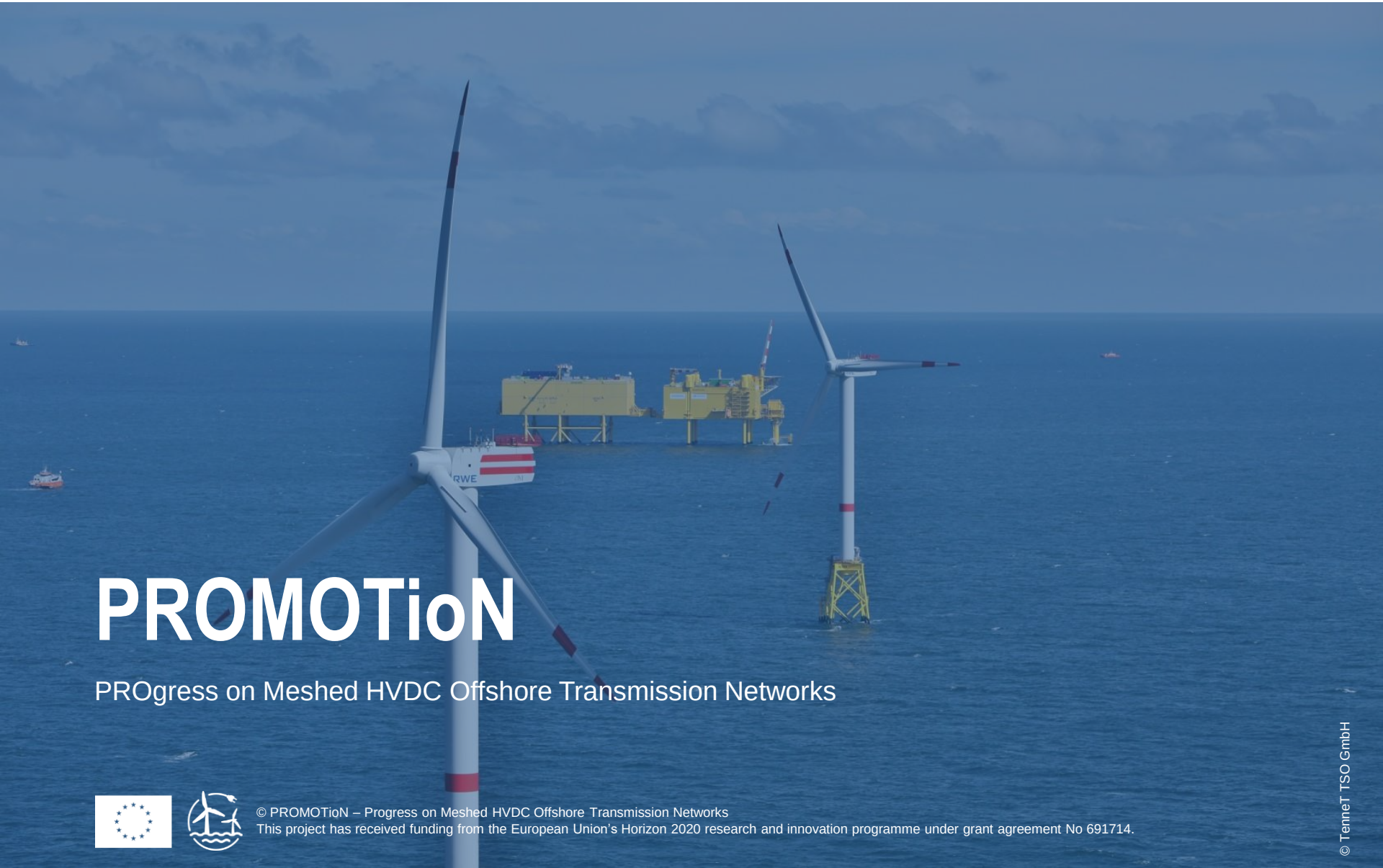
PROMOTioN
PROGRESS ON MESHED HVDC
OFFSHORE TRANSMISSION
NETWORKS



PROMOTioN

PROgress on Meshed HVDC Offshore Transmission Networks

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

CONTENT

- What?
- Why?
- How?
- Who?

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What?

Objectives

- Identify **technical requirements** and investigate possible **topologies** for **meshed HVDC offshore grids**
- Develop **protection schemes** and **components** for HVDC grids
- Establish components' **interoperability and initiate standardisation**
- **Demonstrate cost-effective** offshore HVDC equipment
- Develop recommendations for a coherent EU and national **regulatory framework** for HVDC offshore grids
- Develop **recommendations for financing mechanisms** for offshore grid infrastructure deployment
- Develop a **deployment plan** for HVDC grid implementation

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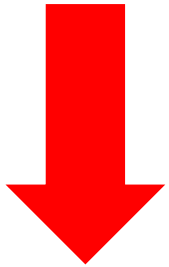
Why?

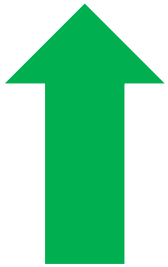
European Commission energy strategy

By 2030…..



