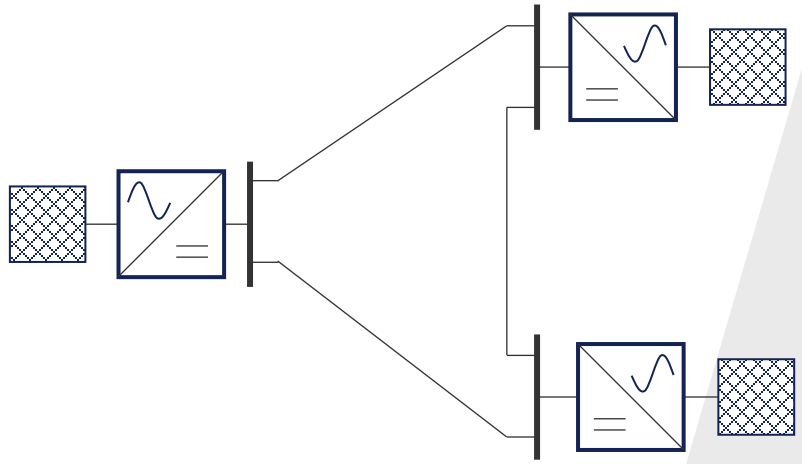
Cornelis Plet, Principal Consultant, Offshore Power Systems, DNV GL

- The technology for multi terminal DC grids is available and feasible.
- Further standardisation work needed on multi-vendor HVDC grid integration.
- International collaboration & coordination key to establish regulatory compatibility, project and planning compatibility, and political agreement.
- Power density of cables and converters must be further increased to ease planning and permitting issues:
  - ❖ Clearance distances due to high voltage air insulation in converters are main volumetric driver.
  - ❖ Superconducting high current, medium voltage cable technology combined with low-loss wide bandgap power electronics such as silicon-carbide can potentially mitigate these issues.
  - ❖ Greater circuit capacities possible in a meshed DC Grid scenario.



Meshed multi-terminal system

- Reduced impact on AC grids
- Requires DC protection system
- Multiple routes to market

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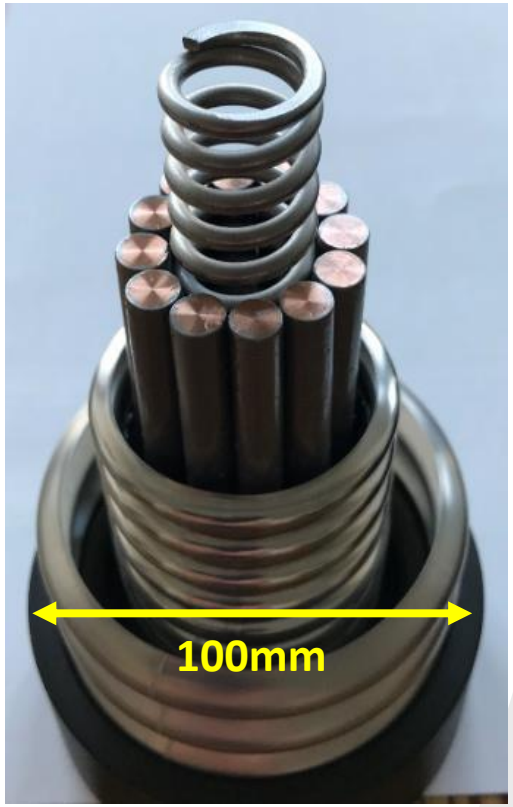
Wolfgang Reiser, Managing Director, VESC

- Superconductors operate with zero electrical resistance at very high currents (10kA +) offering the ability to operate cables at medium voltage for bulk power transfer (2GW +)
  - ❖ Superconductors have an increasing number of applications and is the ideal technology for meshed DC grids
- Projects such as the Ampacity project in Essen have shown operational reliability in a real use case for over 6 years.



