

120 innovation projects & beyond: The ENTSO-E RDI Monitoring Report

22 June 2023



Agenda

15.00-16.30 - Online

What?	When?	Who?
Welcome	15.00-15.05	Uroš Salobir – ENTSO-E RDIC vice-chair
Keynote speech	15.05-15.15	George Paunescu , DG ENER policy officer
The RDI Monitoring Report - overview	15.15-15.25	Nuno Pinho da Silva – WG RDIP convener
Flagship by flagship analysis	15.25-15.50	WG RDIP members (Kevin Lunge , Luca Orrú , Lóránt Dékány)
TSO Experiences: - OneNet - InterOPERA - BD4NRG	15.50-16.20	Jukka Rinta-Luoma , FINGRID Philipp Ruffing , Amprion Mitja Antončič , ELES
Q&A	16.20-16.25	
Closing remarks	16.25-16.30	Nuno Pinho da Silva – WG RDIP convener

RDI Monitoring Report 2022

Keynote

George Paunescu

Policy officer | DG ENER



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Overview

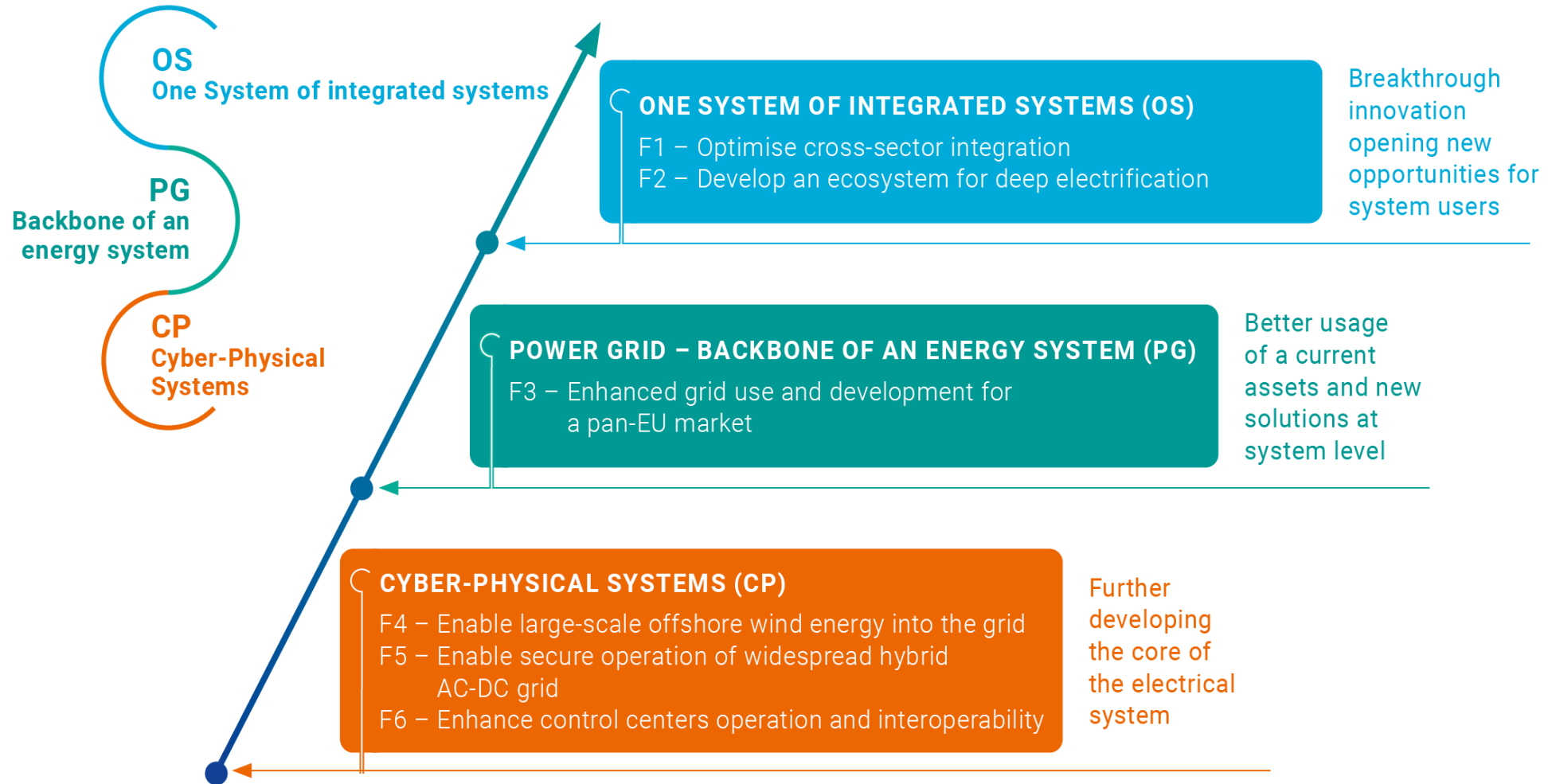
Nuno Pinho da Silva

Convener | Working Group RDI Planning
ENTSO-E



Overview

RDI Roadmap 2020-2030: 3 cluster, 6 Flagships and 80+ milestones



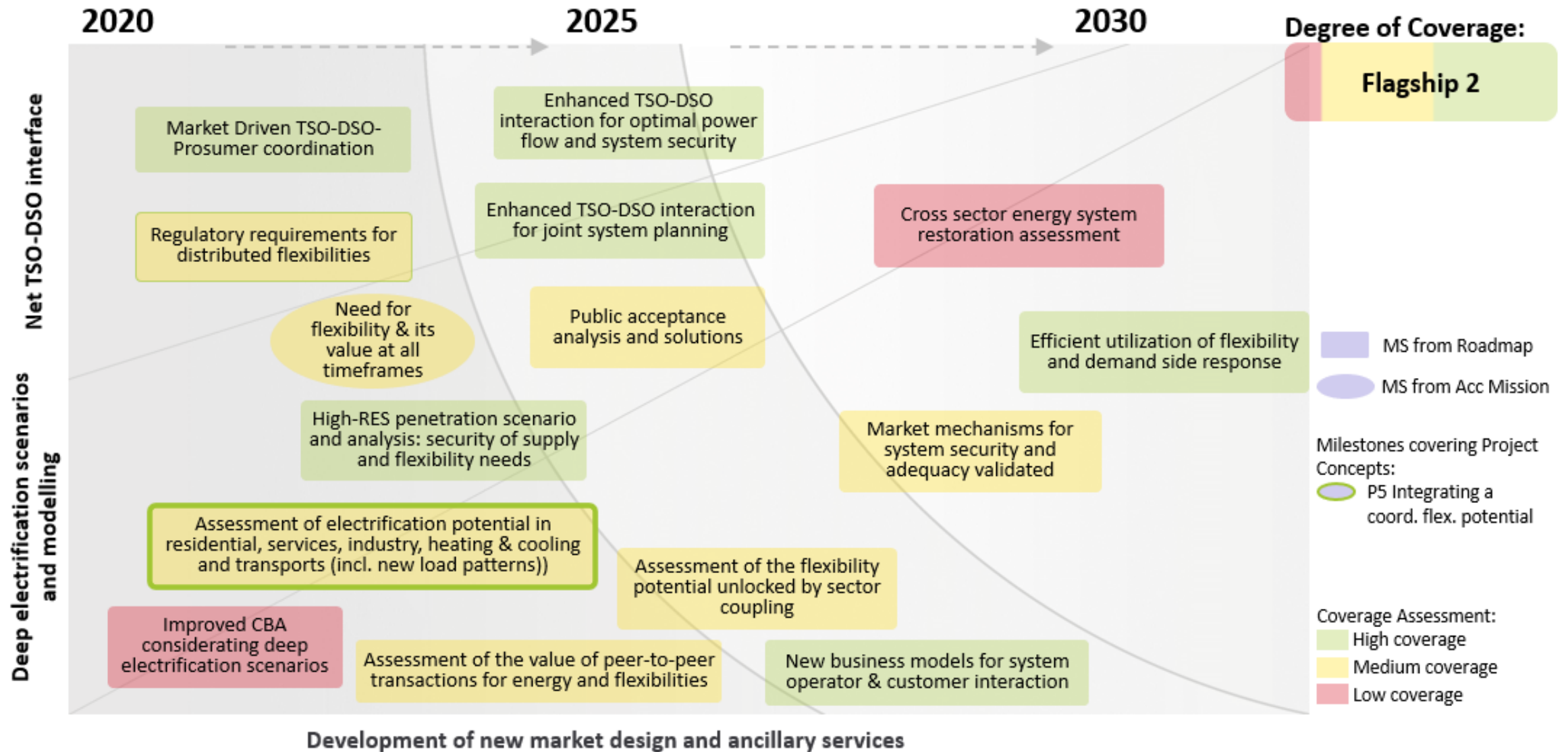
Overview

The RDI Roadmap cycle: The Monitoring Report is the 3rd item, providing input for the Roadmap review



Overview

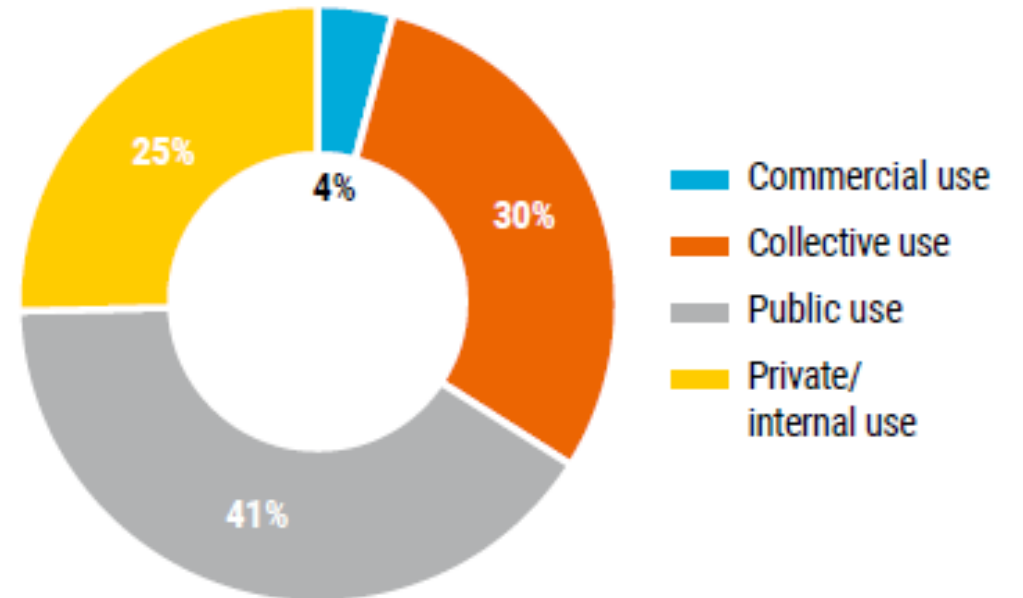
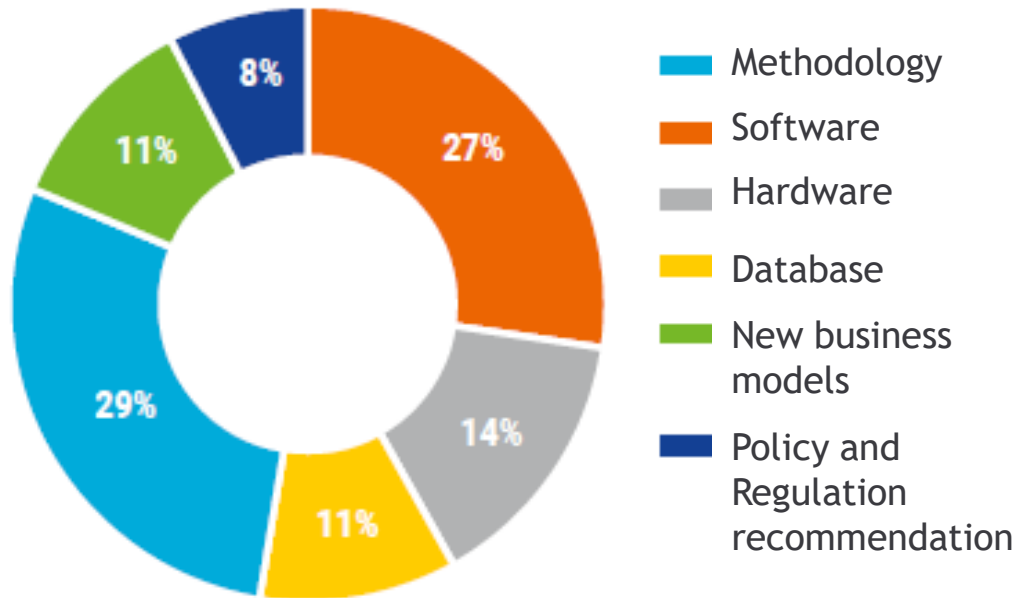
The alignment of the ongoing RDI efforts with the ENTSO-E RDI Roadmap was overlaid in each Flagship map



Overview

Key Exploitable Results (KERs): 160 KERs from 117 projects

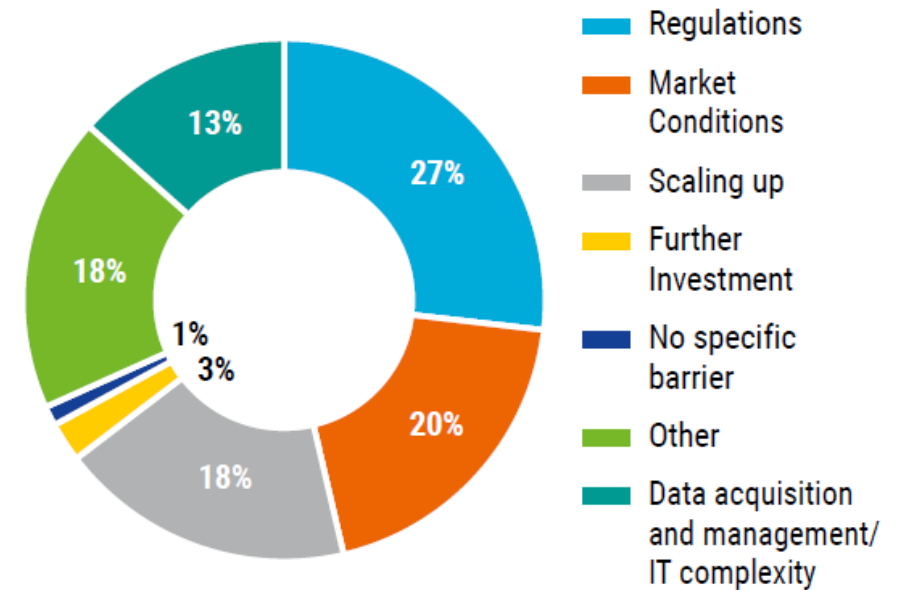
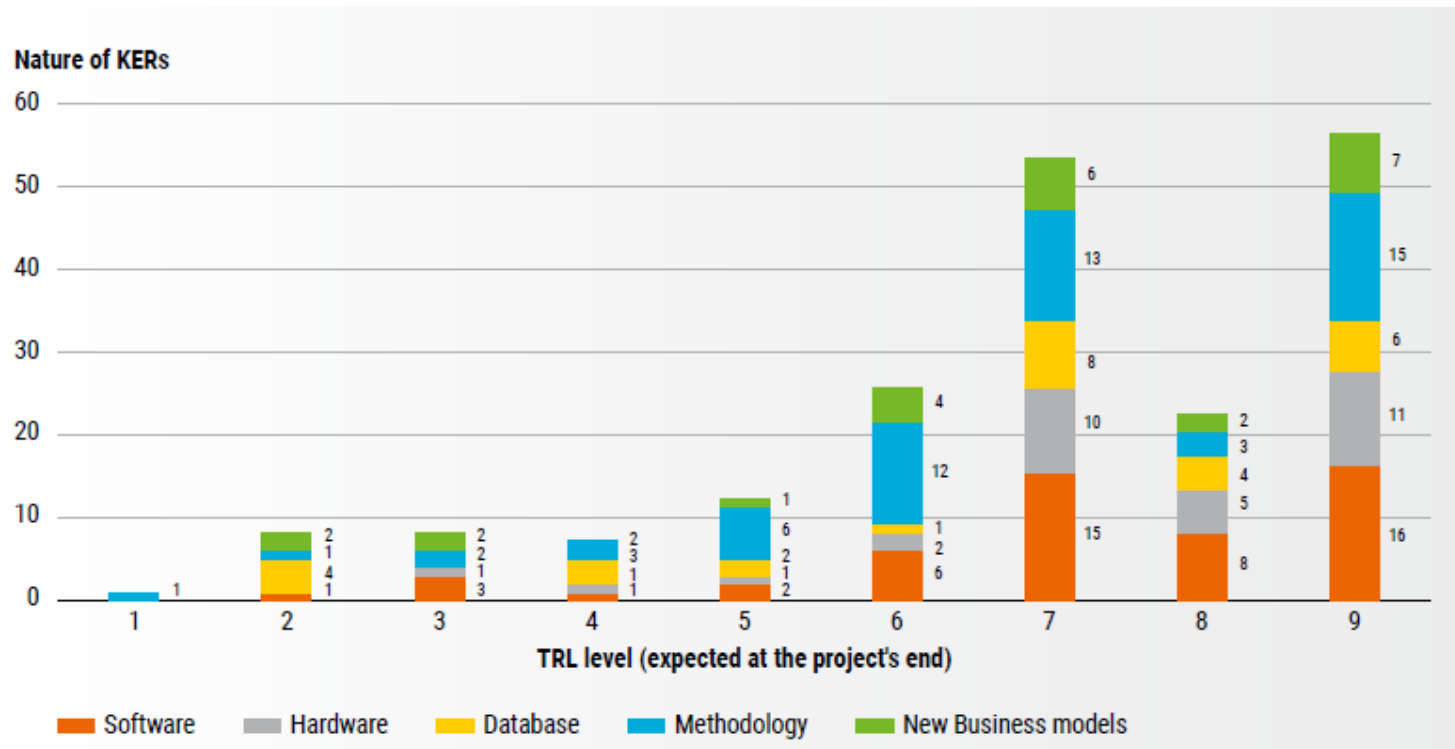
- The Innovative methodologies (29%) and Software tools (27%) are the majority of the KERs
- The **Public use (41%)** followed by **collective use (30%)** are the most frequent effective use of KERs



Overview

Technology Readiness Level: Concentration between 7 to 9

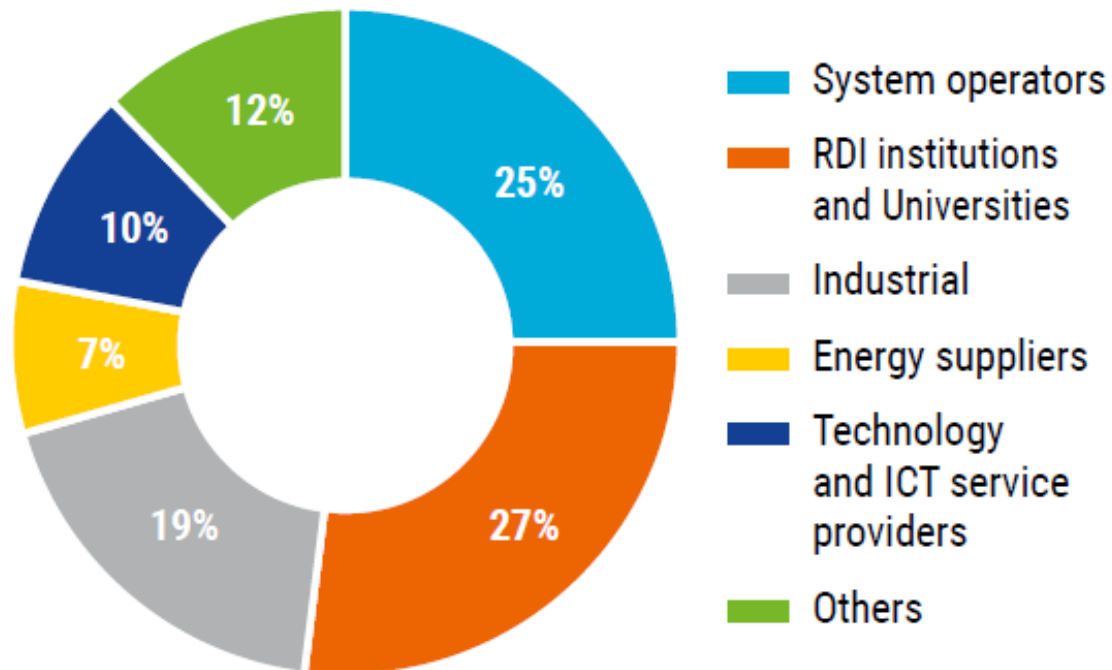
- Less than 5 years is the most frequent expected time for exploitation of the Key Exploitable Results.
- The **regulatory framework followed closely by market conditions** were cited as the biggest barriers to the use of KERs, accounting together for almost 50% of the responses regarding barriers.