40%

cut in greenhouse gas emissions compared to 1990 levels

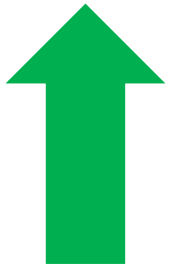


27%

share of renewable energy consumption

27%

energy savings compared with the business-as-usual scenario



15%

electricity interconnection target

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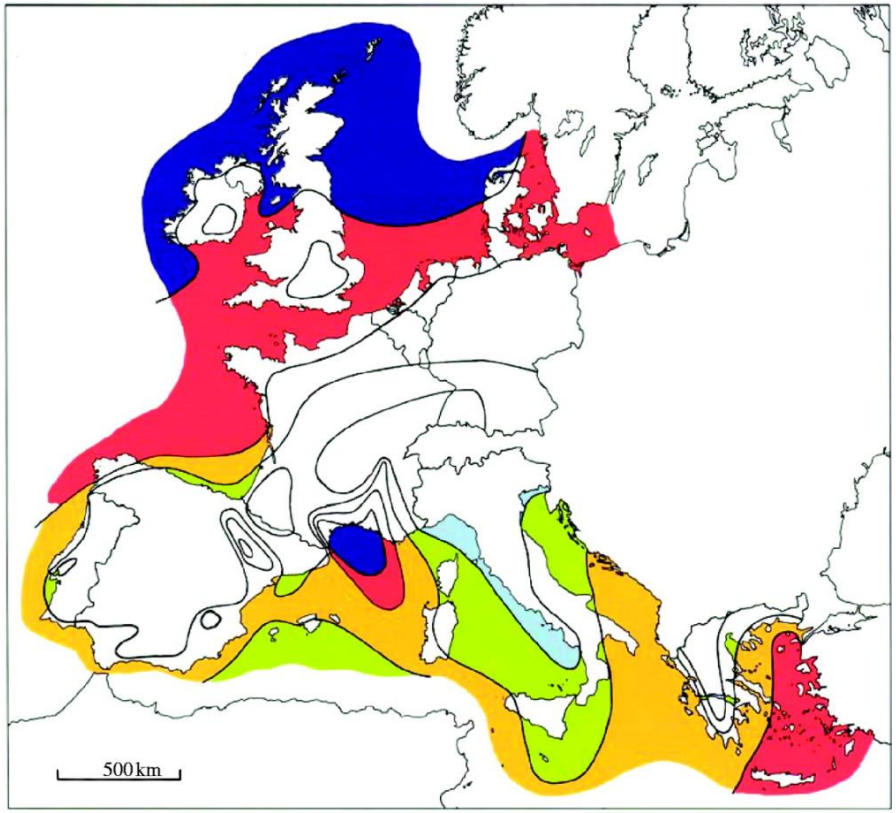
European offshore wind energy resources



wind resources over open sea (more than 10 km offshore) for five standard heights

	10 m		25 m		50 m		100 m		200 m	
	$m s^{-1}$	$W m^{-2}$	$m s^{-1}$	$W m^{-2}$	$m s^{-1}$	$W m^{-2}$	$m s^{-1}$	$W m^{-2}$	$m s^{-1}$	$W m^{-2}$
	>8.0	>600	>8.5	>700	>9.0	>800	>10.0	>1100	>11.0	>1500
	7.0–8.0	350–600	7.5–8.5	450–700	8.0–9.0	600–800	8.5–10.0	650–1100	9.5–11.0	900–1500
	6.0–7.0	250–300	6.5–7.5	300–450	7.0–8.0	400–600	7.5 – 8.5	450 – 650	8.0 – 9.5	600 – 900
	4.5–6.0	100–250	5.0–6.5	150–300	5.5–7.0	200–400	6.0 – 7.5	250 – 450	6.5 – 8.0	300 – 600
	<4.5	<100	<5.0	<150	<5.5	<200	<6.0	<250	<6.5	<300

Source: Petersen, E. L. (1993). Wind resources part I: The European wind climatology. In A. D. Garrad, W. Palz, & S. Scheller (Eds.), 1993 European Community wind energy conference. Proceedings. (pp. 663-668). Bedford: H.S. Stephens and Associates.

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Political Context

Political Declaration on energy cooperation between the North Seas Countries

- Aim: Create good conditions for offshore wind energy to ensure sustainable, secure and affordable energy supply in the North Seas Countries

Regional cooperation in the energy Union – MEP manifesto

- Increase of regional cooperation as a way to realize the full potential of the Northern Seas energy system
- Large scale deployment of offshore wind farms and completion of a meshed electricity grid

Projects of common interest

- Help deliver Europe's energy and climate objectives and form key building blocks of the EU energy union.

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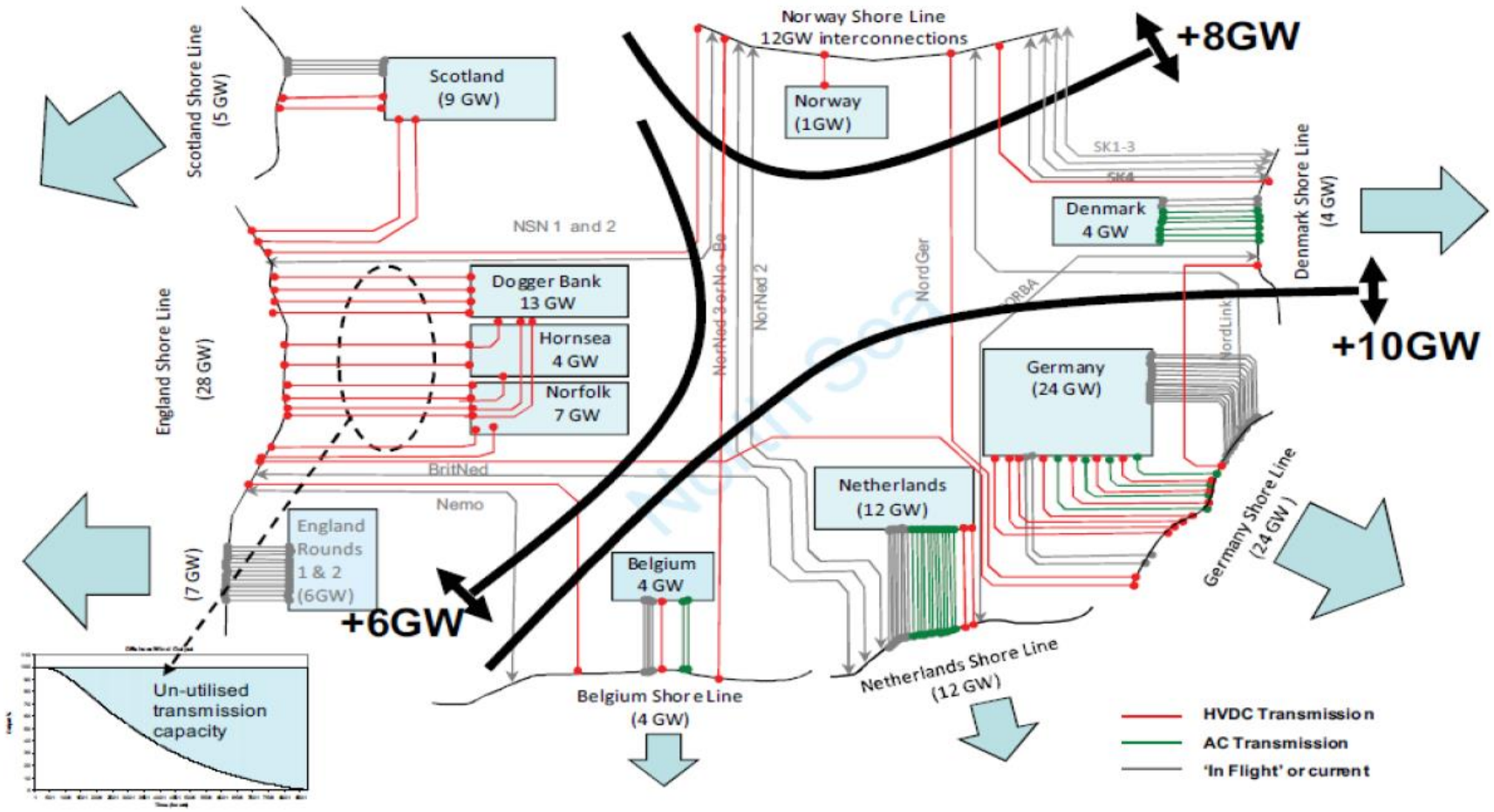
ENTSO-E vision 2030 for the North Sea