Power / Voltage	250 MW	500 MW	1 GW	2 GW	3 GW	5 GW
± 25 kV	5 kA	10 kA	20 kA	40 kA		
± 30 kV		8,5 kA	17 kA	33 kA	50 kA	
± 50 kV		5 kA	10 kA	20 kA	30 kA	50 kA

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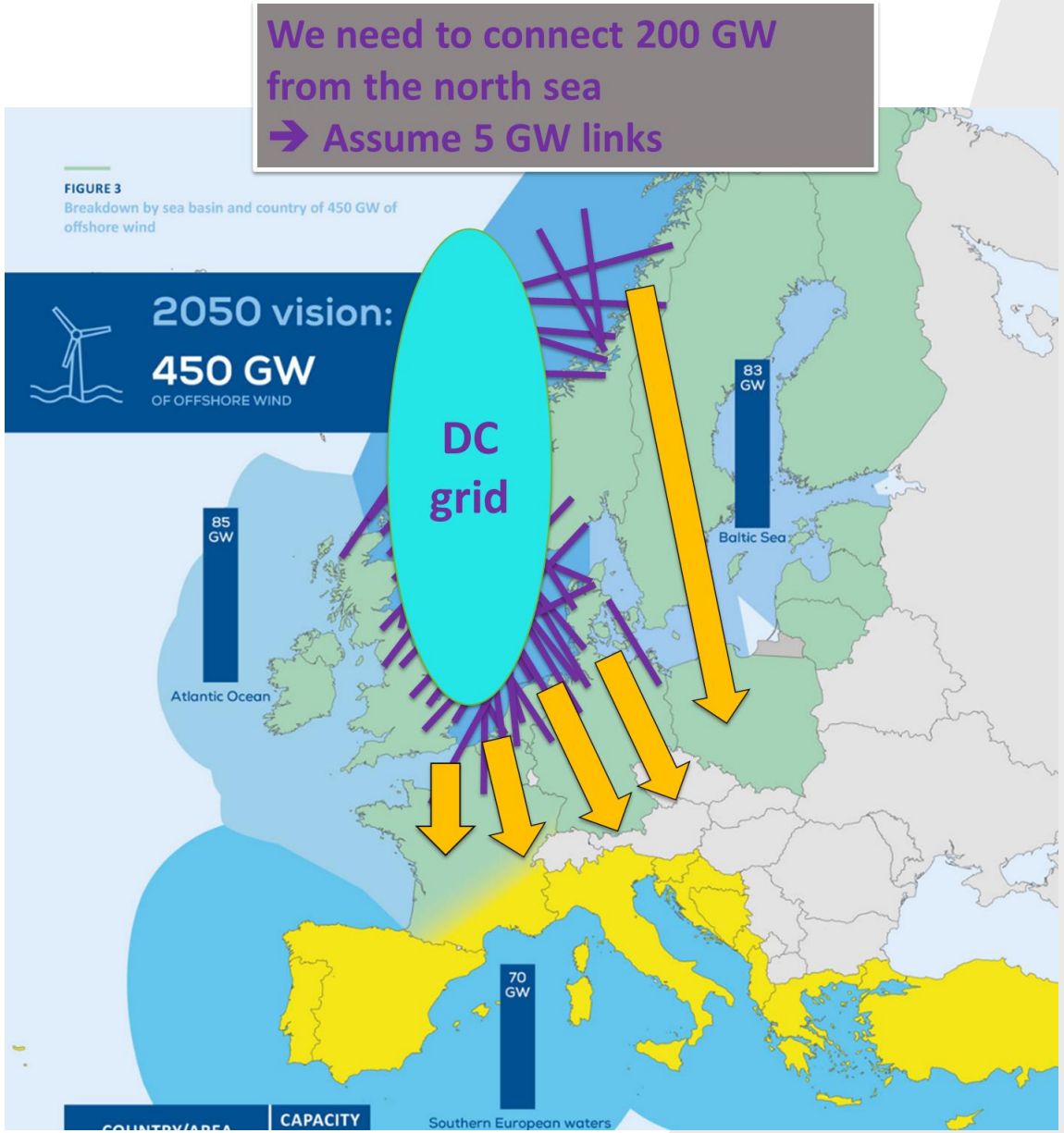
Dirk Van Hertem, University of Leuven

- DC grids are the (near) future of transmission.
- Perceived risks have delayed developments to date but have since been proven unsubstantial.
- The required upgrade of the grid is fundamental:
  - ❖ Providing patchwork solutions will not suffice.
  - ❖ “This is not how we do it today” is not relevant.
- Regulation should never be the blocking issue.