Overview

Projects in partnerships: bridges from fundamental research towards technology development and integration

- RDI institutions and Universities are the largest group of partners, followed by other TSOs and Industry partners
- The TSO's research projects are a “hands on” platform for knowledge transfer, serving as a bridge from fundamental research towards technology development and integration



Overview

Further observations

- Over 80% of the milestones from the ENTSO-E RDI Roadmap 2020-2030 are already covered by the current research activities
- 3 Acceleration Mission topics have a high coverage degree by the surveyed research efforts.
- The analysis of the ongoing RDI efforts shows the deep commitment of TSO towards carbon neutrality and the strong [alignment with the Green Deal and the REPowerEU action plans](#).

Overview

Key recommendations

1

The increased trend of projects aiming at **direct public use should be further maintained and monitored**. Such approach might help to embed outcomes and new competencies within the European electricity industry.

2

The increasing pace of **electrification of transport needs to be more intensively addressed** in the future as a mean of life standard improvement considering environmental and safety factors. Also, it is recommendable to **boost RDI activities towards storage** (in particular long duration), **Power-to-X technologies**, and the metrics and assessment methodology of **Flexibility needs and value at pan-EU level**, since these are key for timely integration of RES at large scale.

3

Emphasis must be placed on **accelerating and carrying out the necessary activities to enable large-scale offshore wind energy into the grid**, as it requires significant advancements and adjustments of the regulatory framework, HVDC modelling tools, technology and materials development followed by system reliability, security and asset management. The development of HVDC multi-vendor & multi-terminal full scale demonstrators remains highly relevant, **as well as the development of services and processes to guarantee stability of the pan-EU grid with high penetration of PEs**.

4

To improve the alignment of topics from Horizon Europe with the RDI Roadmap, **the milestones of the RDI Roadmap should become part of the set of outcomes of the research topics of the Horizon Europe**.

5

It is necessary to **work together with regulatory authorities to dismantle innovation barriers** in order to create an environment for innovation uptake, as suggested by the ENTSO-E paper “Innovation Uptake through Regulation”.

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Flagship by Flagship analysis

Nuno Pinho da Silva

Convener | WG RDIP - REN

Luca Orrú

Expert | WG RDIP - Terna

Kevin Lunge

Expert | WG RDIP - Amprion

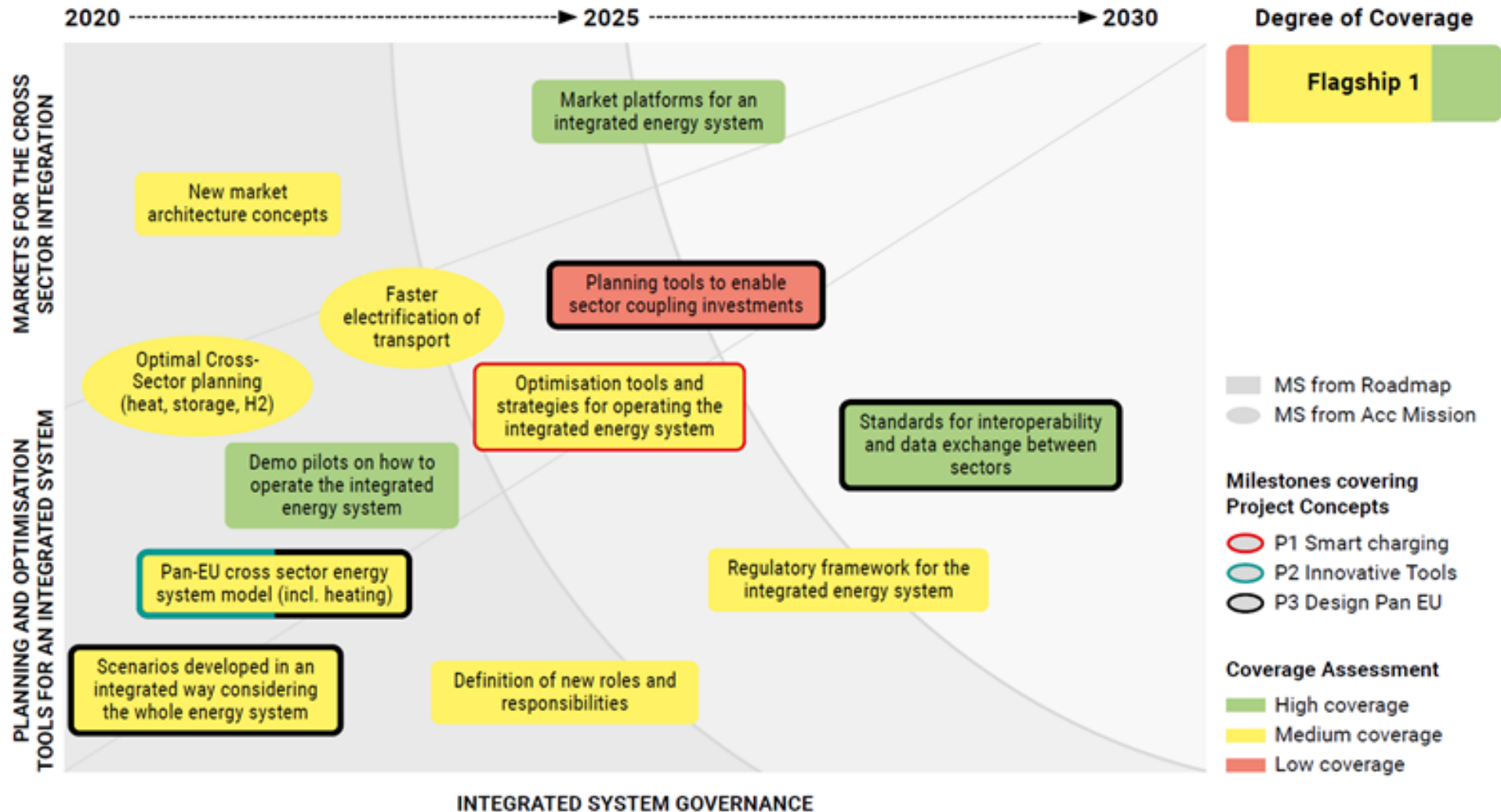
Lóránt Dékány

Specialist | ENTSO-E



Flagship 1 – Optimise cross-sector integration

24 surveyed projects addressed this Flagship



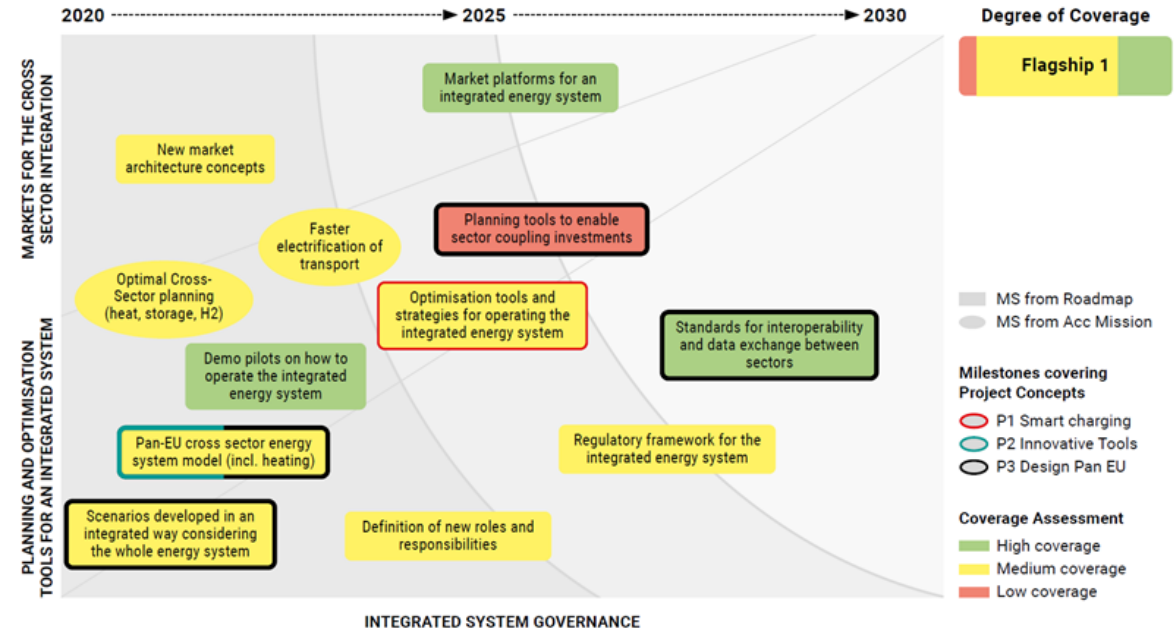
Flagship 1 – Optimise cross-sector integration

Key requirements to significantly improve efficiency and flexibility, as well as reliability and adequacy of the energy system

- Markets for cross-sector integration developed and coupled
- Availability of (integrated) planning and optimisation tools for system operators and market parties
- An integrated system of governance

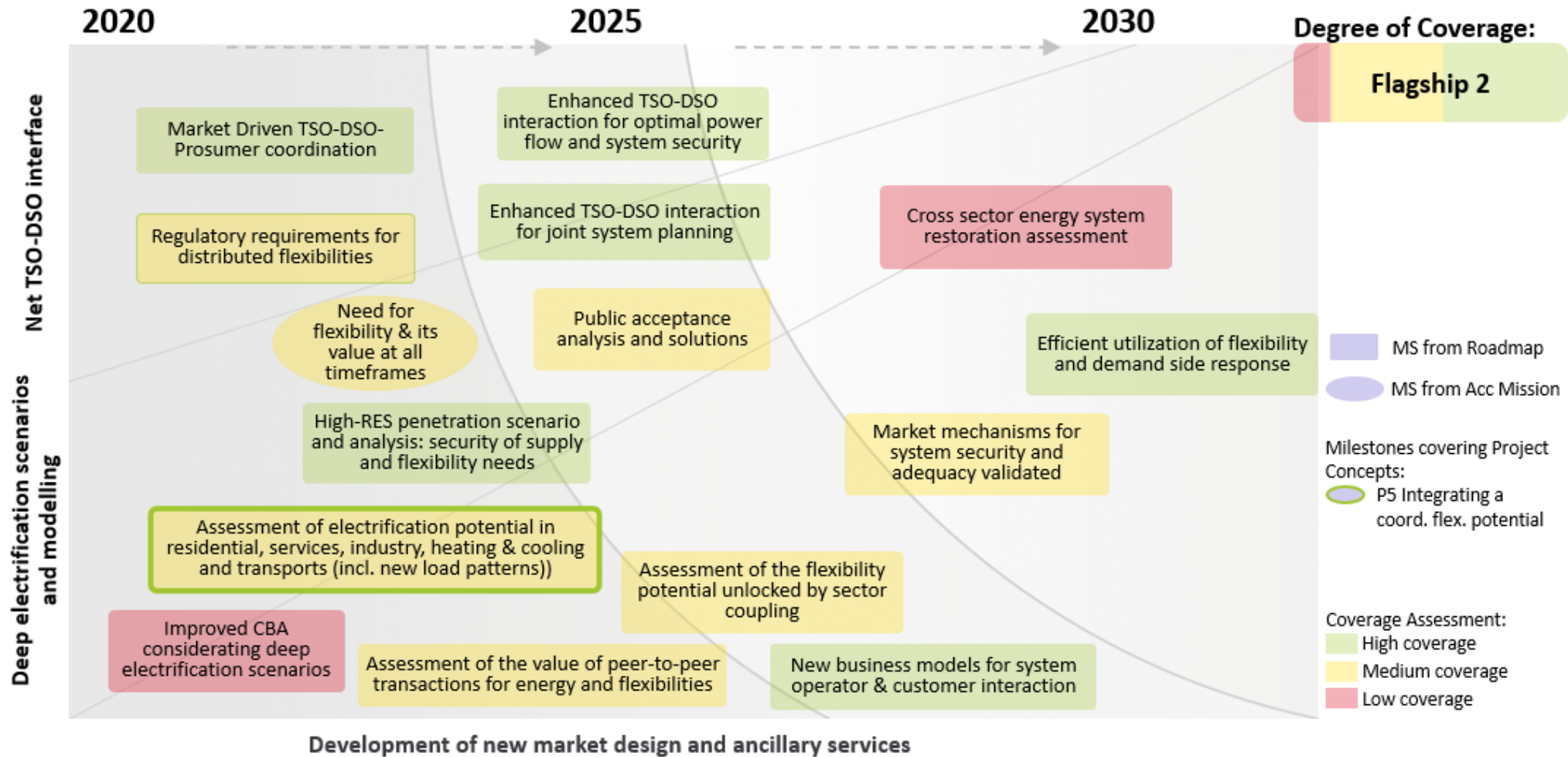
Key observations from the monitoring activity of the 12 milestones in this Flagship

- The majority of milestones in this Flagship have medium coverage degree (8 out of 12 partially addressed)
- Highlights about Milestones related with RDI Implementation Report:
 - ✓ Milestone “**Planning tools to enable sector coupling investments**” results with low coverage: this requires attention for future project’s proposal
 - ✓ Milestone “**Standards for interoperability and data exchange between sectors**” is well aligned with existing projects
 - ✓ Milestone “**Optimisation tools and strategies for operating the integrated energy system**” has medium coverage
- Two milestones identified in the Acceleration Mission have medium coverage



Flagship 2 – Develop an eco-system for deep electrification

27 surveyed projects addressed this Flagship



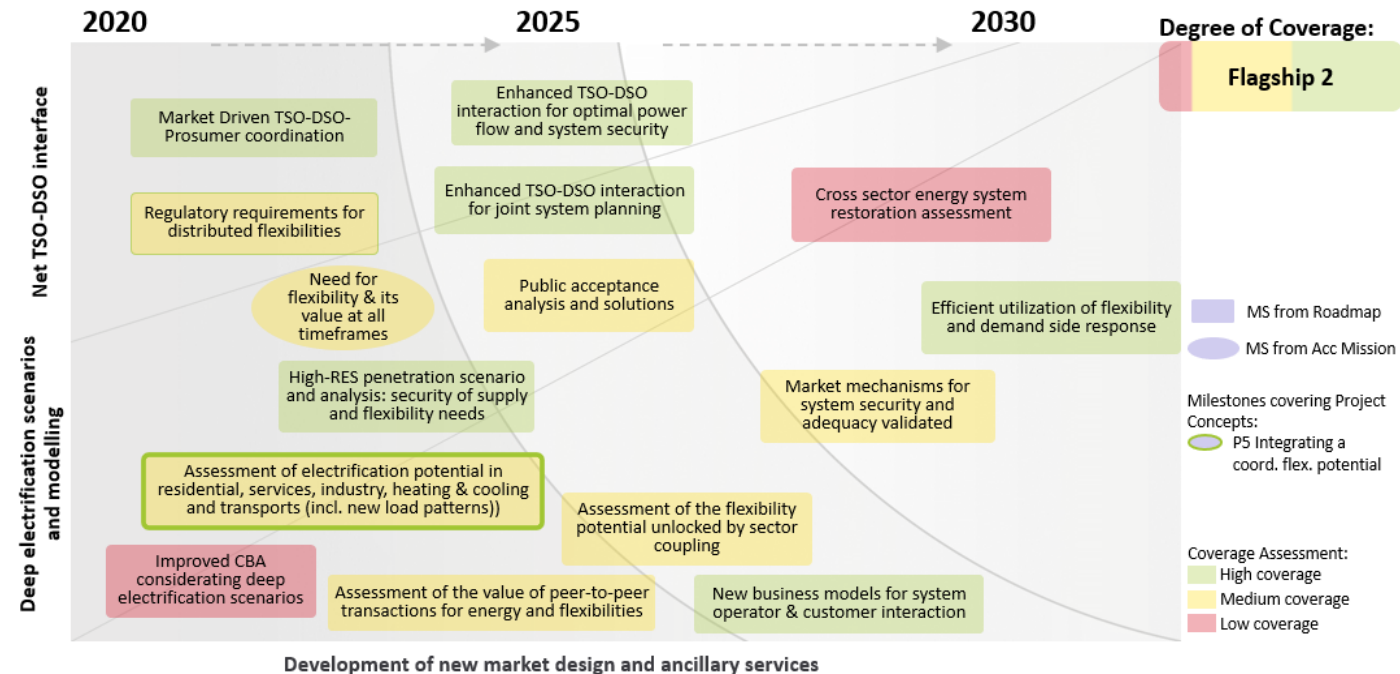
Flagship 2 – Develop an eco-system of deep electrification

Key requirements to develop an eco-system for deep electrification

- A new and comprehensive TSO-DSO interface to provide grid users with the best service
- New scenarios and modelling techniques
- The development of new market concepts and ancillary services to integrate flexible new sources.