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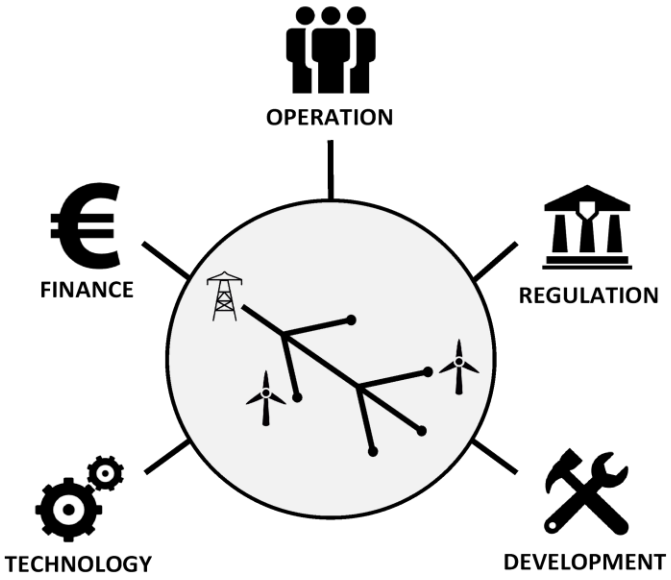
Challenges for deployment of meshed offshore HVDC grid

- Cost effective and reliable converter technology
- Grid protection systems
- Financial framework for infrastructure development
- Regulation for deployment and operation
- Agreement between manufacturers, developers and operators of the grid



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HOW?

Project Structure

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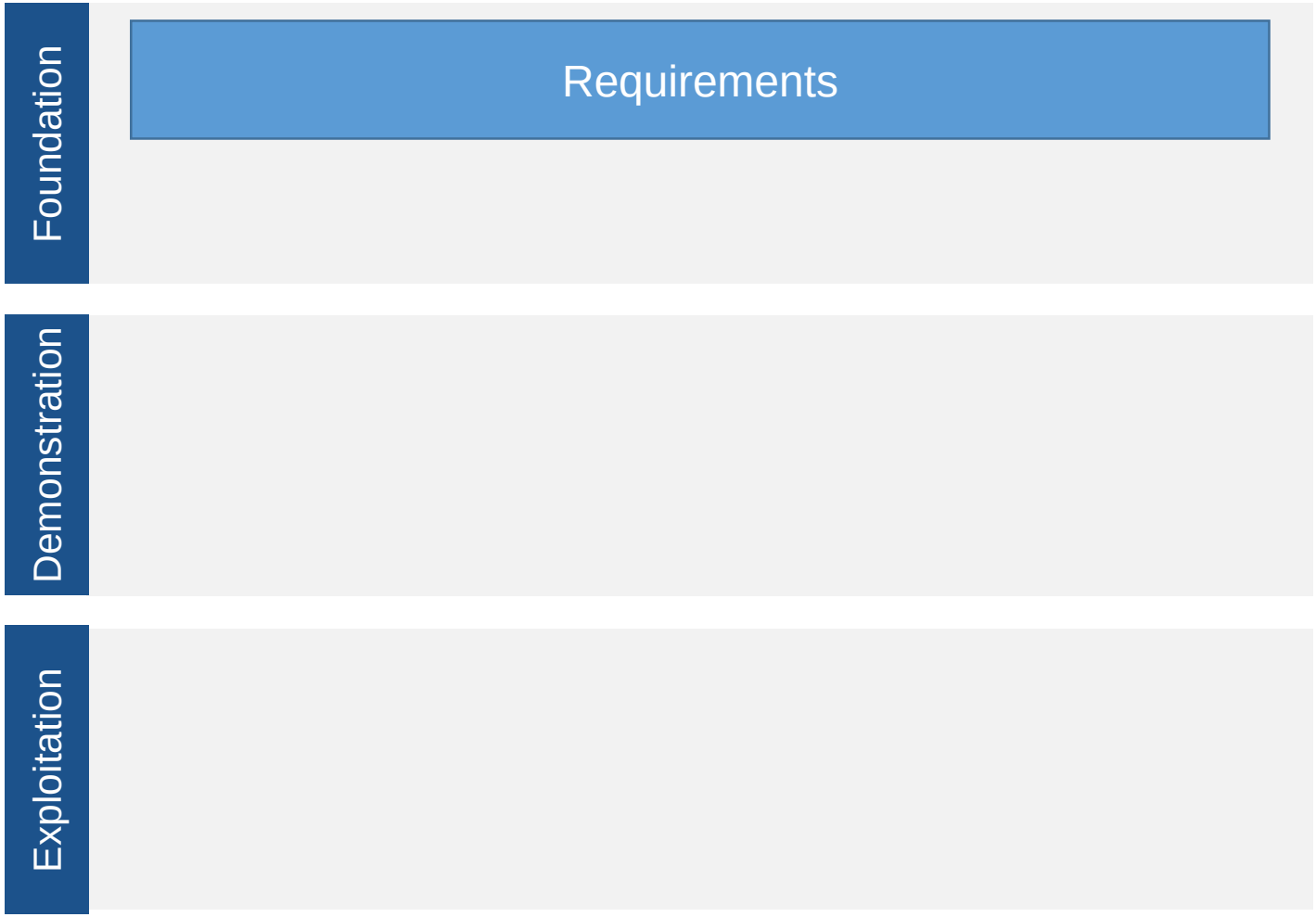
Project Structure - Requirements



