ETIP Wind

EUROPEAN TECHNOLOGY & INNOVATION PLATFORM ON **WIND ENERGY**

Technology roadmap

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Technology Roadmap

Table of content (indicative)

1. Introduction
2. Wind in the energy transition – what are the scenarios
3. R&I impact and policy context
4. Rationale for the roadmap – in relation to SRIA
5. How does it compare to older / other roadmaps
6. Content per pillar
7. Implementation

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Pillars and priorities

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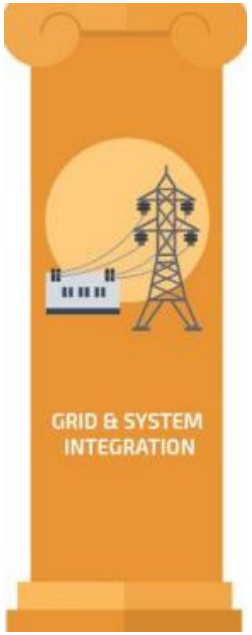
Grid & system integration



Challenge: Demonstrating adaptability of wind

- Demonstration of system services.
- Empower TSO/DOS to match wind power production and consumption
- Increase accuracy in communication and forecasting of demand.
- Increase flexibility in power production/dispatch.

	Short term	Medium term	Long term
High criticality	Integrated forecasting of power production and power demand Storage (Wind + battery) (e.g. for power firming)	seasonal storage Phase II (Wind + P2X) Sustainable hybrid solutions (Solar PV, other RES?)	/
Medium criticality	seasonal storage phase I (Wind + P2X)	System services: flexibility, black start, VAR support…	/
Low criticality	Power quality Low & high wind speed combined wind farm concepts	/	/

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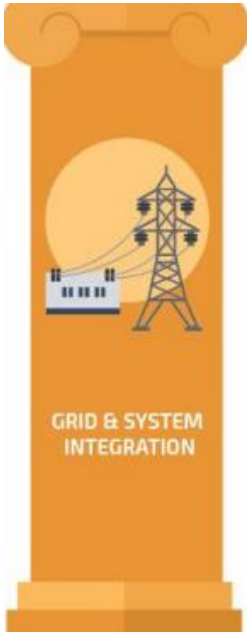
Grid & system integration



Challenge: Towards a system fit for RES

- Grid structure and operating principles/models.
- Grid technology HVDC/MVDC and HVAC/MVAC.

	Short term	Medium term	Long term
High criticality	Synergies with other RES	Optimising the utilisation of the current grid infrastructure (inflexibility)	Stable system with 100% RES
Medium criticality	/	Cost-efficient offshore transmission and electrical infrastructure	/
Low criticality	System modelling	/	/

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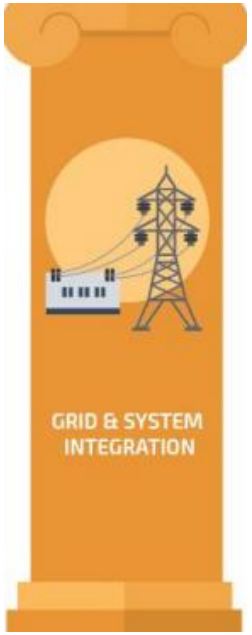
Grid & system integration



Non technical barriers

- EU wide long term energy policy on EU and national levels
- Harmonisation of regulation across the EU
- Sector coupling (electrification) to improve demand side management
- PPA's
- Planning of grid infrastructure

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Operations & maintenance

Challenge: optimising operations

- Improve forecasting of environmental conditions.
- Enhanced control (wind farm<>wind turbine).
- Improved understanding of the asset.

	Short term	Medium term	Long term
High criticality	Lifetime assessment and condition monitoring (wear & tear of materials)	Digital solutions for smart operations	/
	Digital tools for control and monitoring	Prediction of environmental parameters (including climate change effects)	
Medium criticality	/	Solutions for operating in extreme environment (e.g. icing)	/
Low criticality	/	/	/

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Operations & maintenance

Challenge: Increasing energetic availability

- Limit human intervention.
- End of life decisions.
- Logistics and installation.