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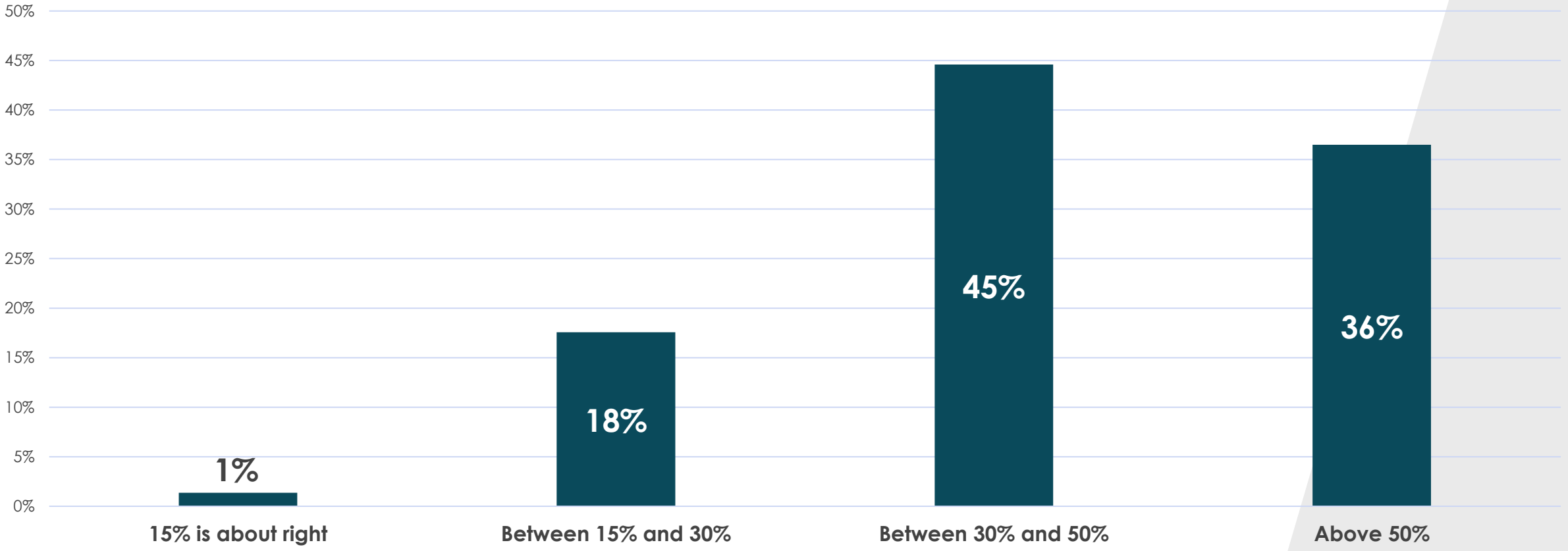
Webinar Takeaway Messages

- Europe has set ambitious goals for its offshore resource and needs to start planning for their integration now.
- Decarbonisation requires harmonisation of national standards and regulations to encourage cooperation.
- The technologies needed are proven; Europe needs a meshed DC grid embeded into the existing AC grid to achieve its goals.
- Network innovation is no longer an optional extra; business as usual will not deliver a decarbonised electricity system; systemic change in how we adopt innovation is needed.

Poll 1: What level of connection between countries is required for a decarbonised European grid?