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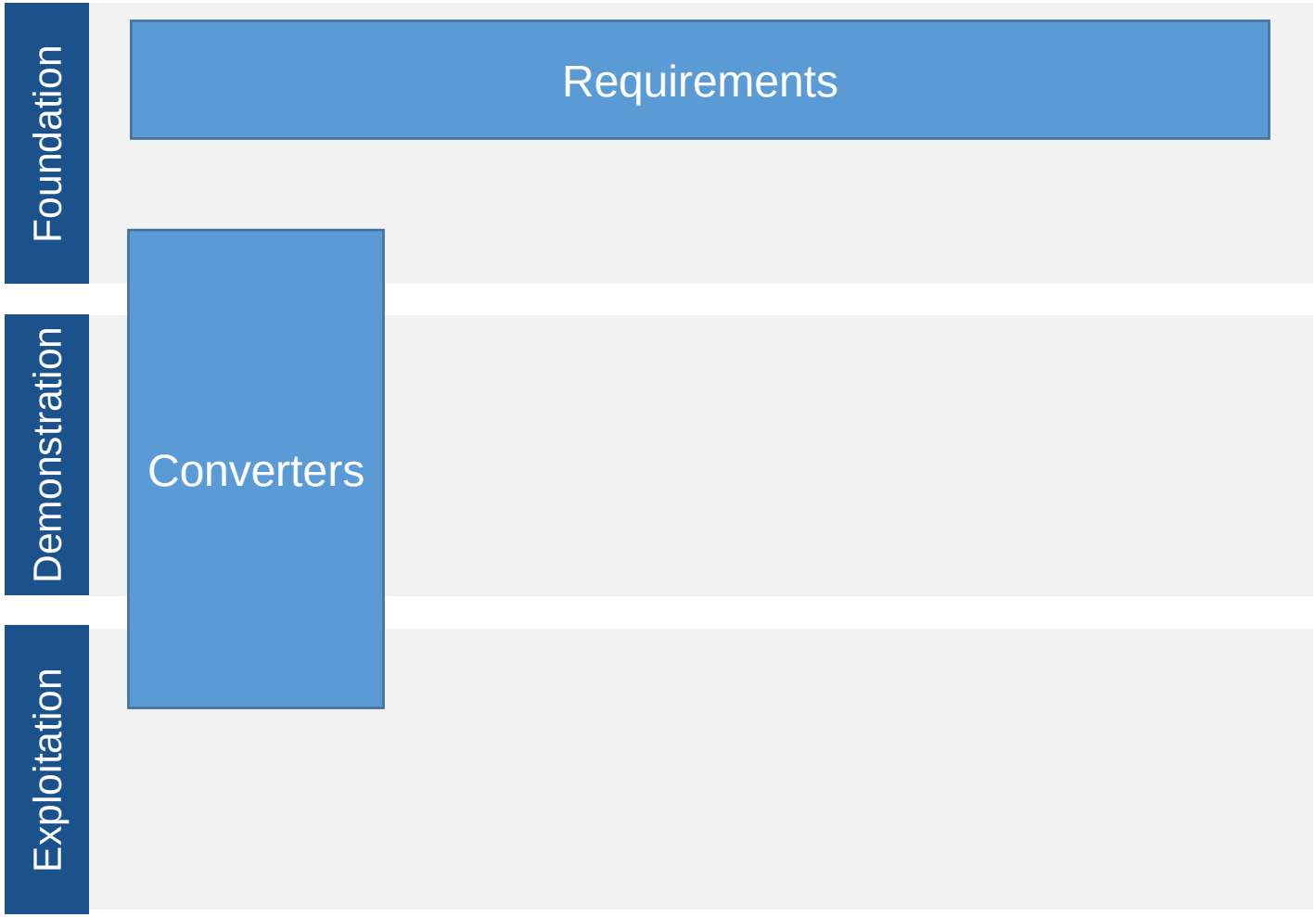
Project Structure - Converters