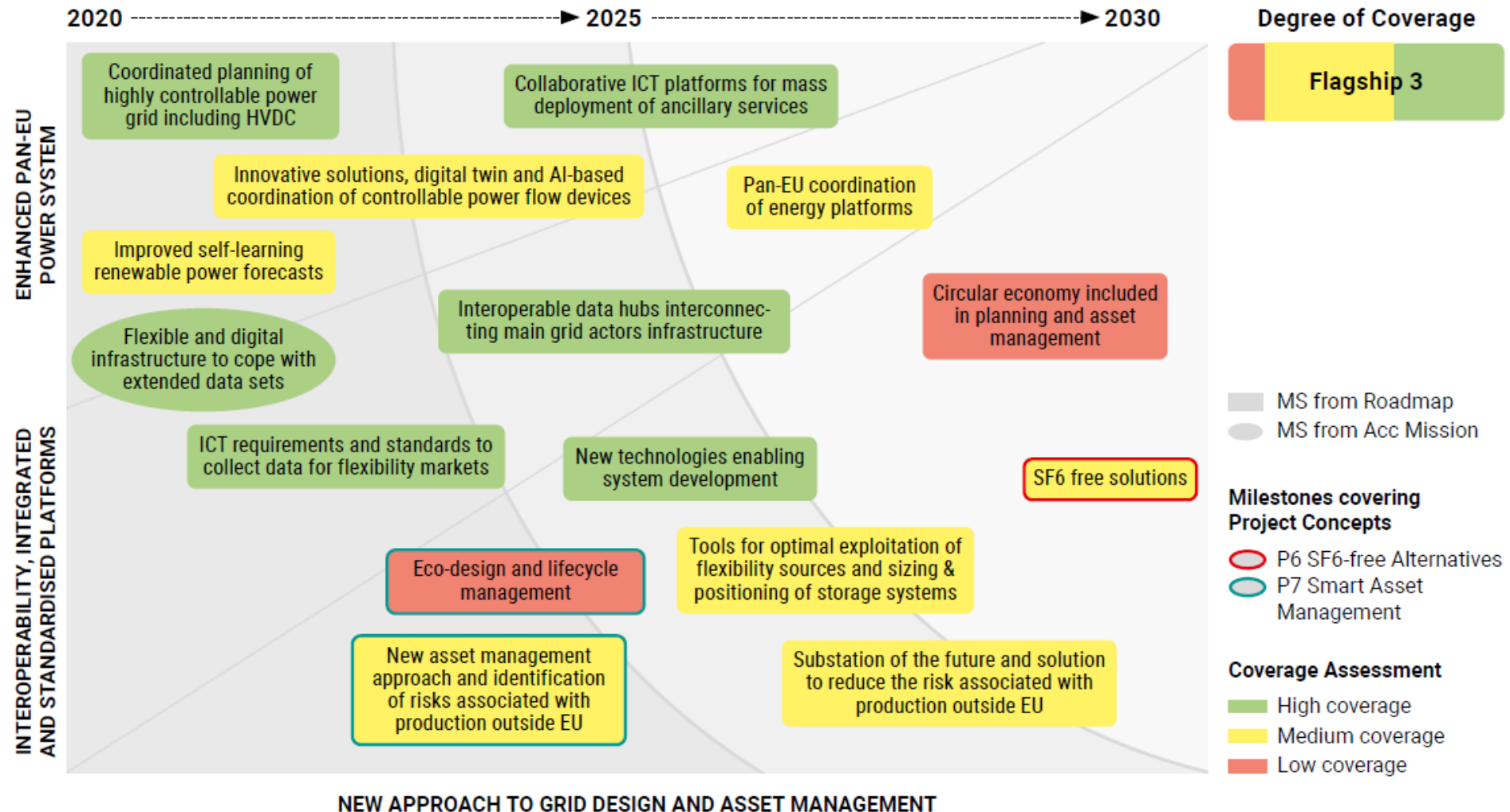
Key observations from the monitoring activity of the 15 milestones in this Flagship

- The majority of milestones in this Flagship have high coverage degree
- Highlights about Milestones related with the ENTSO-E Vision and the RDI Implementation Report
 - ✓ The “Efficient utilization of flexibility and demand side response” is with high coverage, which is supporting the acceleration of delivering the ENTSO-E Vision of a Power System for a Carbon Neutral Europe
 - ✓ The milestone “Assessment of electrification potential” related to the Project Concept “Integrating the coordinated flexibility potential into the future energy system of systems” is with medium coverage. This should be accounted for by novel projects in the near future.
- The Milestone “Improved CBA considering deep electrification scenarios” requires careful analysis in the next Roadmap revision as it is currently with low coverage degree



Flagship 3 – Enhance grid use and development for pan EU market

52 surveyed projects addressed this Flagship



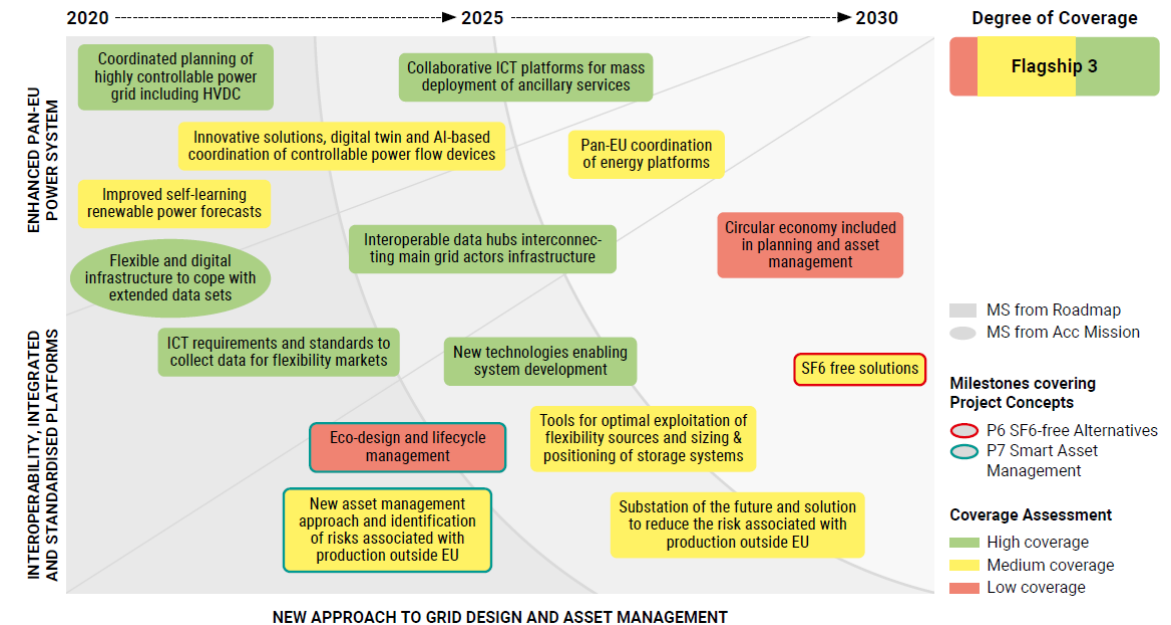
Flagship 3 – Enhance grid use and development for pan EU market

Key requirements to enhance grid use and intensify the development for the pan EU market

- Enable enhanced Pan-EU power systems
- Develop interoperable, integrated and standardized platforms
- Find new approaches to grid design and asset management

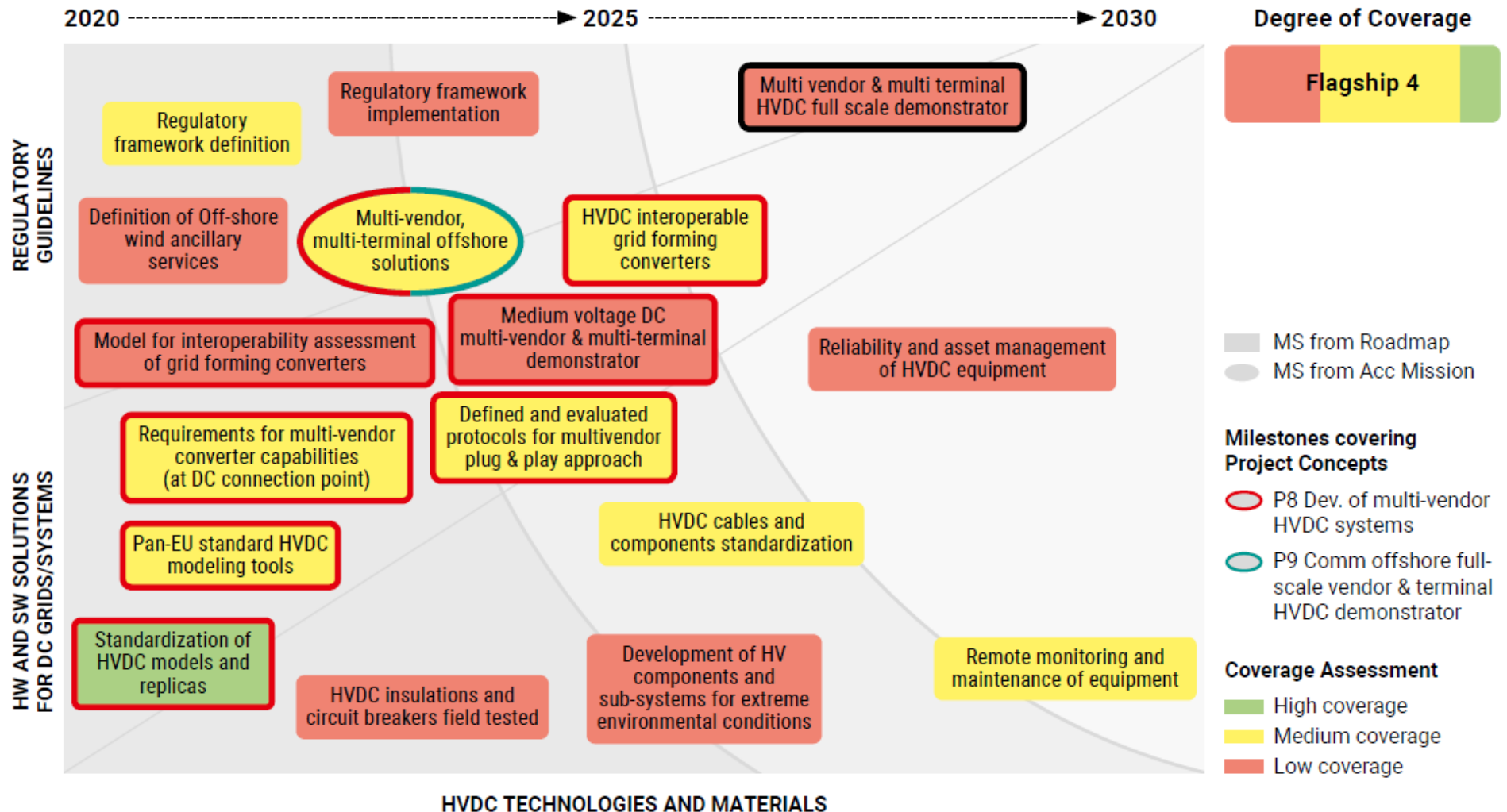
Key observations from the monitoring activity of the 15 milestones in this Flagship

- Most milestones (13 out of 15) have a medium (7 milestones) or a high coverage (6 milestones) in this Flagship, which underlines that the current *research works are covering Flagship 3 at a good pace*
- Highlights about Milestones related with the Acceleration Mission and the RDI Implementation Report:
 - ✓ Milestone “*Flexible and digital infrastructure to cope with the extended data sets*” shows a high coverage
 - ✓ Milestones “*New asset management approach and identification of risks associated with production outside EU*” and “*SF6 free solutions*” have a medium coverage
 - ✓ Milestone “*Eco-design and lifecycle management*” results not covered: this requires attention for future projects
- Long-term milestone “*Circular economy included in planning and asset management*” is the other milestone of Flagship 3, which results at low coverage and leaves space for future work



Flagship 4 – Enable large-scale offshore wind energy into the grid

11 surveyed projects addressed this Flagship



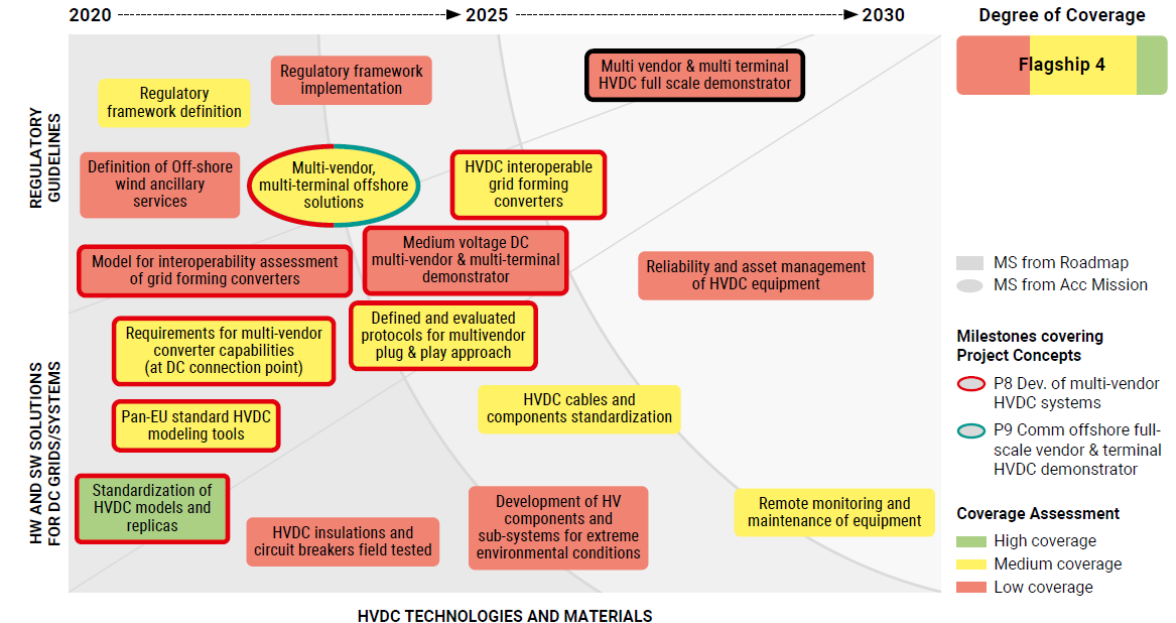
Flagship 4 – Enable large-scale offshore wind energy into the grid

Key requirements to enable large-scale integration of offshore wind into the grid

- Thoughtful regulatory guidelines
- The development of interoperable hardware and software solutions for DC grids and systems
- Consistent attention towards developing new HVDC technologies and materials

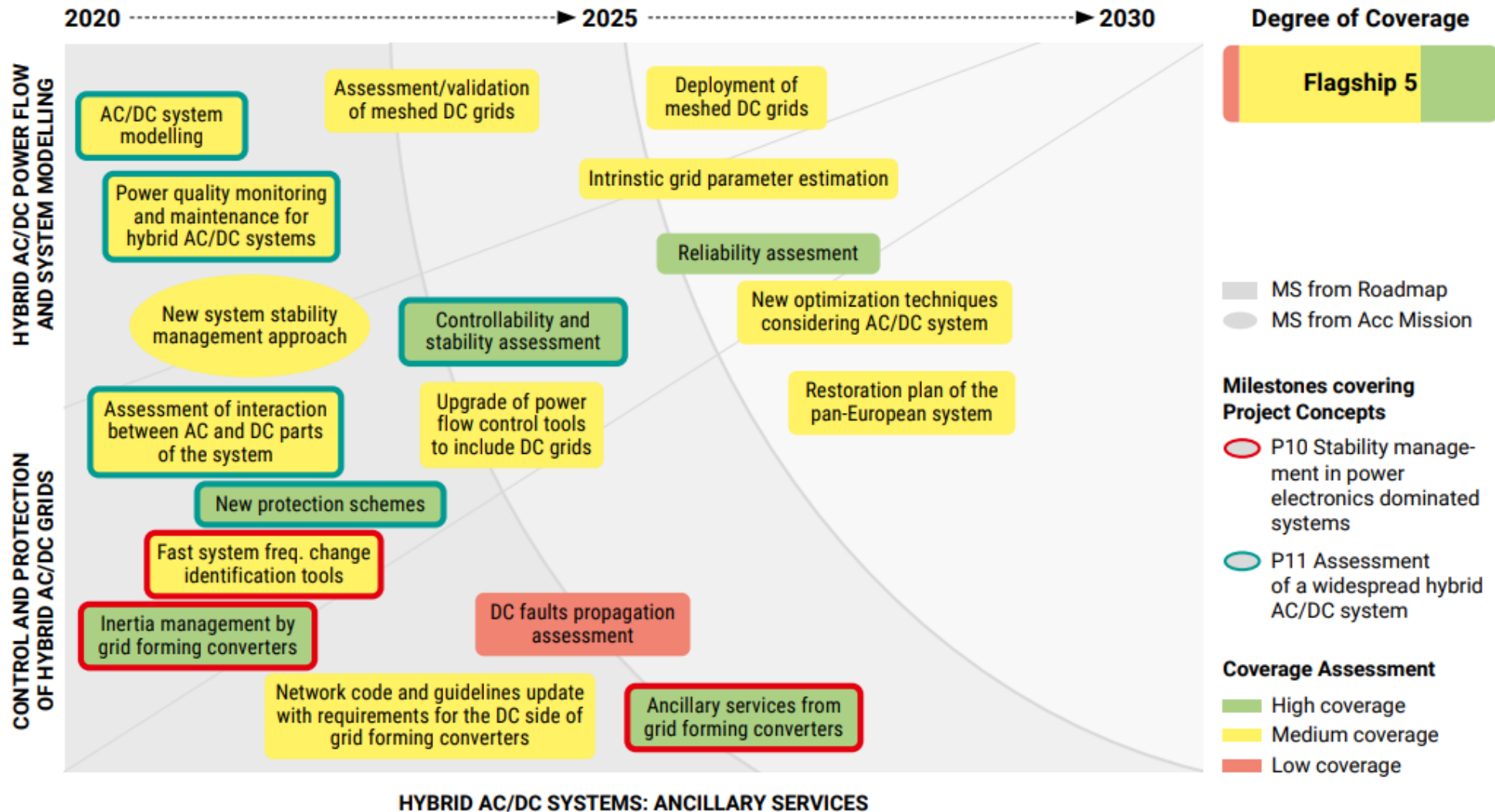
Key observations from the monitoring activity of the 17 milestones in this Flagship

- More than half of the milestones (9 out of 17) have a medium (8 milestones) or a high degree of coverage (1 milestone), which shows that *at some points accelerating and carrying out the necessary activities to enable large-scale offshore wind energy into the grid is required*
- The milestones relevant to the RDI Implementation Report and the Acceleration Mission projects show a pathway to 2030 for the development and commercial *availability of multi-terminal, multi-vendor offshore HVDC systems*:
 - ✓ 6 of the 9 related milestones have at least medium coverage, with "*Standardization of HVDC models and replicas*" highly covered. The technology development takes time, but the *coverage here shows important progress*
- In the fields of "*Regulatory Guidelines*" and "*HVDC technologies and materials*" *further steps must be taken because more than half of these milestones result in a low coverage*



Flagship 5 – Enable secure operation of widespread AC/DC grids

11 surveyed projects addressed this Flagship



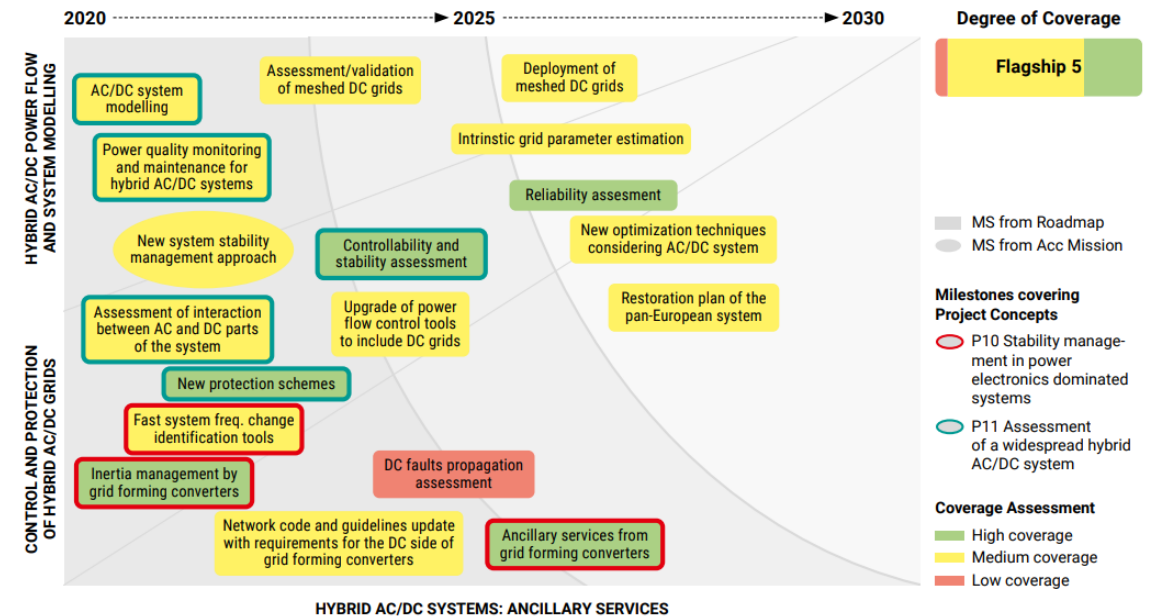
Flagship 5 – Enable secure operation of widespread AC/DC grids