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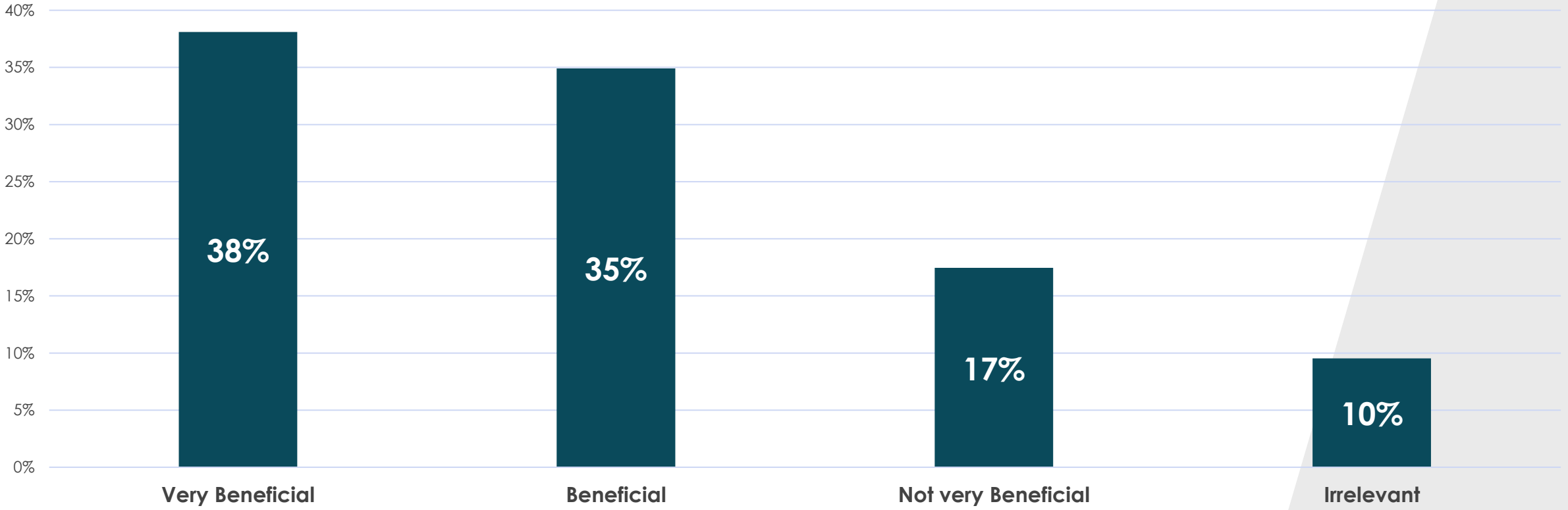
Poll 2: For future transmission projects (2 GW+), how beneficial (delivery, consenting, integration, other) is having medium voltage DC (<200 kV)?



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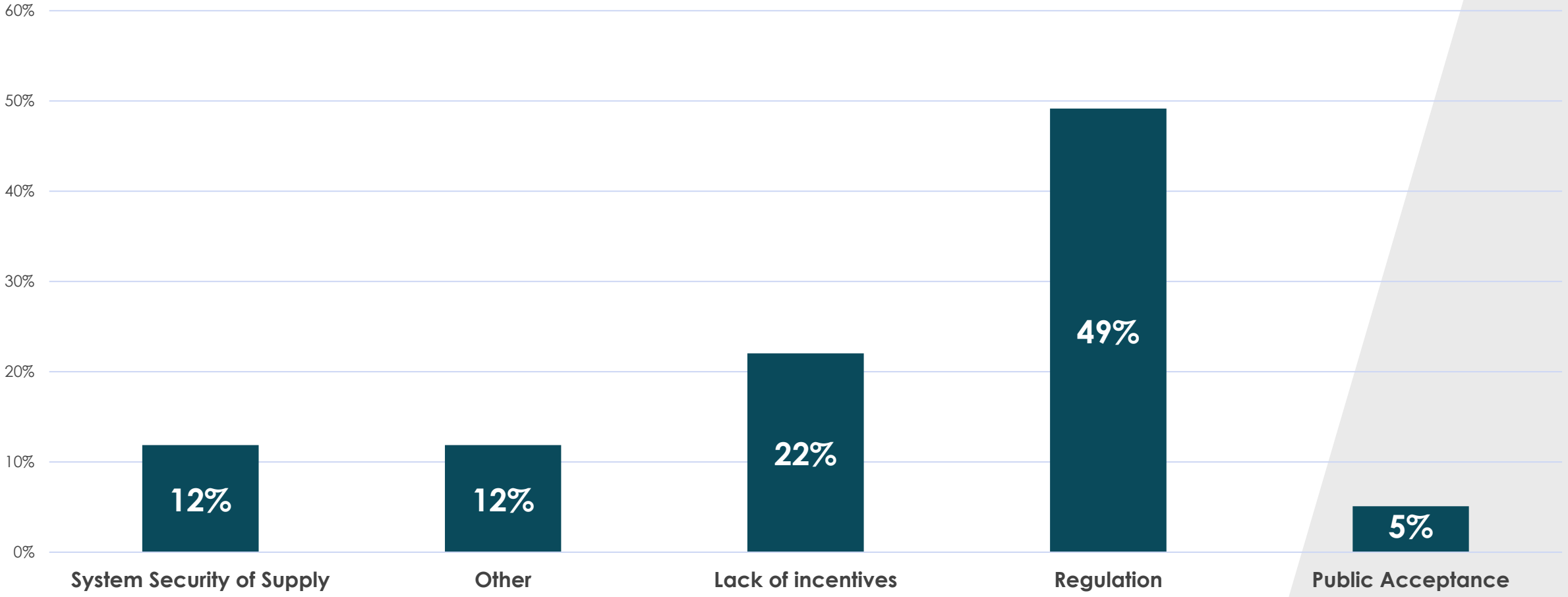
Poll 3: What is the main barrier to implementing innovative solutions in grids?