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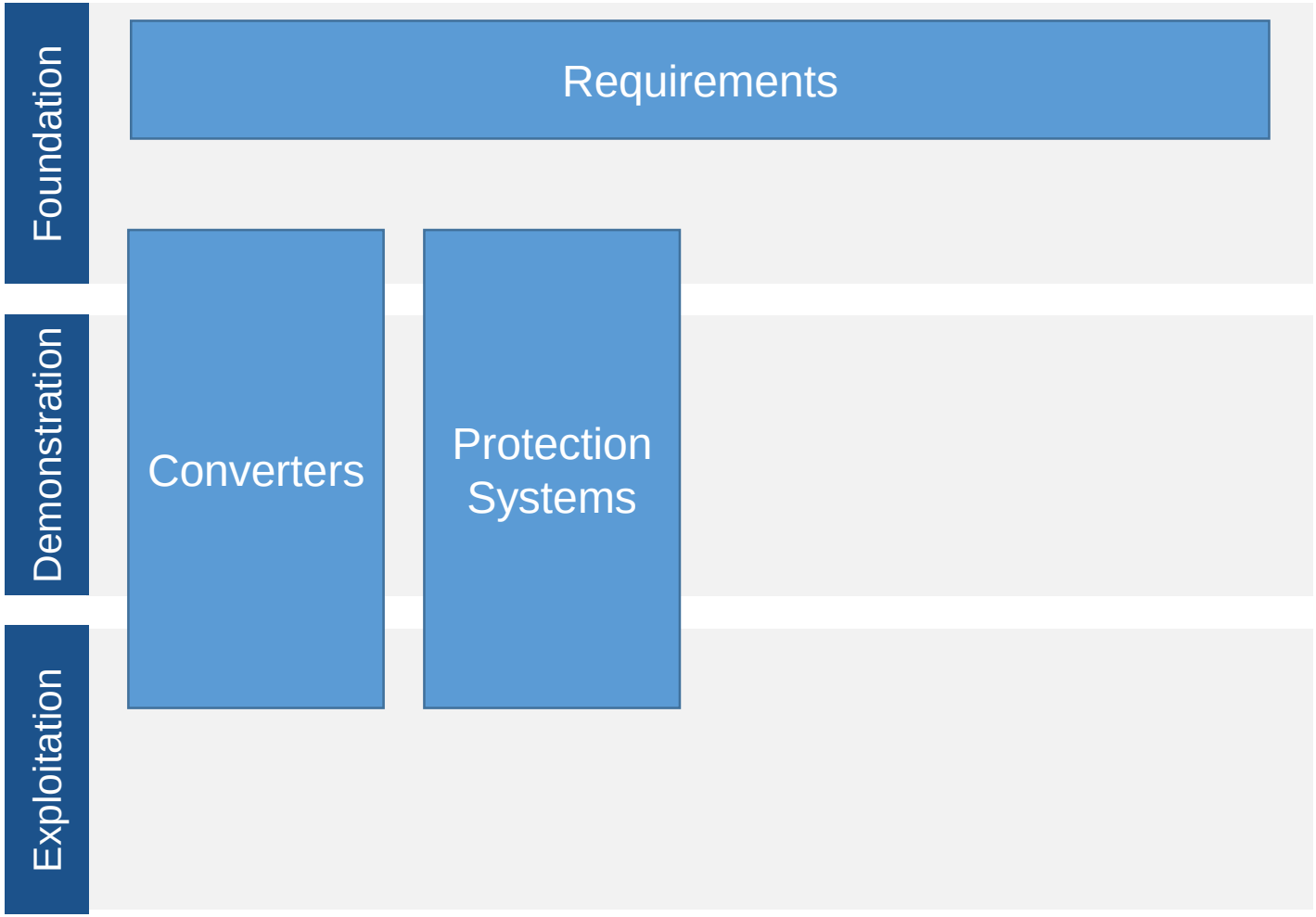
Project Structure – Protection Systems



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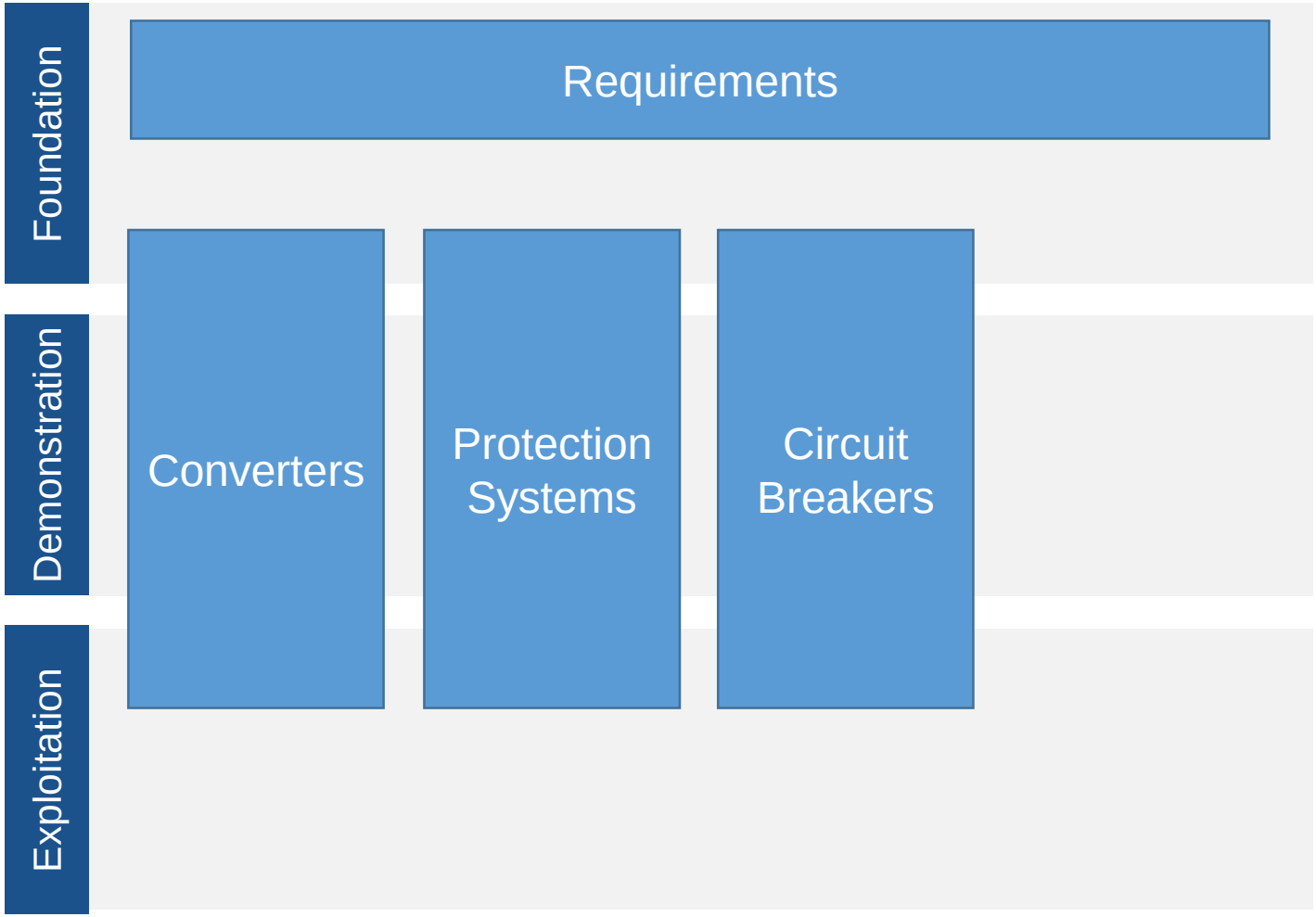
Project Structure – Circuit Breakers