To enable secure operation of widespread AC/DC grids, the following solutions are critical:

- Hybrid AC / DC power flow and system modelling;
- Control, operation and protection of hybrid AC / DC grids
- Hybrid AC / DC systems to provide ancillary services

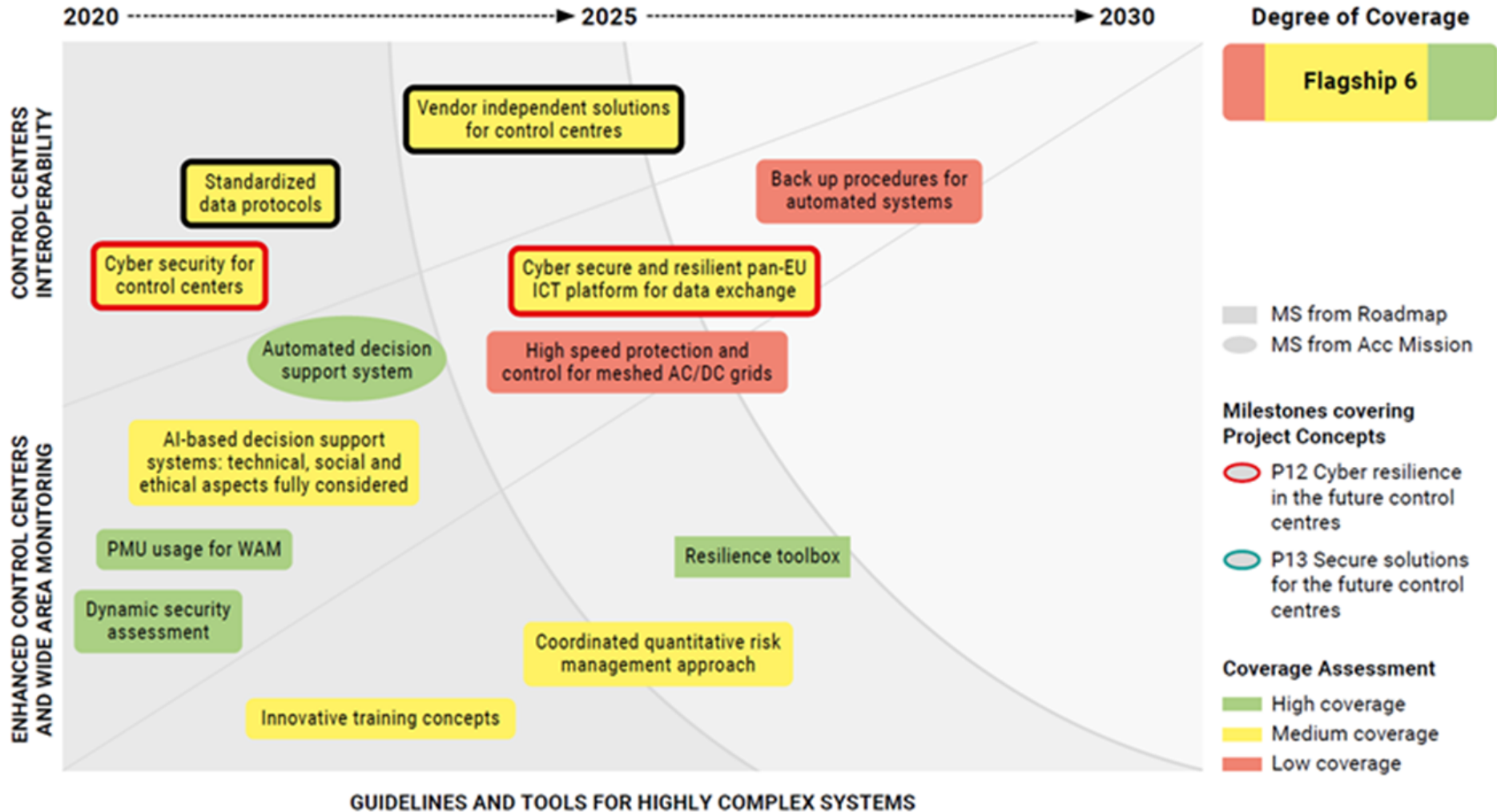
Key observations from the monitoring activity of the 18 milestones in this Flagship

- The majority of milestones within this Flagship (11 out of 18) are given a medium degree of coverage by the surveyed projects, only milestone “DC faults propagation assessment” is with low coverage degree
- Although milestones and project concepts related to [stability management](#) showed to be covered at a medium degree, recent ENTSO-E work showed that [still significant RDI efforts and stakeholder collaborations are required](#) to accelerate the uptake of new technologies related to this subject
- This Flagship mostly has a medium degree of coverage and is highly relevant for addressing power electronic interfaces that increase the availability of renewable energy, storage and demand response in the grid; [there are still considerable RDI efforts to be made to tackle both the many and complex stability issues in a timely manner](#)



Flagship 6 – Enhance control centers operation and interoperability

23 surveyed projects addressed this Flagship



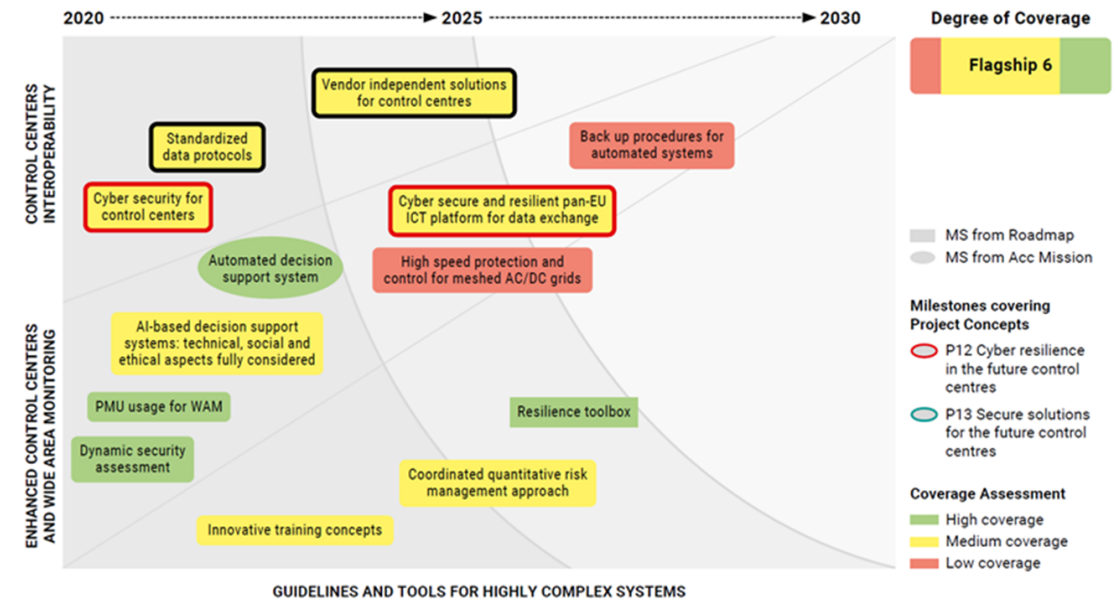
Flagship 6 – Enhance control centers operation and interoperability

Key requirements to improve system monitoring and control capabilities through enhanced information and communications technology (ICT) infrastructure

- Interoperability of control centers
- Enhanced control center development and wide-area monitoring
- New guidelines and tools to manage highly complex interoperated systems

Key observations from the monitoring activity of the 13 milestones in this Flagship

- The majority of milestones in this Flagship have medium coverage degree (7 out of 13 partially addressed)
- Milestones “Back up procedures for automated systems” and “High speed protection and control for meshed AC/DC grids” have low coverage: this is a point of attention for future projects
- Highlights about Milestones related with RDI Implementation Report:
 - ✓ Milestones “Cyber security for control centers” and “Cyber secure and resilient pan-EU ICT platform for data exchanger” result with medium coverage
 - ✓ Milestones “Standardized data protocols” and “Vendor independent solutions for control centres” have medium coverage
- Milestone “Automated decision support system”, identified in the Acceleration Mission, has high coverage



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TSO experiences 1: OneNet project

Jukka Rinta-Luoma

Market Innovations Specialist |
Fingrid



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OneNet - insights from TSO perspective

Jukka Rinta-Luoma, Fingrid



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957739

European Consortium

OneNet brings together more than 70 partners

- Including E.DSO and ENTSO-E
- Together with a large set of TSOs and DSOs
- Leading IT companies and
- Renowned research institutions

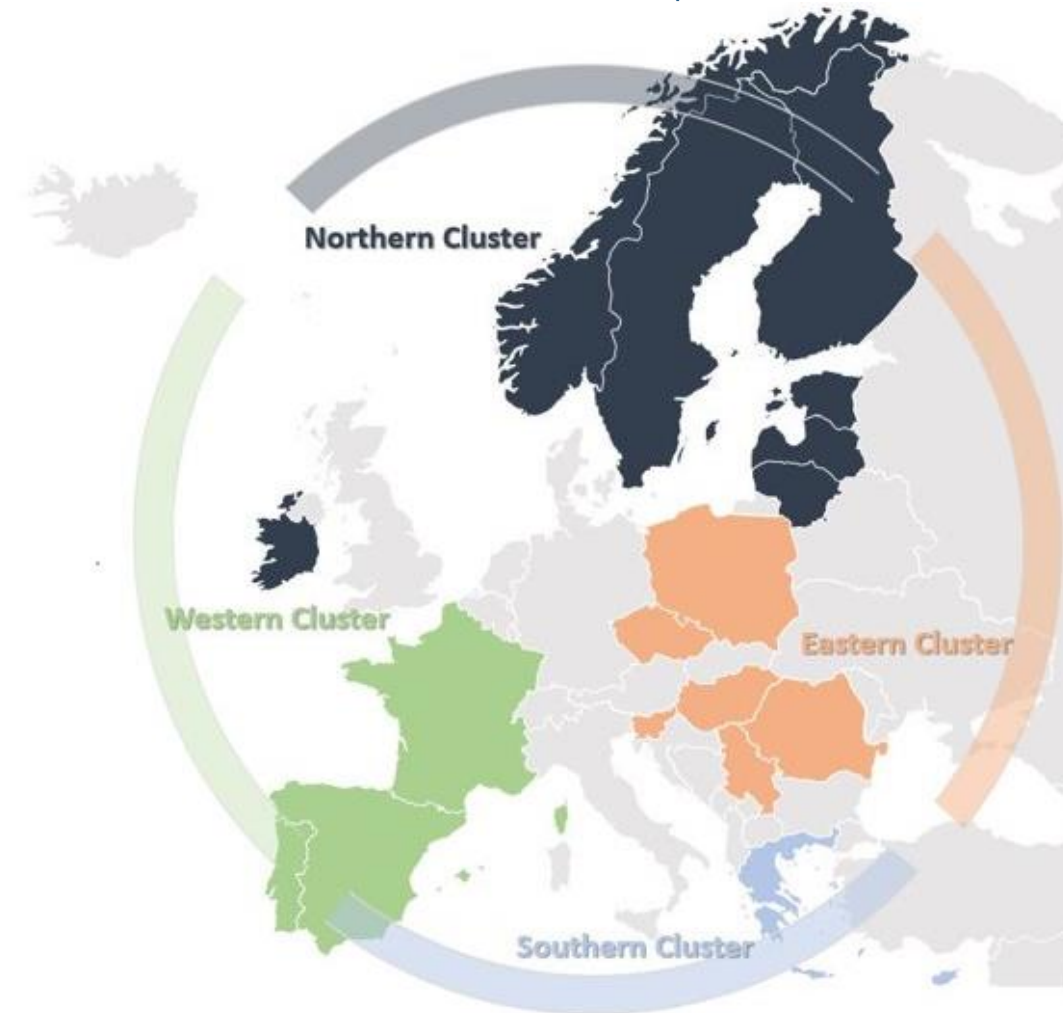
Knowledge Base

- Project funded in the last call for **H2020 TDO-DSO-Consumer** cooperation
- OneNet brings together the **large base of knowledge and technology** developed so far in **H2020 projects** such as **CoordiNet** and **INTERFACE**.
- OneNet aims to create a **standardized pan-European system of systems approach** combining existing and new solutions



A Pan-European System of Systems Approach:

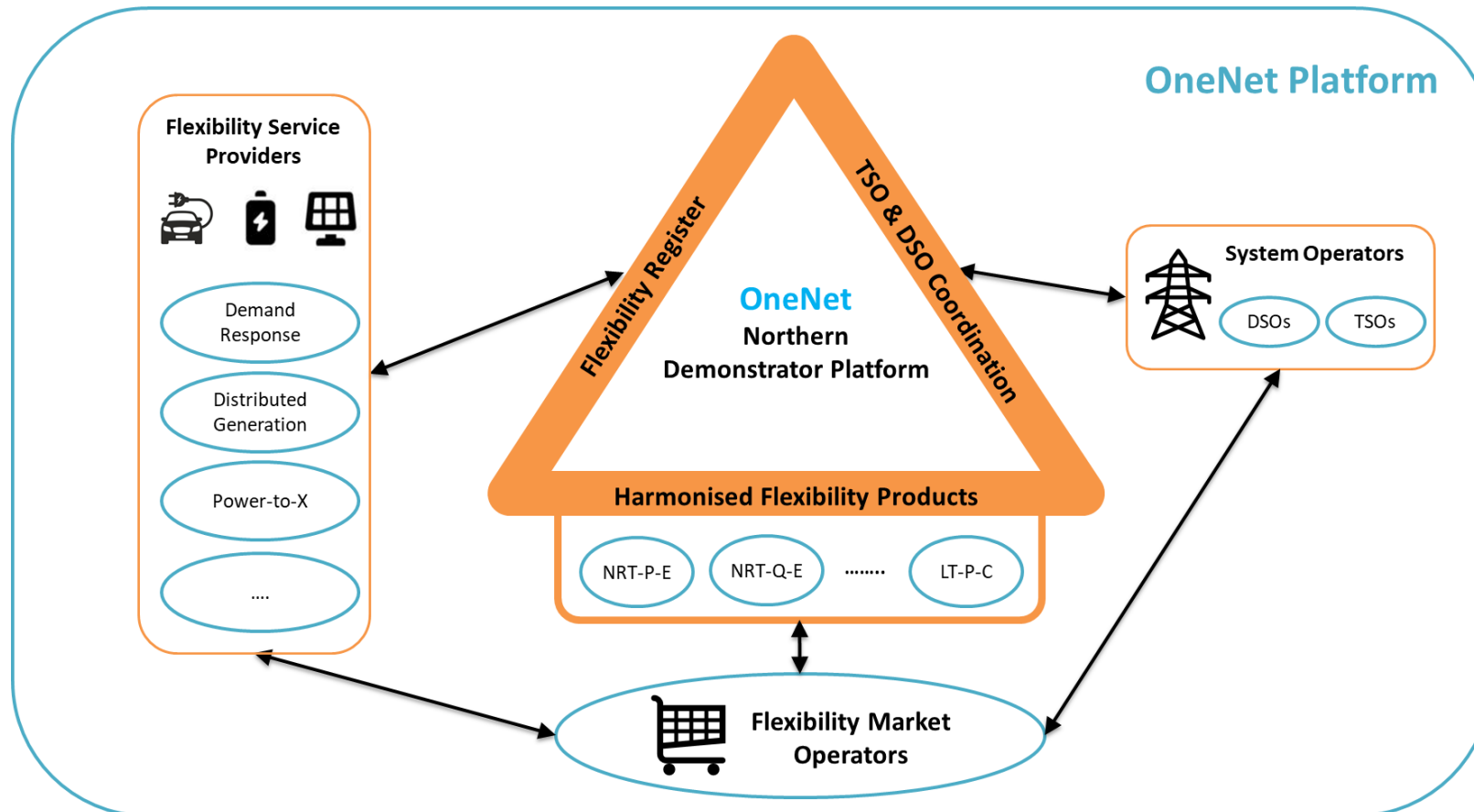
- Bringing together previous knowledge from other H2020 projects;
- Proposing **harmonised products**;
- Developing a **market framework** for the procurement of flexibility;
- Creating **different use cases** according to SOs needs for flexibility and approach to acquire service;
- Developing **OneNet architecture platform** in order to connect all stakeholders.



Northern Cluster - Demonstrating a Joint, Regional, Market-based Approach



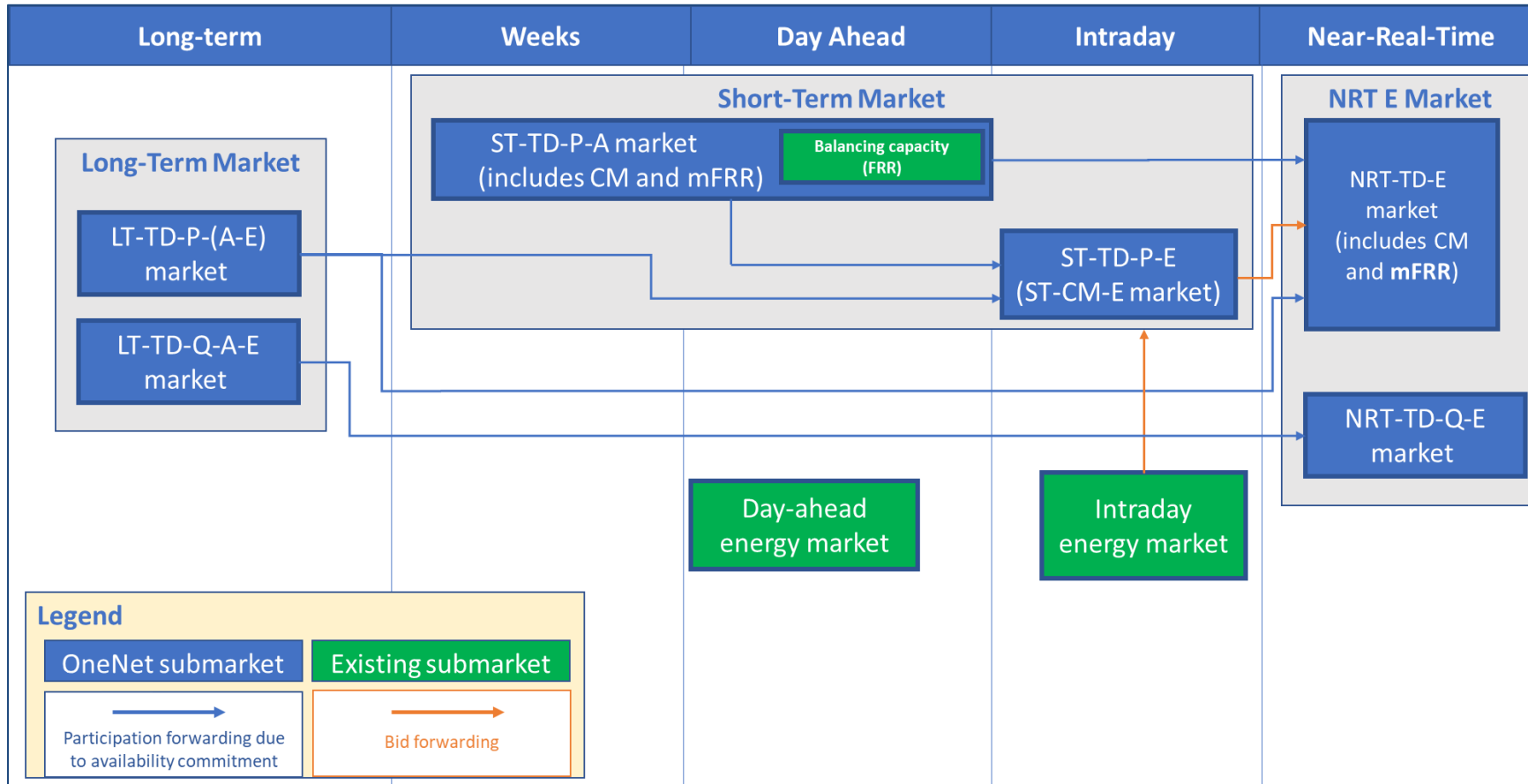
Common IT Architecture



End-to-end approach:

- TSO-DSO Coordination within Northern countries
- Lowers entry barriers for flexibility providers and users
- Simplified and harmonised products
- Interoperability of multiple actors
- Integration with OneNet Middleware

Harmonised Products for the Different SOs



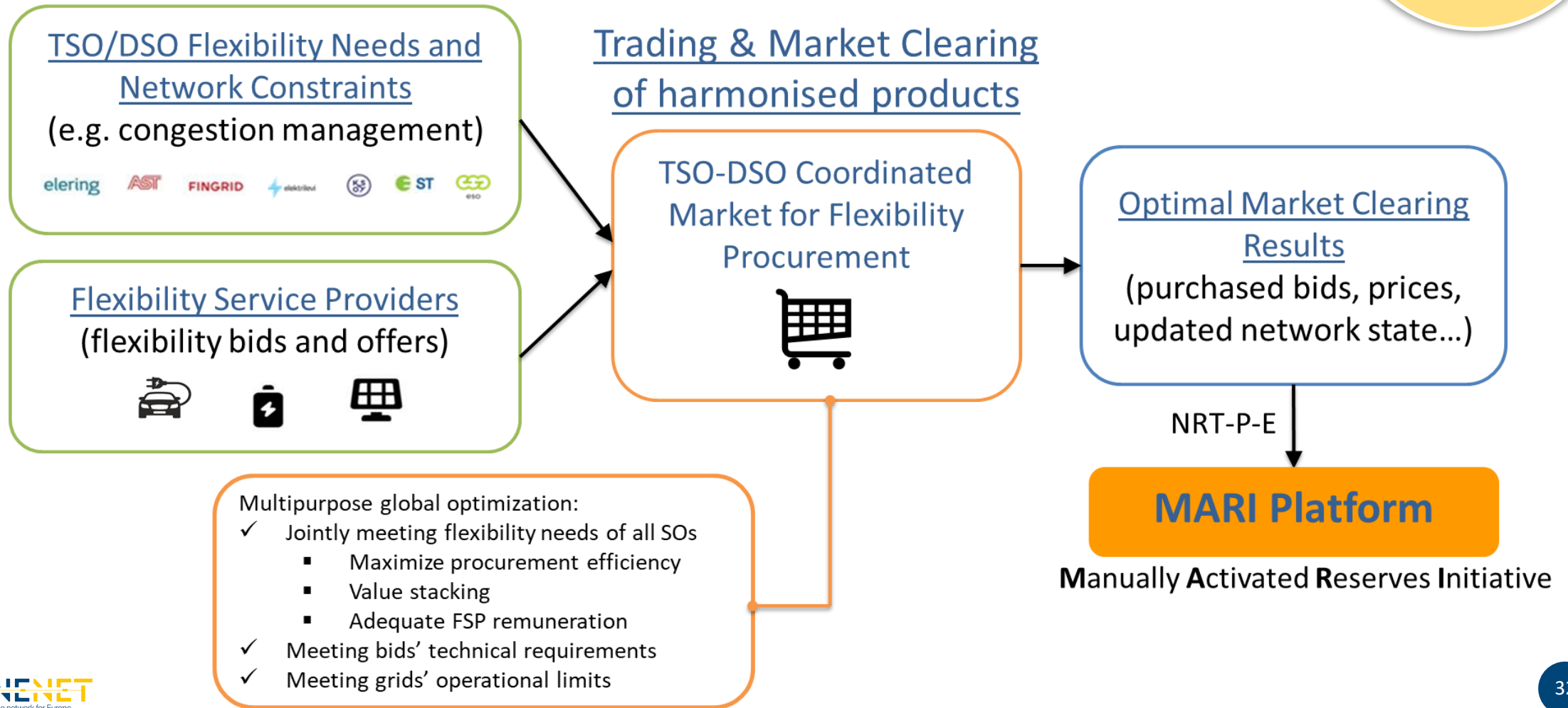
Service-agnostic products:

- Corrective local active (e.g. NRT-P-E)
- Predictive short-term local active (e.g. ST-P-E)
- Predictive long-term local active (e.g. LT-P-E)

Allow **bid forwarding** and **value-stacking**.

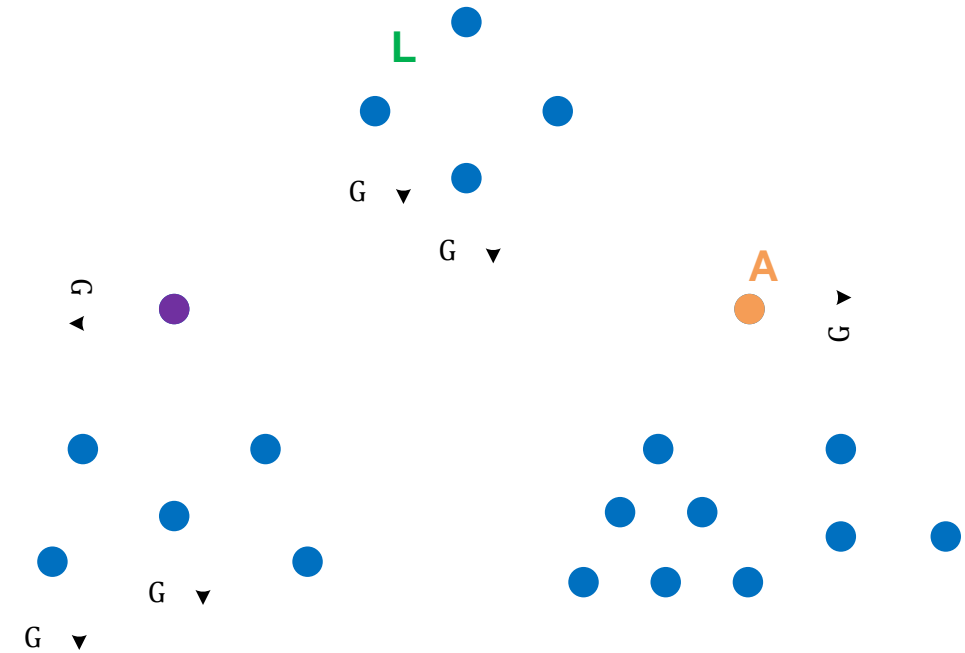
Suited to **multiple SOs**.

Optimal Selection for the Common Trading

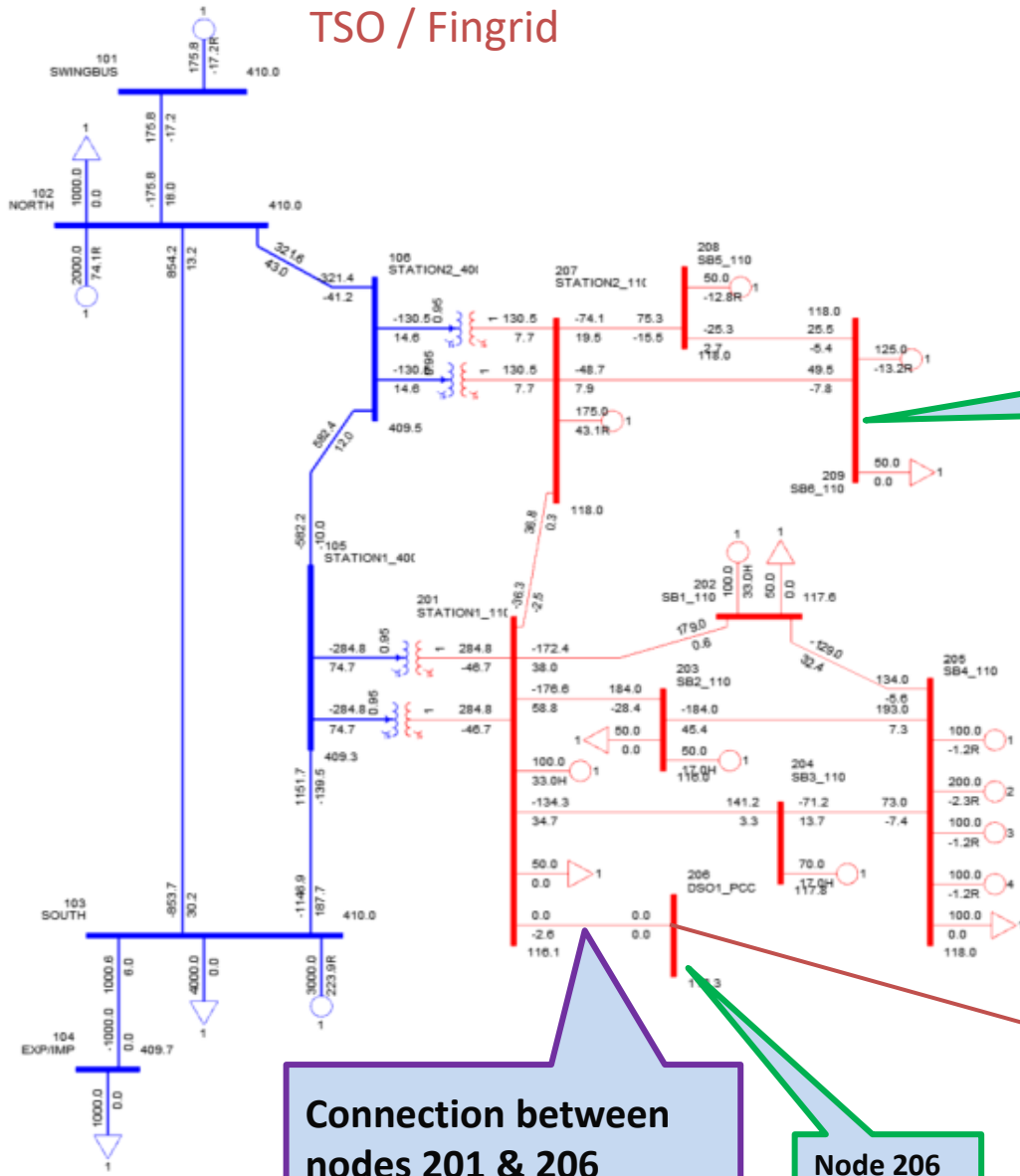


Optimisation-based Market Clearing

- Quantifying value of a bid in meeting the flexibility need
→ *E.g.: How much does 1 MW of flexibility purchased at location A in the grid help resolving congestions over line L?*
- Ensuring that any purchased flexibility for meeting initial system needs does not cause other network operational issues Considering all lines and all bids
- Optimization-based market clearing: approach based on *Power Transfer Distribution Factors*
- TSO-DSO interconnections represented



TSO / Fingrid



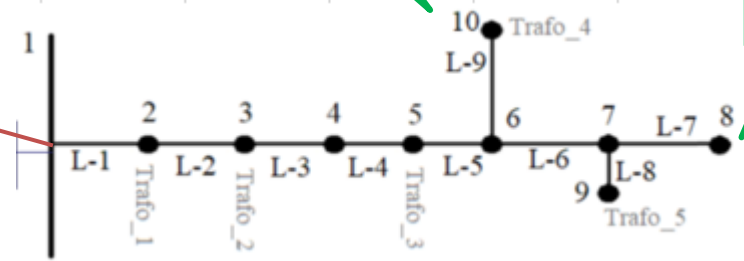
Node 209
5 MW
DOWN
?? €/MW

Node 10
0,5 MW UP
zz €/MW

Connection between nodes 201 & 206
Capacity 22 MW
Flow 25 MW
→ Need 3 MW

Node 206
2 MW UP
xx €/MW

DSO / KSOY



Node 8
1 MW UP
yy €/MW



Fingrid's learnings so far

- Products – harmonization and upgrading existing products to enable congestion management
 - Foster liquidity on the existing markets
 - Link to resource information in flexibility register – procurement through TSO-DSO coordination platform
- Optimization is working in the test scenarios – in real use would require lot of data to be managed and sent
 - Optimization tool would be beneficial in a complex grid with several congestions
 - In the early phase of market-based congestion management, operators can procure flexibility with fairly simple tools
- Lot of insight to information management and roles, which enable the use of multiple markets and utilize current processes where possible. Achieving harmonized and common processes also require a lot of work.

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TSO experiences 2: InterOPERA project

Philipp Ruffing

Head of Offshore System Design |
Amprion



InterOPERA

Enabling interoperability of multi-vendor high-voltage direct current (HVDC) grids

Philipp Ruffing | Amprion | Offshore System Design

InterOPERA | WP5 Leader

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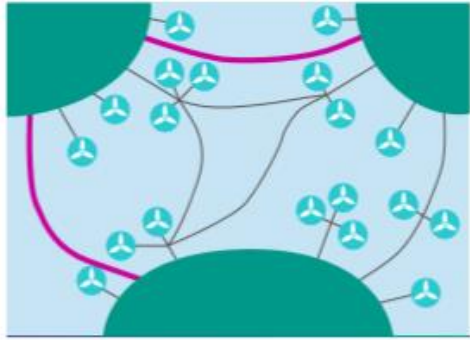


Context

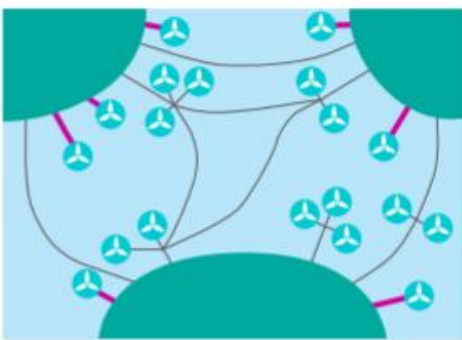
interopera.eu

HVDC offshore grid development

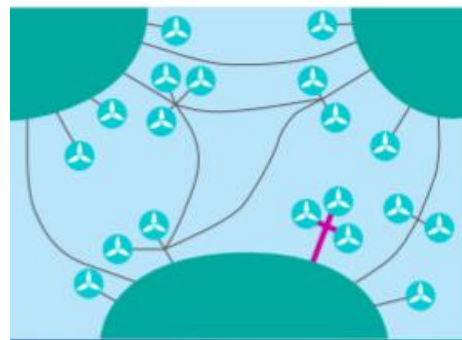
From **TODAY** point-to-point (*single purpose*) to **TOMORROW** hybrid and multiterminal (*multi-purpose*)



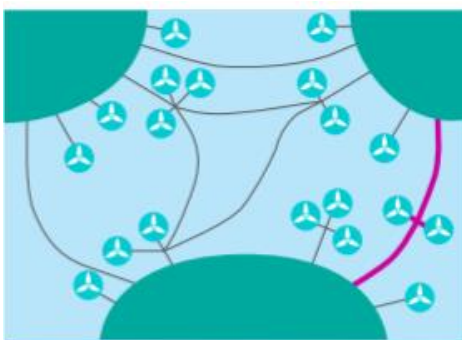
i) Point-to-point IC



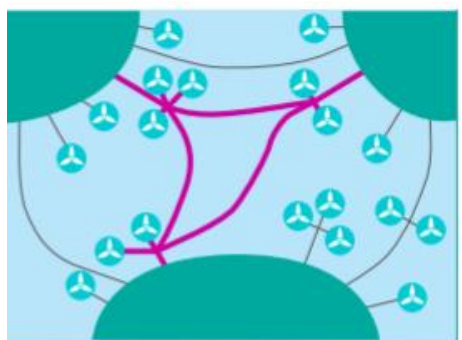
ii) Radial offshore park-to-shore



iii) Radial hub-to-shore



iv) Hybrid project



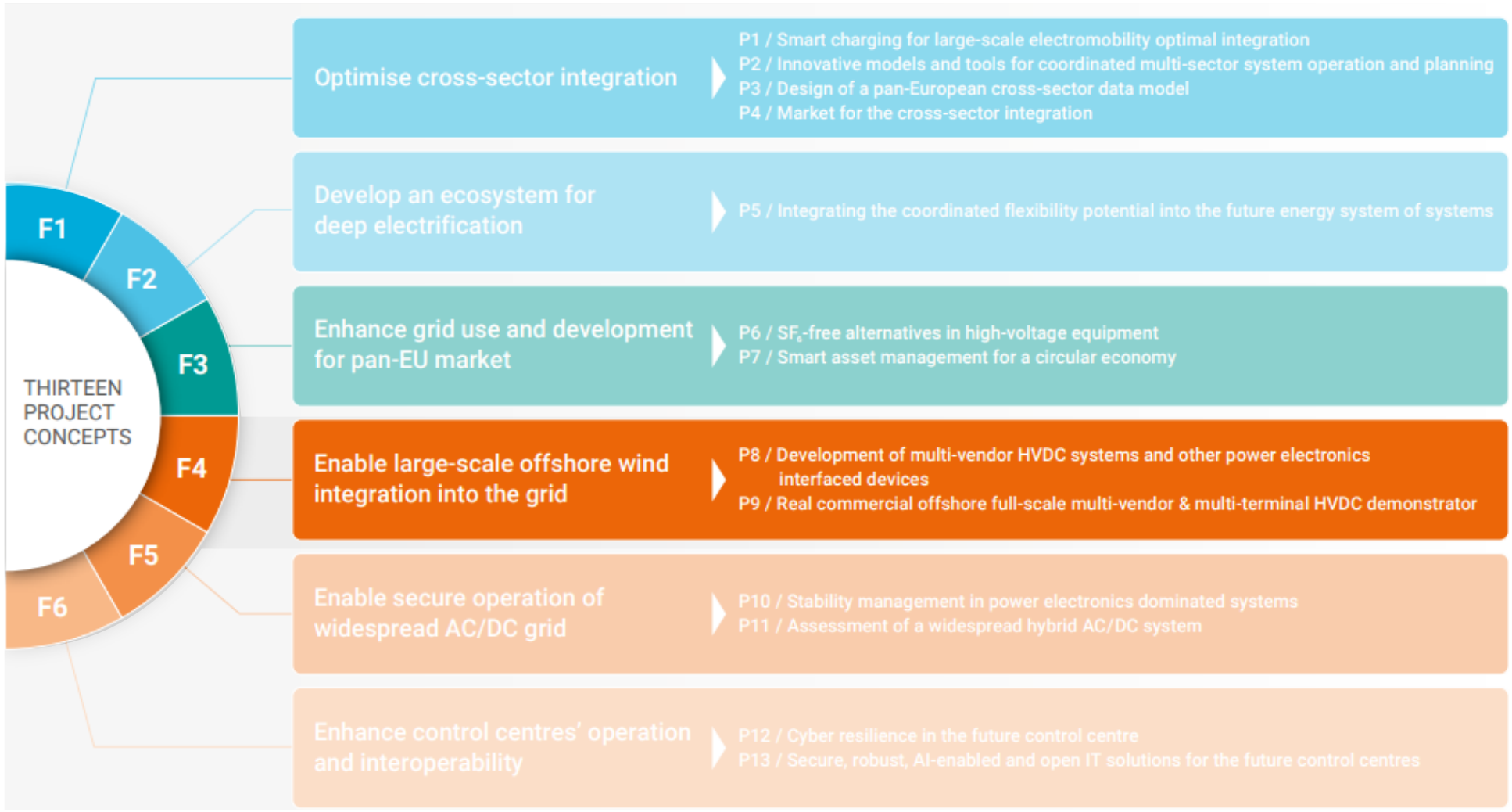
v) Multi-terminal offshore hubs

"Make DC as easy as AC"