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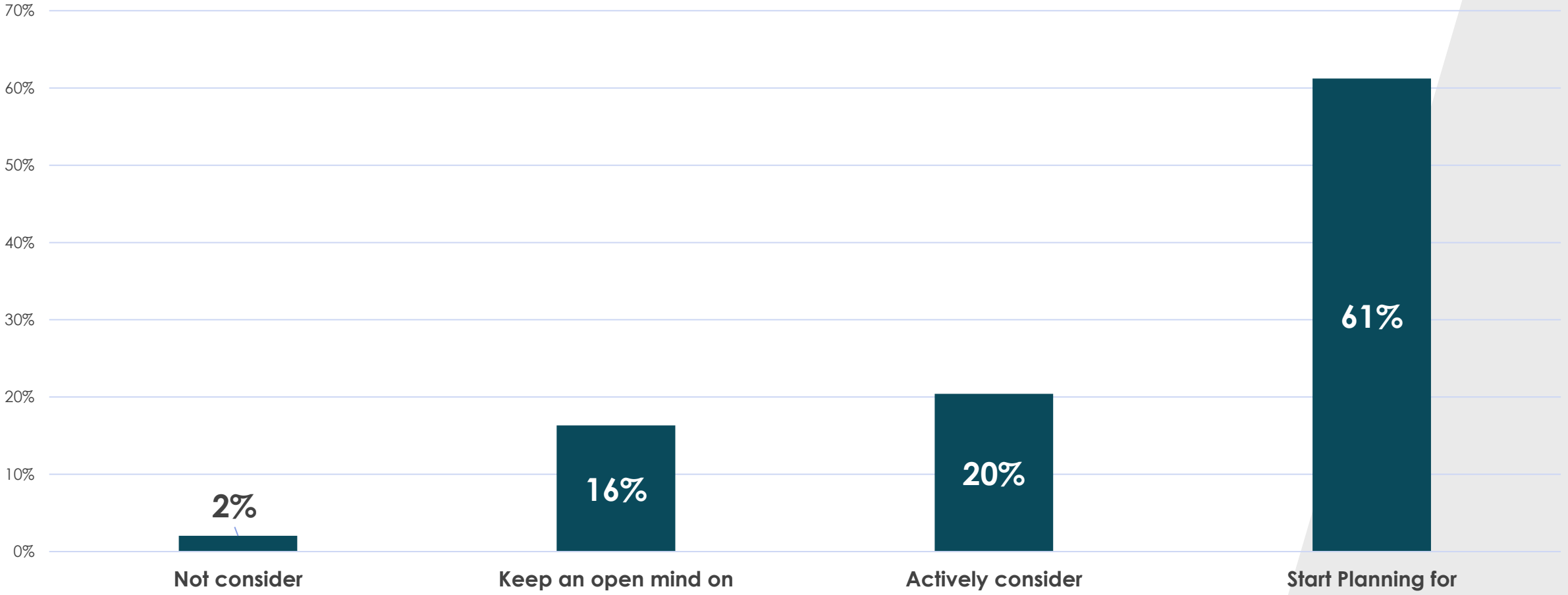
Poll 4: Is an overlay meshed DC Grid something that Europe should:



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