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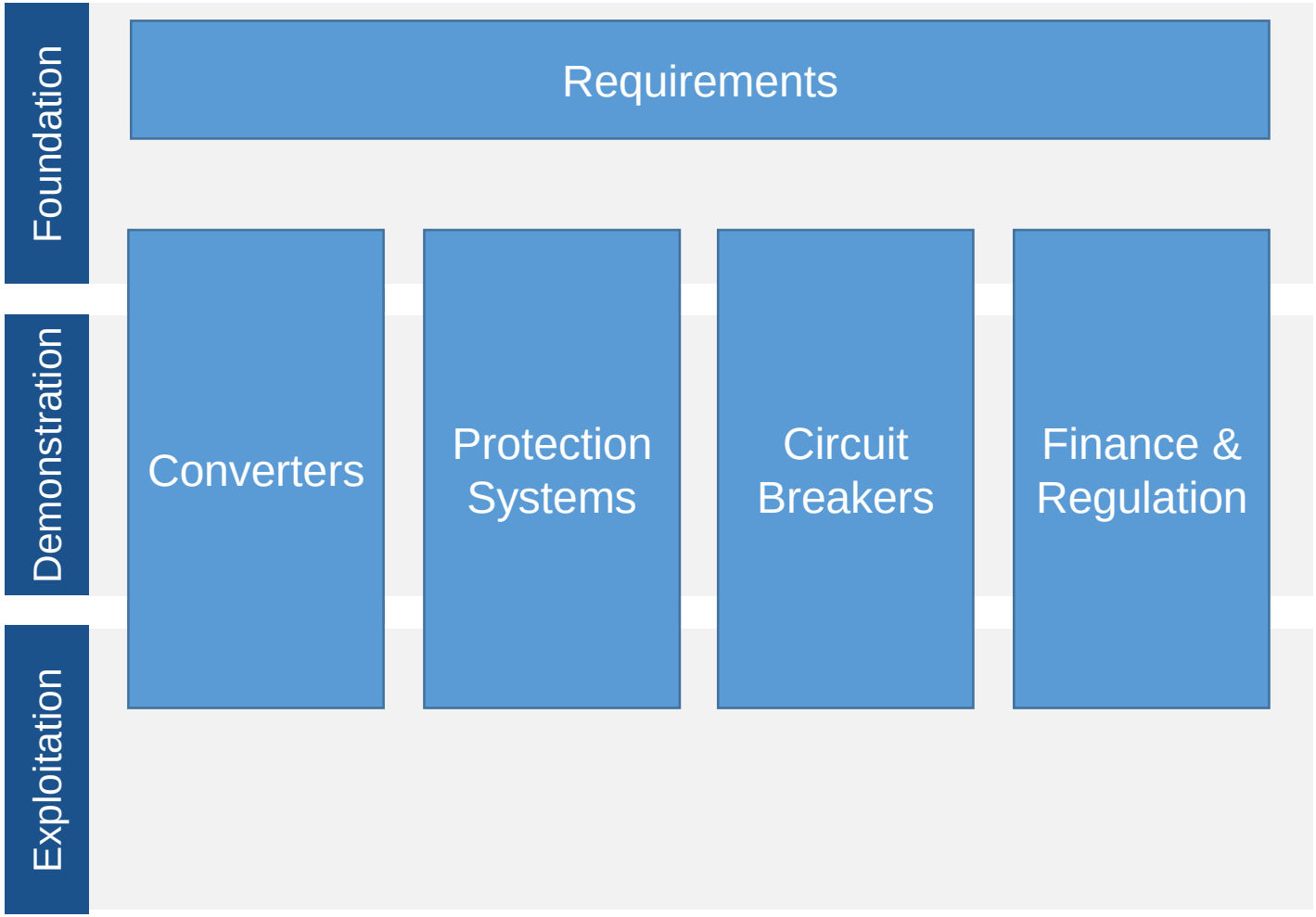
Project Structure – Finance & Regulation