Multi-vendor, multi-terminal, multi-purpose HVDC grids

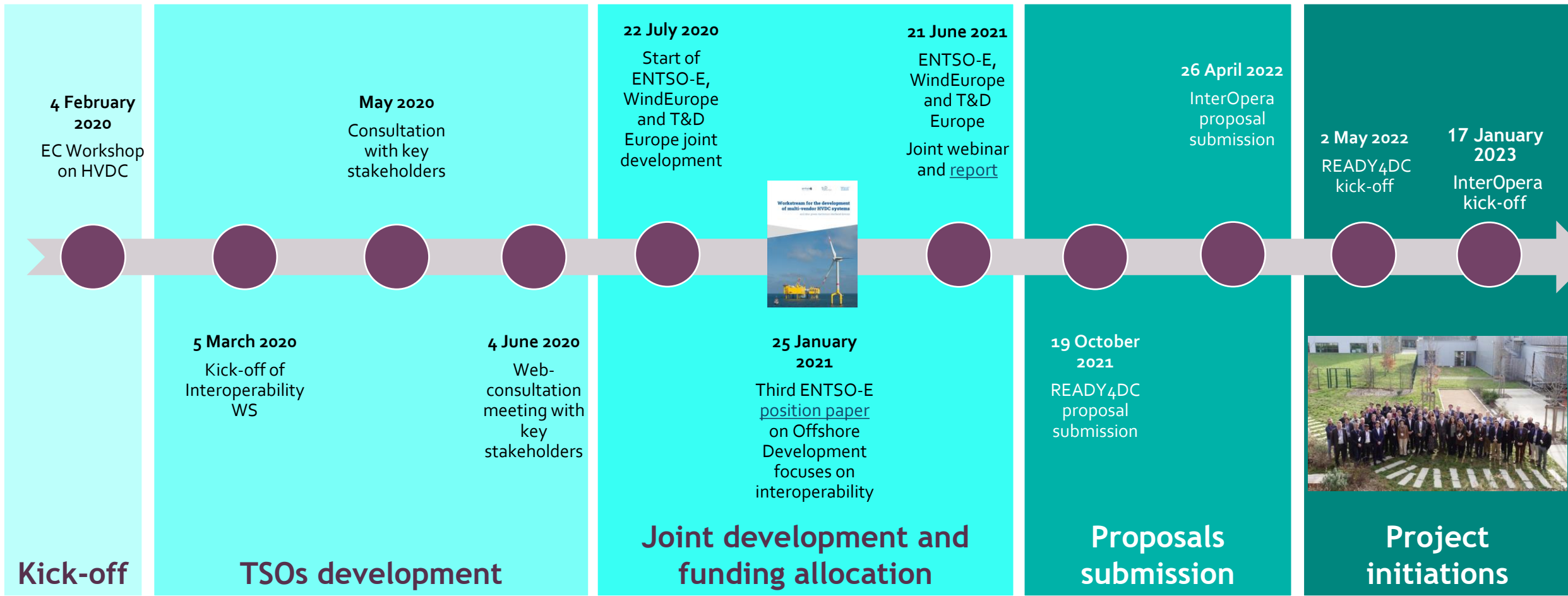
ENTSO-E RDI Implementation Report 2021–2025

Project concepts for delivering the ENTSO-E RDI Roadmap 2020–2030 ([link](#))



Workstream for the development of multi-vendor HVDC systems

Long road of successful collaboration



InterOPERA

interopera.eu

InterOPERA

InterOPERA – Enabling Interoperability of Multi-Vendor HVDC Grids

EU funded Innovation Action // Funding: 55 Mio € // Duration: 4 Years



Pave the way to the first real-life multi-vendor multi-terminal HVDC projects in Europe and to enable the development of the European HVDC grid for offshore wind energy integration

WP1 RTE

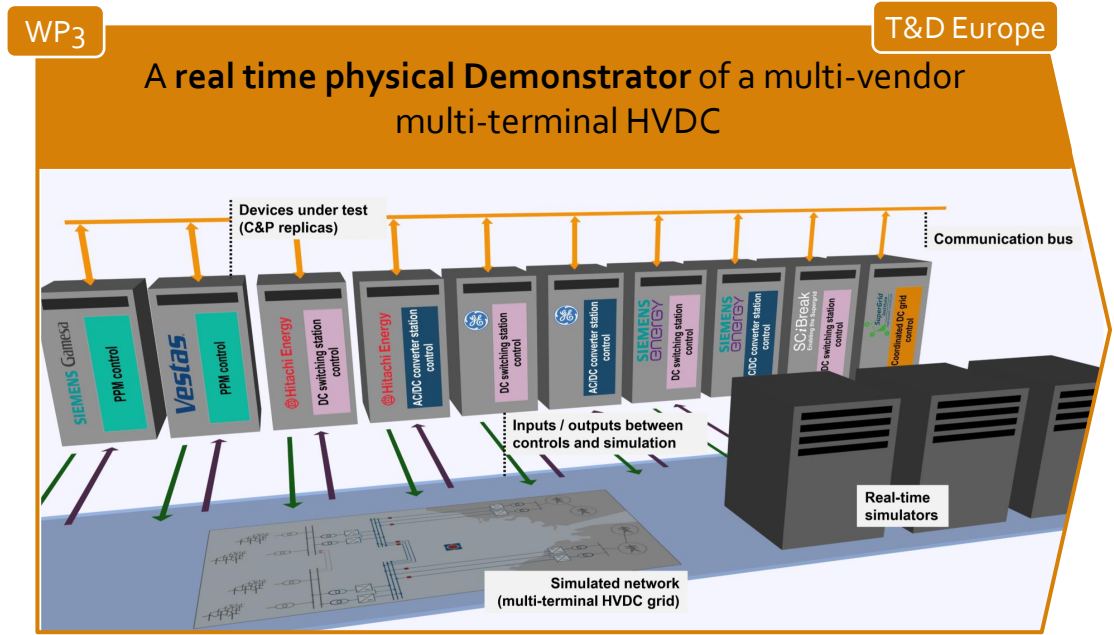
Development of **standardised interaction study processes** and interfaces

WP2 TenneT

Functional, technical integration and validation, and in view of achieving modular and interoperable control and protection systems

WP4 Ørsted

Multi-party cooperation frameworks in view of achieving modular and interoperable systems



WP5 Amprion

Way-opening solutions for multi-vendor HVDC project's preparation and procurement, new pathways to offshore energy and grid development.

WP6 WindEurope

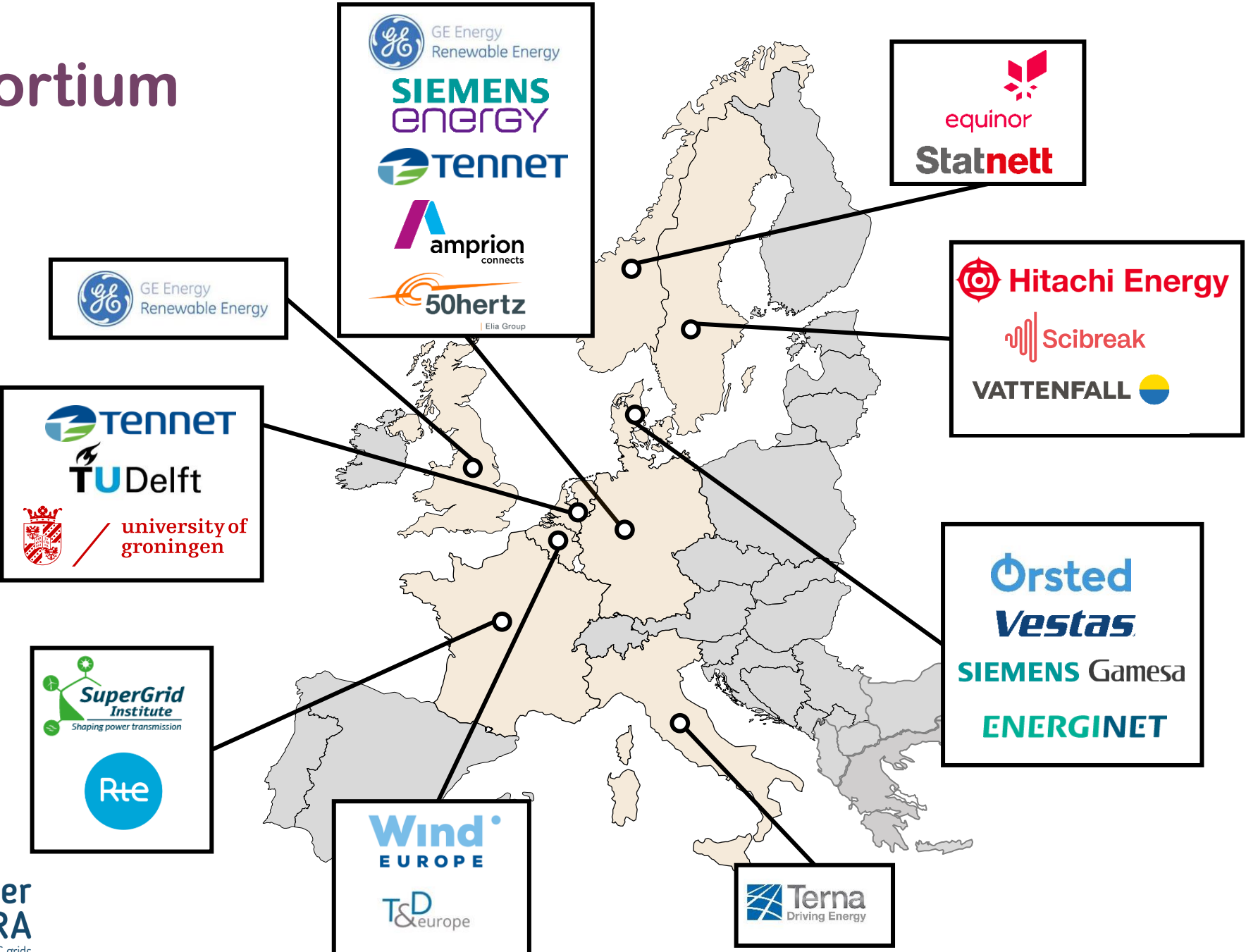
Communication, dissemination and exploitation

WP7 SuperGrid Institute

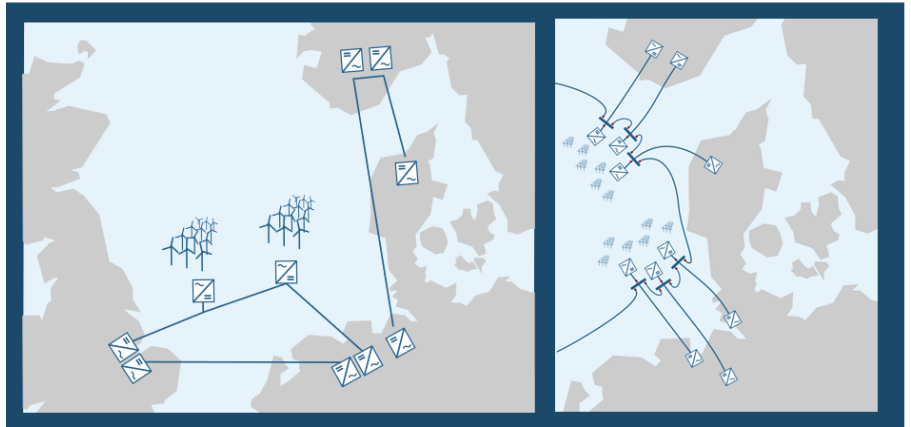
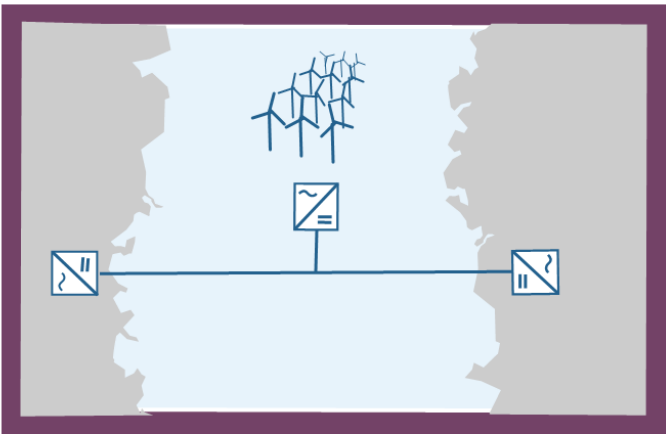
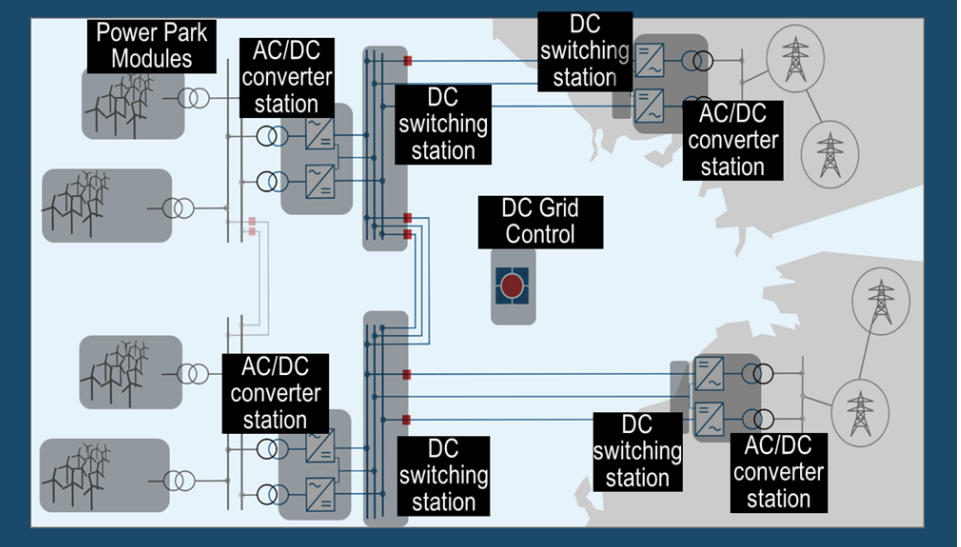
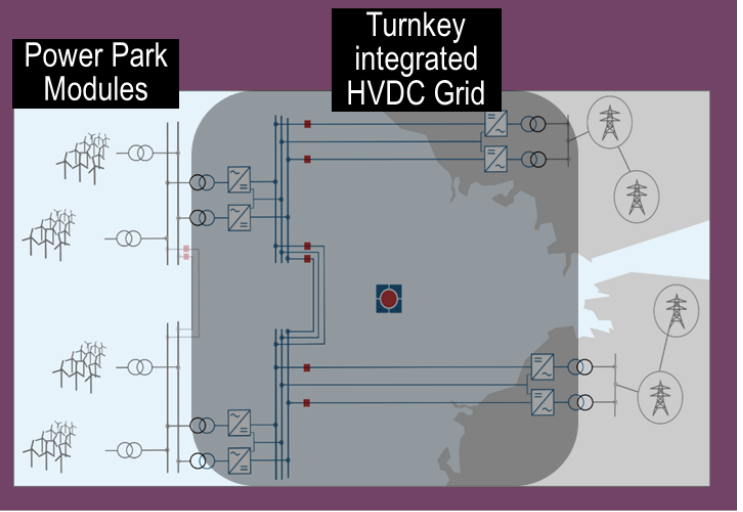
Management and coordination