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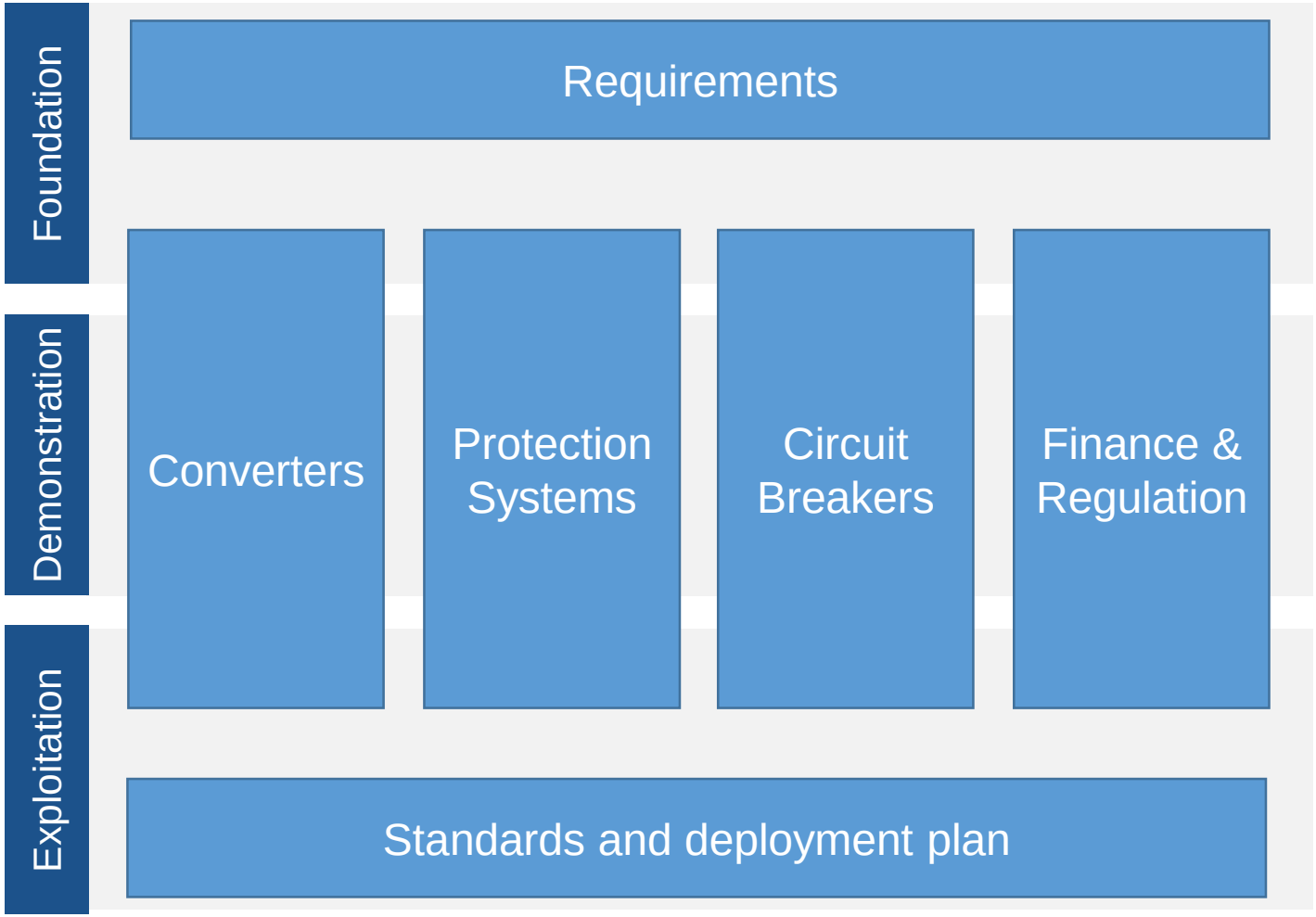
Project Structure – Standards & Deployment plan



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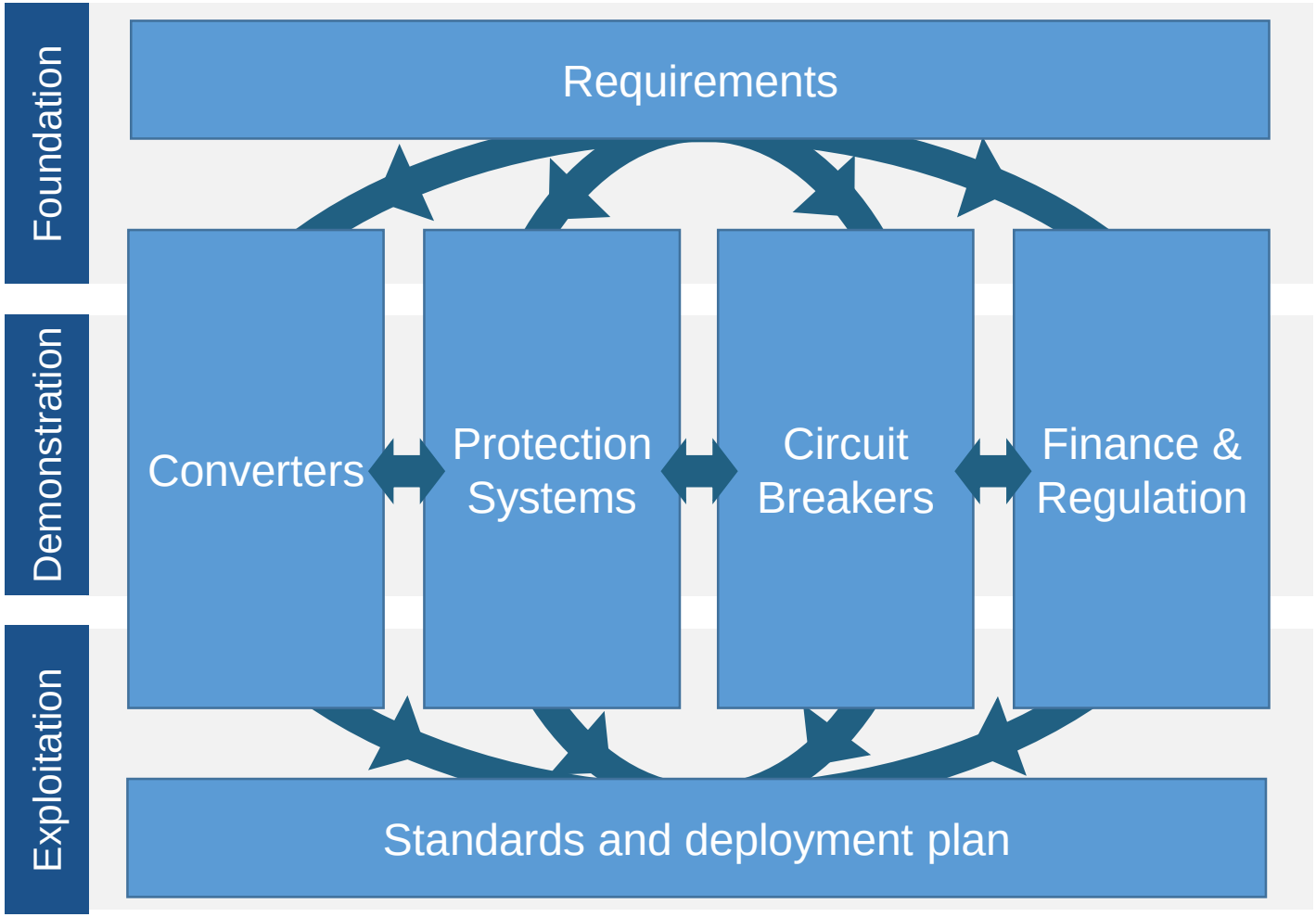
Project Structure – Coordination & dissemination