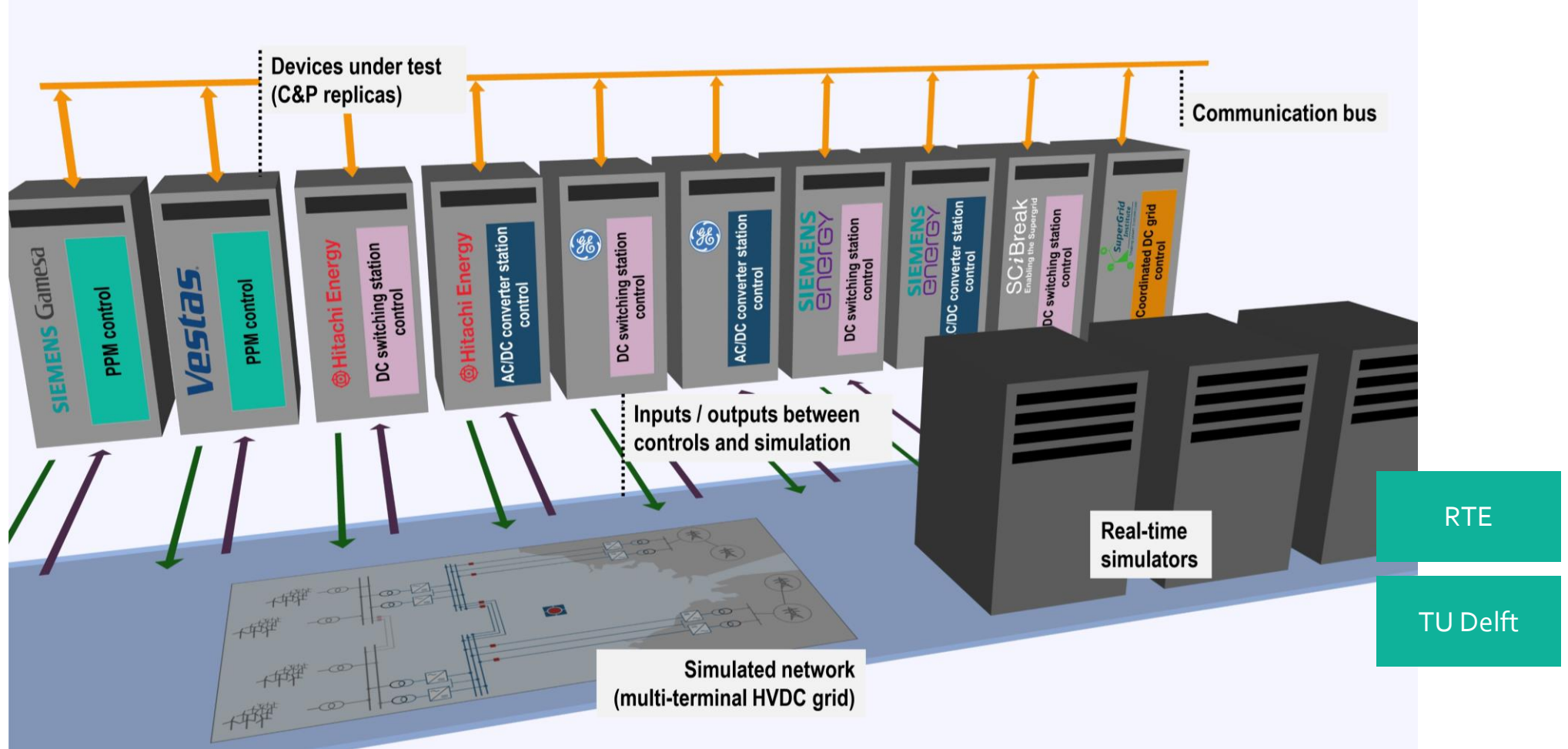
Consortium



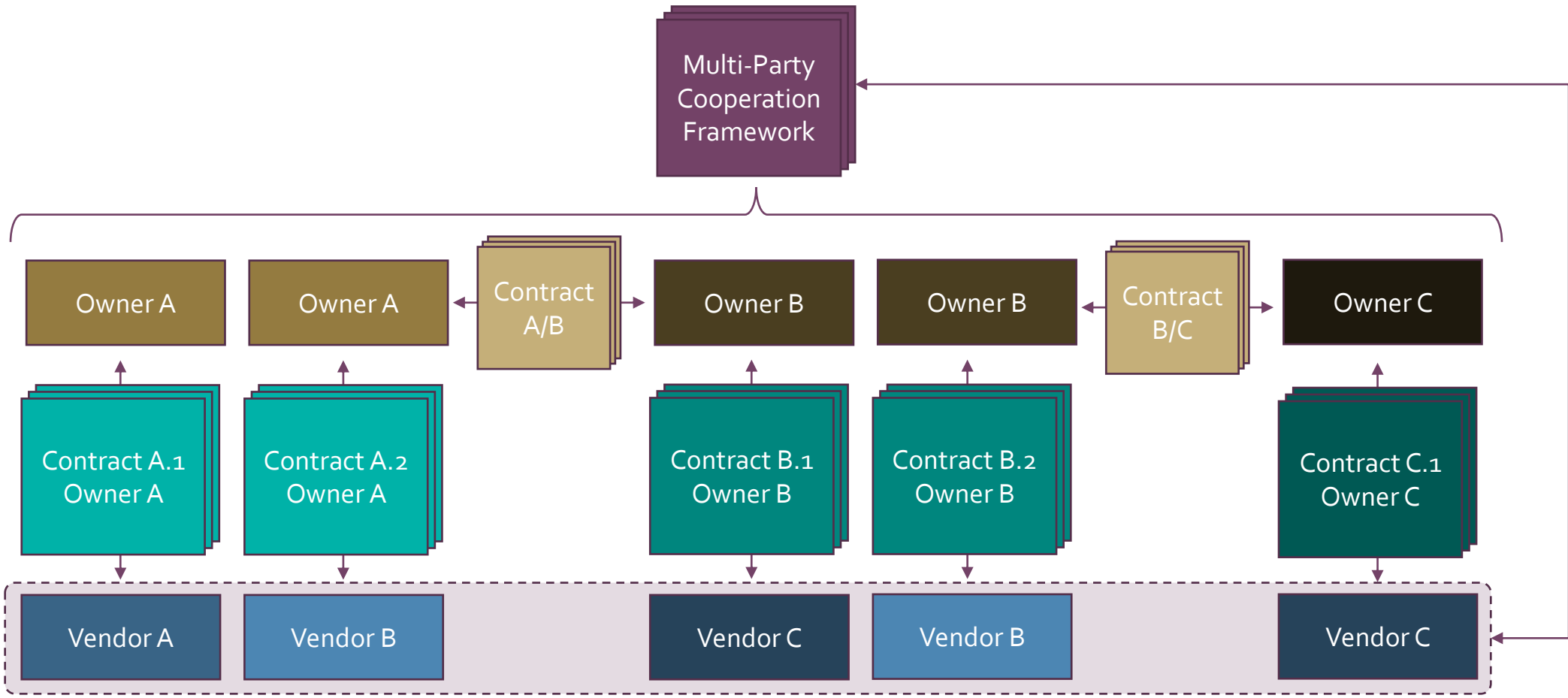
Project objectives



Project objectives



Project objectives



InterOPERA and other R&D projects, Standards Agencies

InterOPERA will utilise lessons learned from former R&D projects and practical experience in Europe



PROMOTION
PROGRESS ON MESHED HVDC
OFFSHORE TRANSMISSION
NETWORKS

Johan Sverdrup project



ABOUT INTEROPERA

The InterOPERA project will define technical frameworks and standards for electricity transmission and accelerate the integration of renewable energy. Ensuring that HVDC systems, HVDC transmission systems or HVDC components from different suppliers can work together – making them “interoperable” - is a top priority to accelerate Europe’s energy transition.

Thank you



Co-funded by
the European Union

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PROJECT DETAILS:

Duration: 1 January 2023 – 30 April 2027
Grant agreement: 101095874

interopera.eu

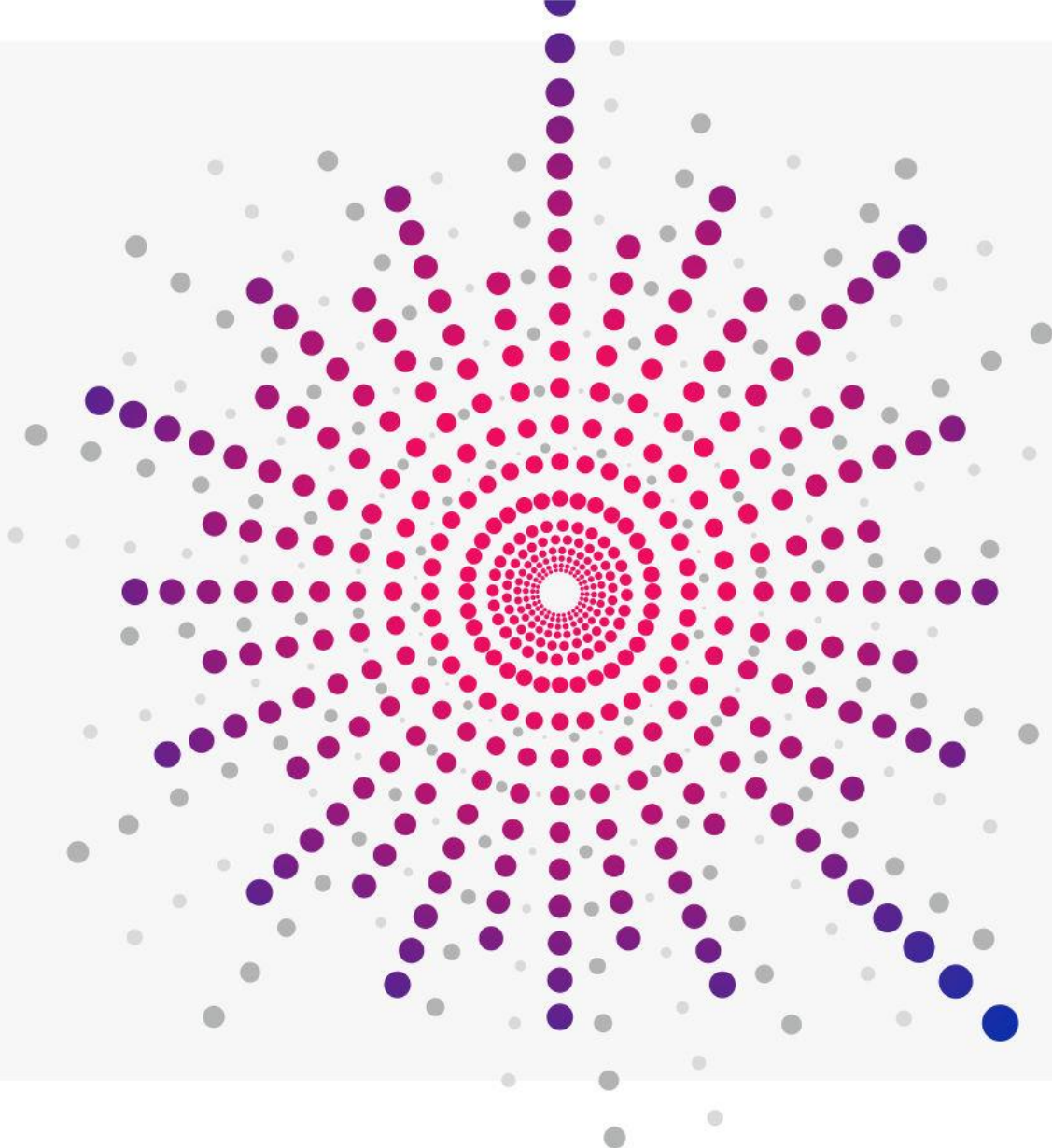
RDI Monitoring Report 2022

TSO experiences 3: BD4NRG project

Mitja Antončič

Senior Data Analyst |
ELES





**BD4
NRG**
Big Data for Next
Generation Energy

BD4NRG to ENTSO-E

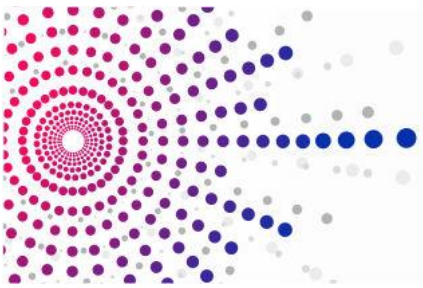
120 innovation projects & beyond

Mitja Antončič, LSP2 leader
ELES d.o.o, Slovenia



26/06/2023





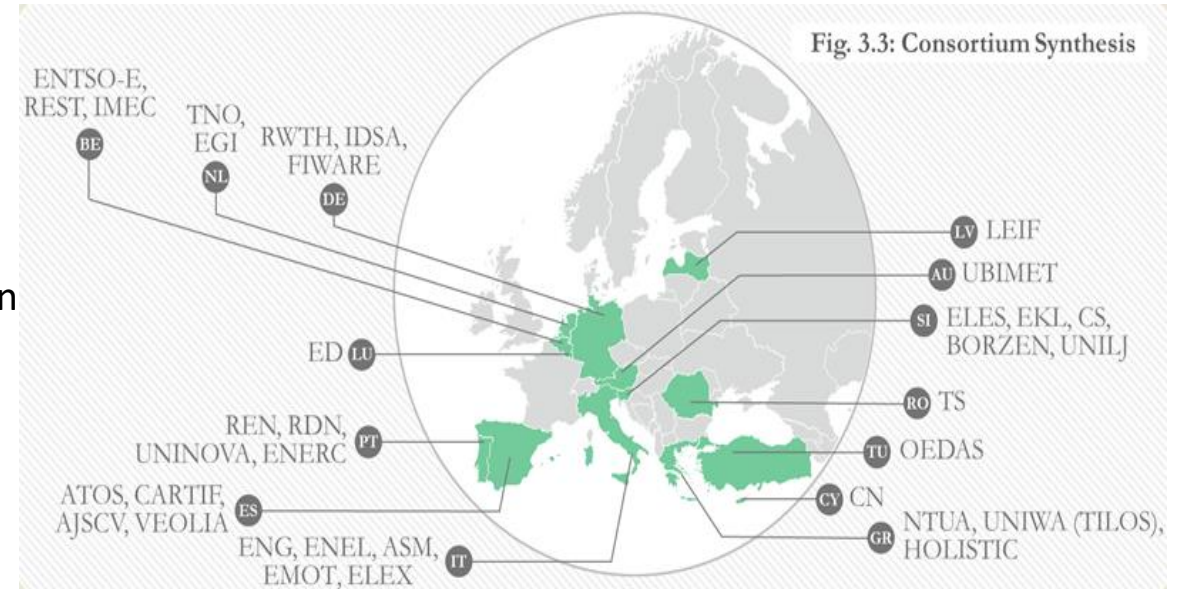
BD4NRG project

www.bd4nrg.eu

**BD4
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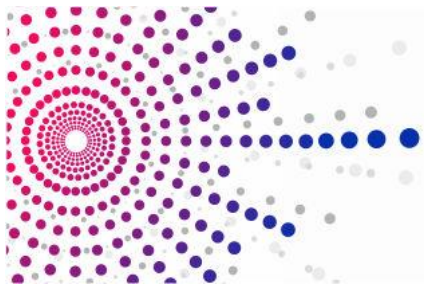
Project Identity card

- Call -> H2020-DT-2019- / DT-ICT-11-2019 IA
- Starting Date: 1st January 2021 – Duration: 36 months
- Total Costs: 11.883.025 Euro - EU contribution: 9.996.700 Euro
- **35 partners from 11 Countries** covering the whole energy value chain
- **12 Large Scale Pilots**



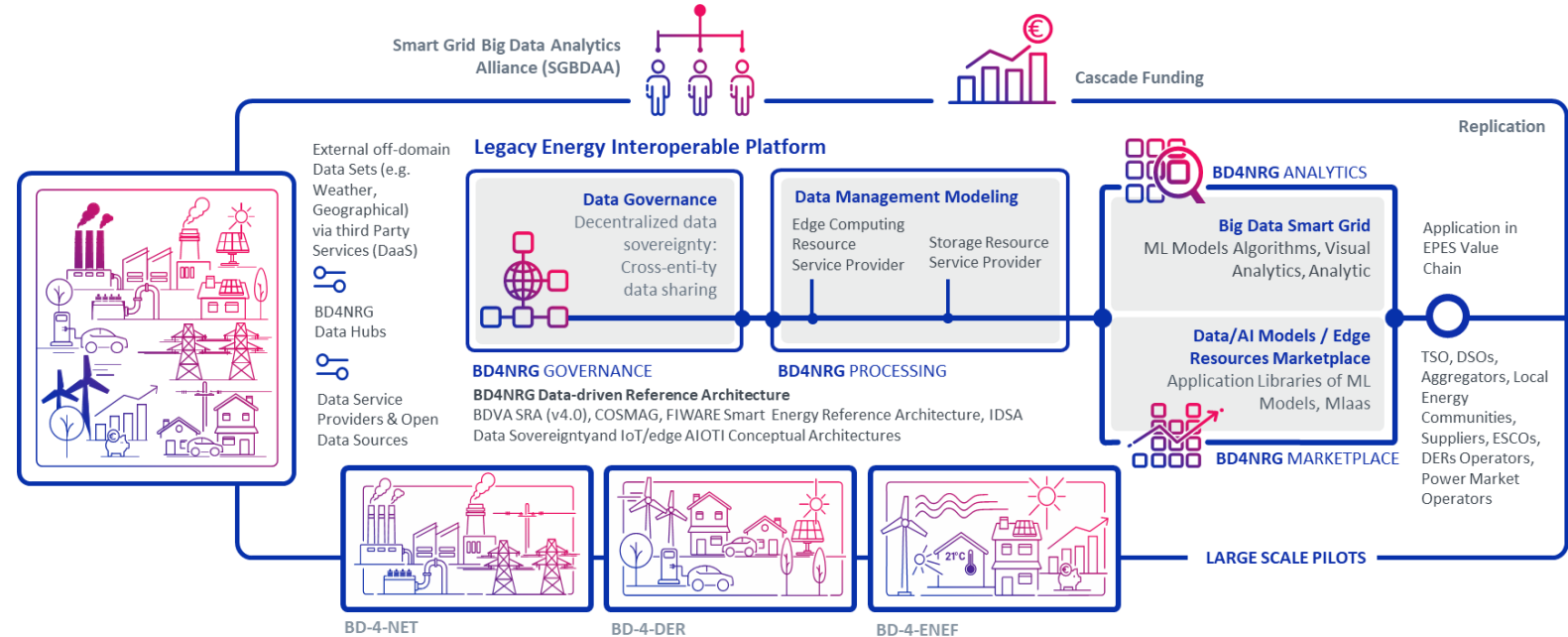
Coordinated by Engineering Ingegneria Informatica

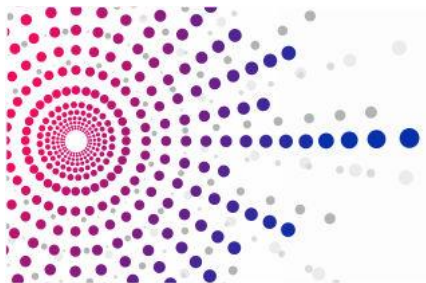




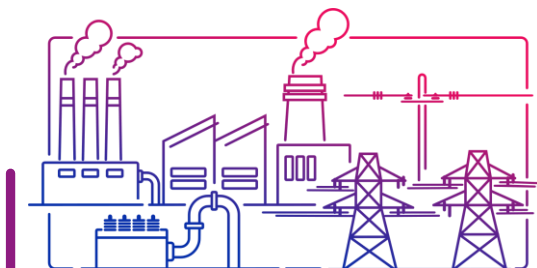
BD4NRG Vision & Goals

- To enable a **consumer-centric electricity-centered energy system**
- Innovative energy-tailored **Big Data Analytics Toolbox (BD4NRG Toolbox)** which will significantly contribute to achieve an optimal techno-economic management of Electric Power and Energy Systems value chain
- Analytics Services** for (i) optimised management of grid and non-grid owned assets; (ii) improved efficiency and reliability of electricity networks operation; (iii) optimal risk assessment for energy efficiency investments planning



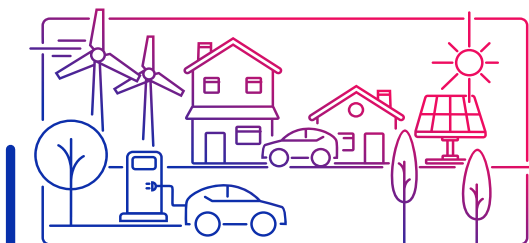


Validation along 12 Large Scale Pilots (LSPs)



BD-4-NET

Predictive Analytics that can forecast and increasing the efficiency and reliability of the electricity network



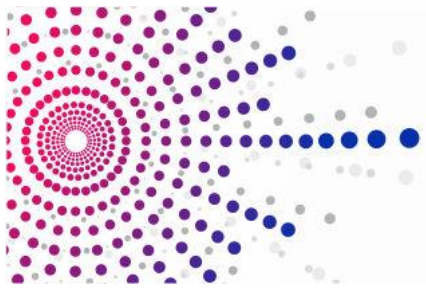
BD-4-DER

Optimizing the management of assets (Distributed Energy Resources – DER) connected to the grid



BD-4- ENEF

Increasing the efficiency and comfort of buildings, and de-risking investments in energy efficiency, as both are interlinked

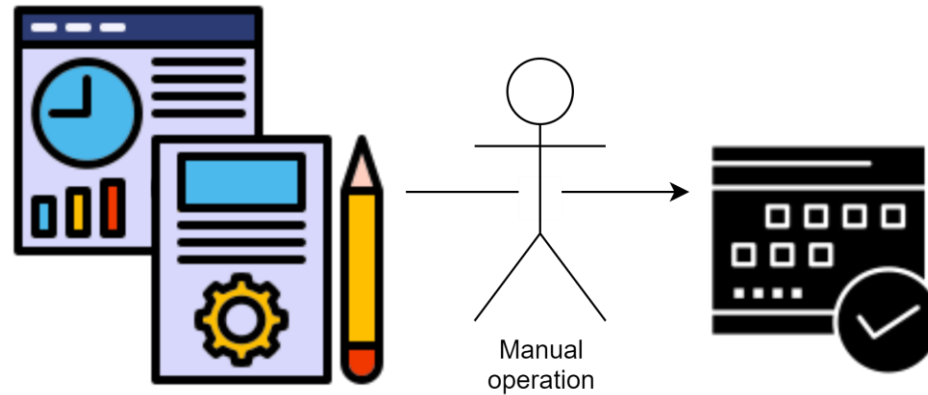


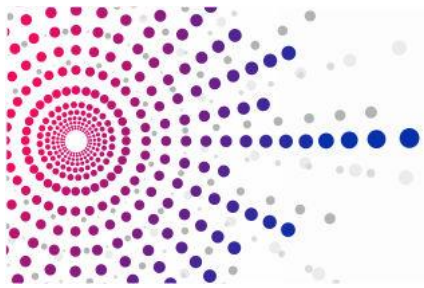
LSP2 (ELES - Slovenia)