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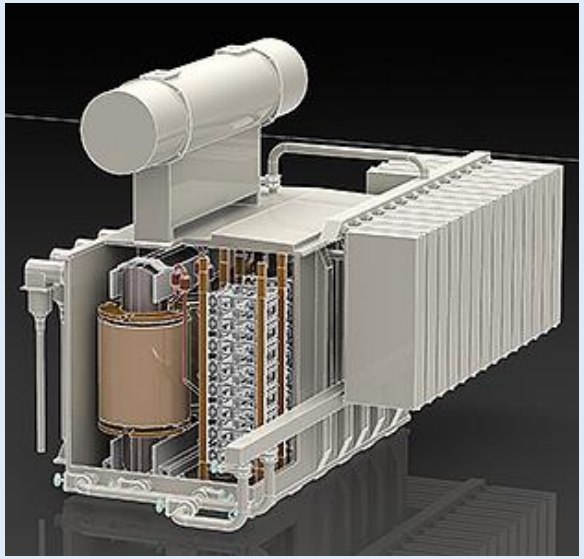
Large scale demonstrators

Diode Rectifier



Wind farm in Denmark

HVDC Grid Protection

The National HVDC center

HVDC Circuit Breaker testing

KEMA Laboratories

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Who?

Progress on meshed offshore HVDC networks PROMOTioN

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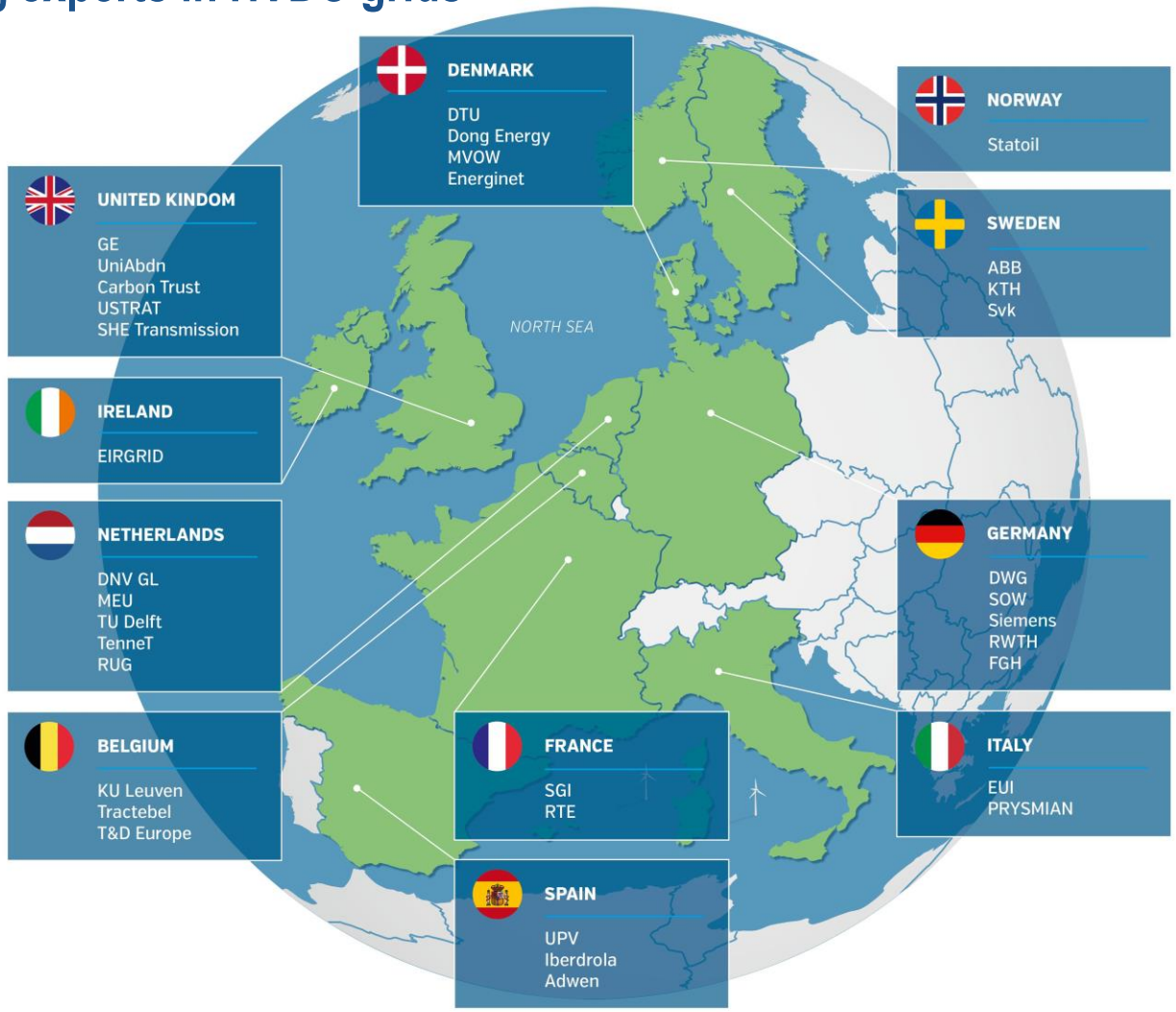
European Partners

34 leading experts in HVDC grids



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Thank you!

Any questions?

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APPENDIX

DISCLAIMER & PARTNERS

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