Cross-functional Integration of Grid Operation with Predictive Asset Management

Use Case: Maintenance Plan Optimisation

- Resources
- Outage costs





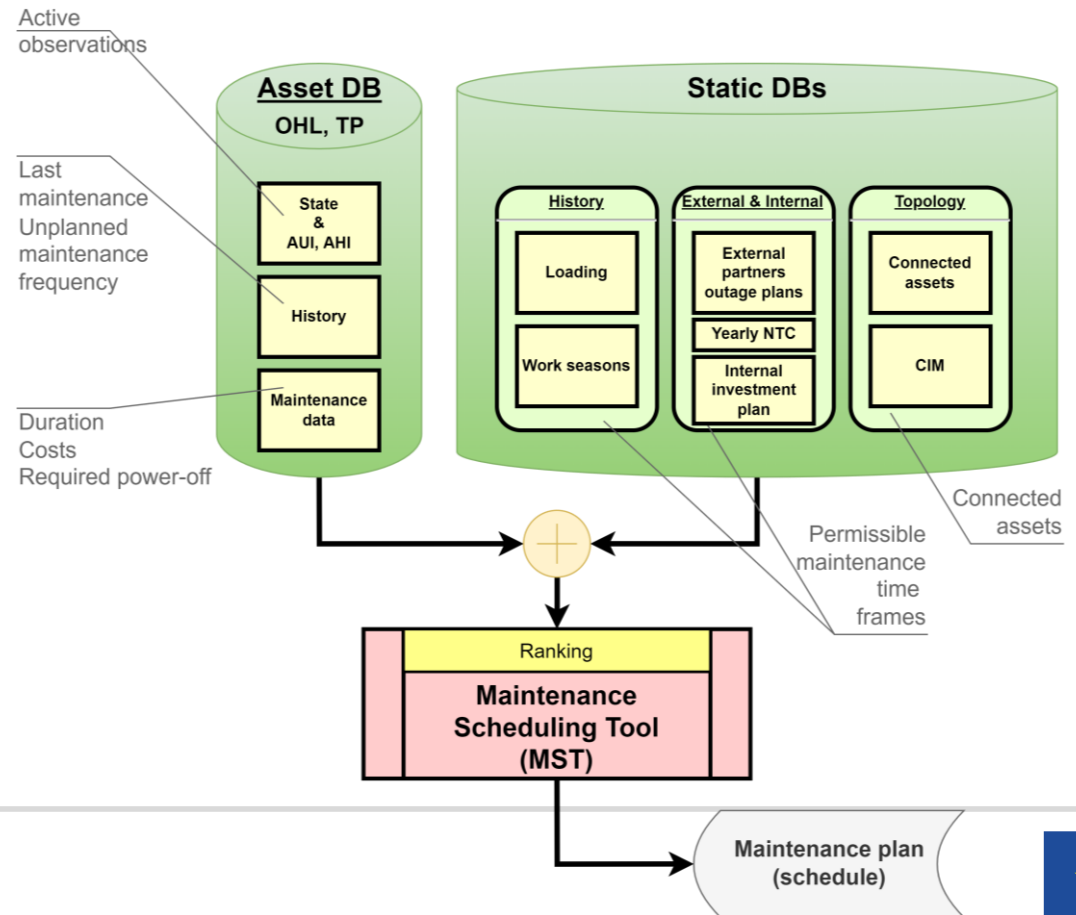
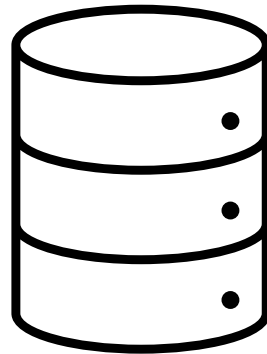
Cross-functional Integration of Grid Operation with Predictive Asset Management

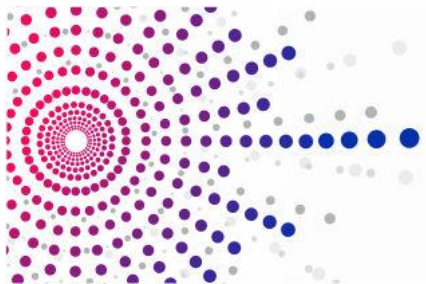
Use Case: Maintenance Plan Optimisation

- Resources
- Outage costs
- Data driven

Infrastructure & Data

- Internal and external **outage requests**
- **Maintenance history** and **intervals**
- **Topological** data
- **Technical** data
- **Inspection** data
- **Diagnostics** data
- **Operational** data
- **Environmental** data

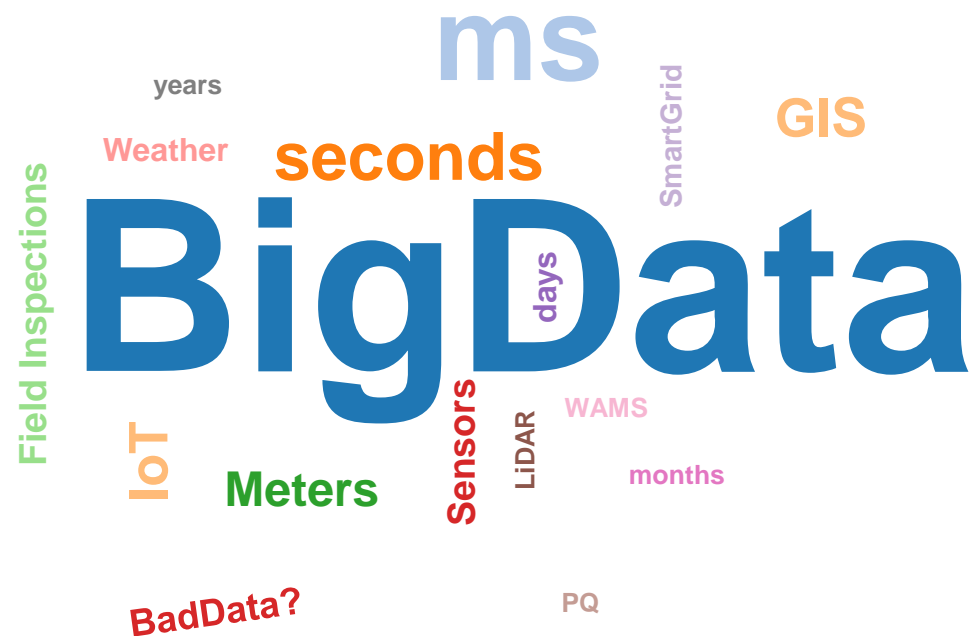


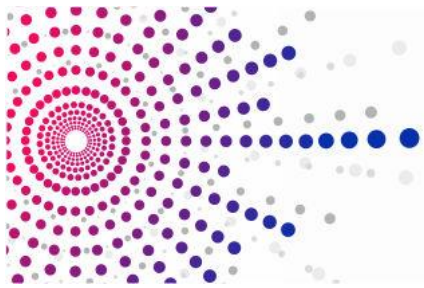


LSP2 (ELES - Slovenia)

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Cross-functional Integration of Grid Operation with Predictive Asset Management





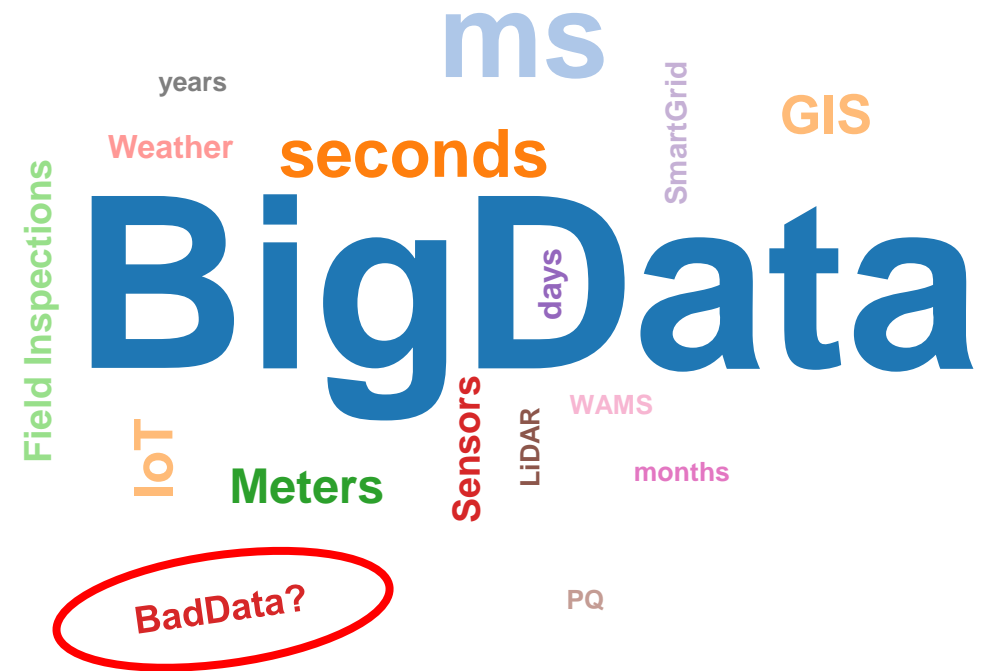
Cross-functional Integration of Grid Operation with Predictive Asset Management

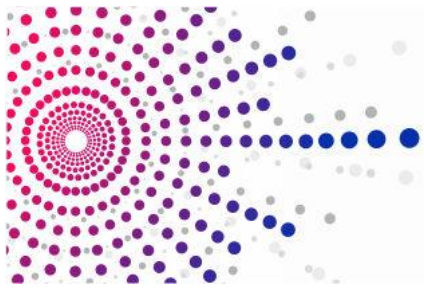
Database improvement:

- Duplicates
- Missing values
- Inconsistent IDs

- Automation

- Imperfect procedures





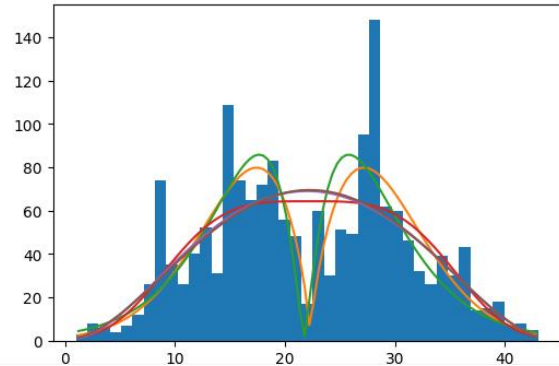
LSP2 (ELES - Slovenia)

Cross-functional Integration of Grid Operation with Predictive Asset Management

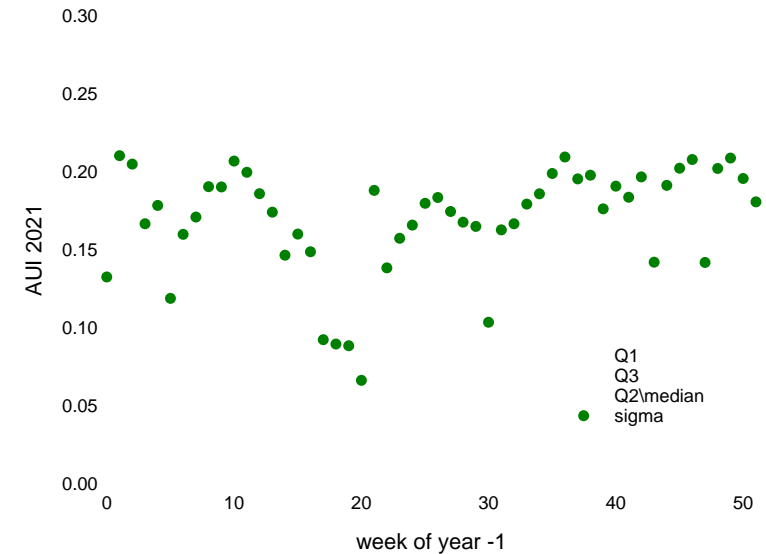
Asset state:

- TR Health Index
- OHL Field Observations Index
- Asset Utilisation Index
- Probability of Failure

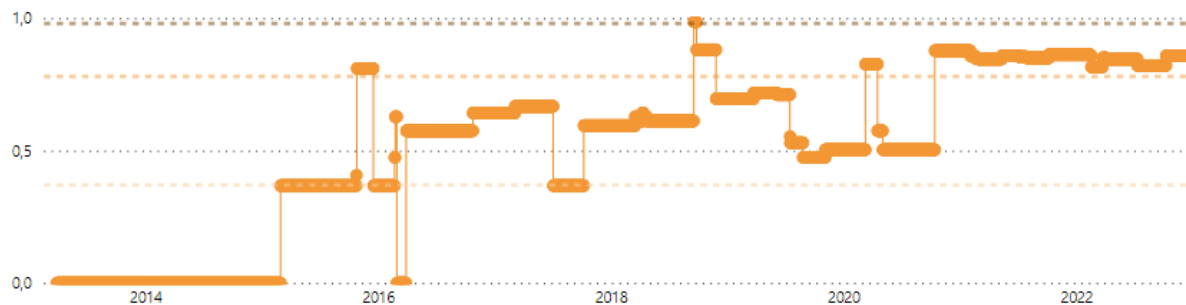
- Environmental factors



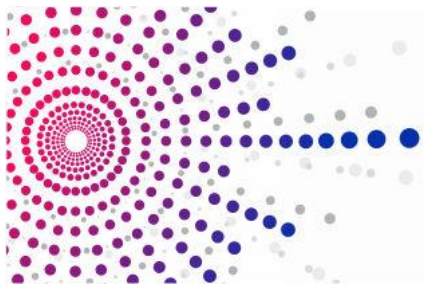
Asset removal count over their age and PDFs



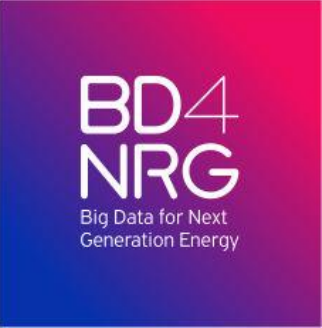
Asset utilisation index over time



OHL field observations index over time



LSP2 (ELES - Slovenia)

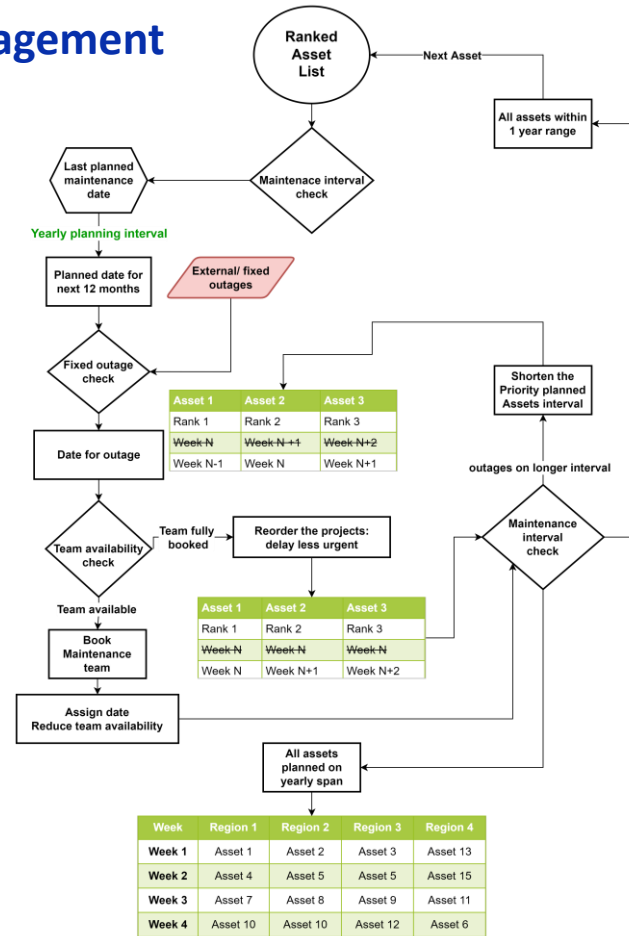


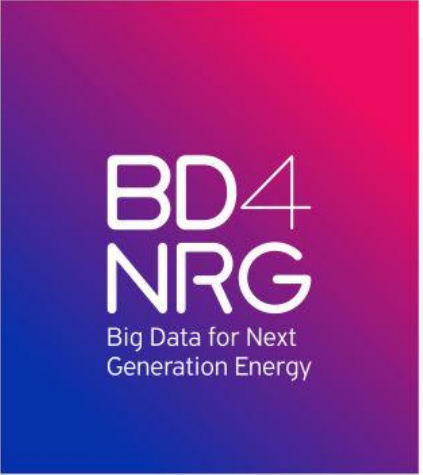
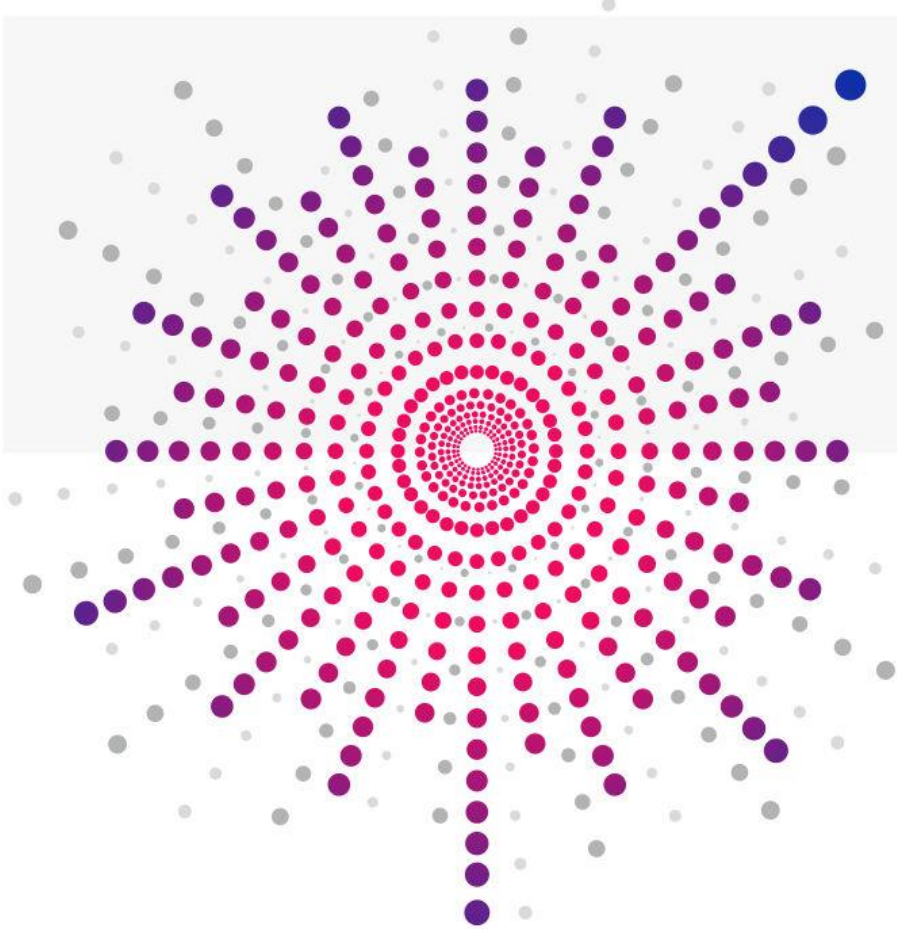
Cross-functional Integration of Grid Operation with Predictive Asset Management

Outcomes:

- Improved Databases
- Developed Asset Indices
 - Maintenance
 - Asset comparison
- Maintenance Scheduling Tool
 - Data driven
 - TBM->CBM
 - Benchmarking






Index	0	1	2	3	4	5	6	7
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Thank you!

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- 



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Questions |
Answers



RDI Monitoring Report 2022

Concluding remarks

Uroš Salobir

Vice-Chairman |
ENTSO-E RDI Committee