	Short term	Medium term	Long term
High criticality	/	Dynamic cables repair solutions	Floating installation methods for Offshore
Medium criticality	Electronic inspection methods (drones, rope robotics, AUVs)	Decommissioning technology	/
Low criticality	Site accessibility	/	/

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Operations & maintenance

Non technical barriers

- Harmonisation of end of life & HSE
- Loosen up and reasonability of permitting rules and adaptation of new research results
- Transportation rules
- Education of general public on wind energy
- Cumulative environmental impact assessment

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Next generation technologies

Challenge: cost competitiveness of EU Wind industry

- Keeping wind cost competitive vs other power generation in EU.
- Support position of EU companies on the global market.
- Retain long term technology leadership of EU industry.

	Short term	Medium term	Long term
High criticality	Development and validation of new components and materials (weight reduction, strength, flexibility, corrosion, erosion, recyclable)	Standards Manufacturing processes	/
Medium criticality	New transportation methods for large components.	Sensor technologies, diagnostics & response Reliability of components (reduce downtime)	Disruptive technologies
Low criticality	/	/	Next generation generators.

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Next generation technologies

Challenge: A 100% sustainable wind energy sector

- Facilitate the integration of larges shares of wind energy in the natural and social environment.
- Develop sustainable/circular wind energy supply chain and economy.

	Short term	Medium term	Long term
High criticality	Integrate wind energy in the surrounding natural and social environment. Blade recycling demonstration	Development of sustainable materials.	Recycling methods for materials and components.
Medium criticality	/	Noise reduction Industry transparency	/
Low criticality	/	/	/

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Next generation technologies

Non technical barriers

- Recycling of components and materials
- Existing IEC standards

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Offshore balance of plant

Challenge: Common methodology for integrated offshore wind farm design and development

- Development of engineering design *tools* (for all components & aspects)
- Common procedure for validation and availability of data architecture
- Optimisation loop for integrating multidisciplinary design *tools*

	Short term	Medium term	Long term
High criticality	/	• Common procedures & standardisation for model validation	/
Medium criticality	• Map out and harmonise design process parameters and models • Data availability and sharing	• Synergistic development of design tools	• Industry wide methodologies standards
Low criticality	/	/	• Creating innovative pathways for model design

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Offshore balance of plant

Challenge: Installing large offshore volumes

- Studies & analysis of innovative substructure design (incl. modularisation decommission and environmental aspects, economic viability, cross-over with bottom fixed)
- Integrated design process
- Standardisation

	Short term	Medium term	Long term
High criticality	• Site conditions • Cabling and connection	• Installation procedures and logistics (including port infrastructure)	• Cross-industry agreement and standards • Integrated optimised design plan
Medium criticality	• Floating/gravity based concepts	• Serial production – analysis of substructure production processes	/
Low criticality	/	• New concepts for shallow waters	• Lifetime of support structures (repurpose of offshore monopoles) • Supply chain logistics - decommissioning

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Offshore balance of plant

Non technical barriers

- Standards are not harmonised (eg paint, aviation lights, HS, maintenance)

Collaboration with WindEurope WG offshore Wind

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Floating Offshore Wind

Challenge: Serial production

- Scalability (tower, main flange, aero-hydrodynamics, integrated capabilities)
- Design tools (validation & model testing, control panel, probabilistic design)
- Concept development (extending the library)

	Short term	Medium term	Long term
High criticality	Validation of Design tools	Concept development suited to scalability	/
Medium criticality	/	Integrated design process in supply chain	/
Low criticality	/	/	Extending the library

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Floating Offshore Wind

Challenge: Floating wind farms

- Mooring, anchoring and cables.
- Park level control.
- Park footprint.

	Short term	Medium term	Long term
High criticality	Mooring & anchors dynamic electric cables. Control methods	/	/
Medium criticality	/	Park footprint	Park level control
Low criticality	/	Floating to floating installation & assembly	/

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Floating Offshore Wind

Regulatory barriers

Collaboration with TF Floating Wind

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Human resources

Challenge: Attracting & ret(r)aining talent in Europe

- Make attracting talent part of EU-funded projects.
- Development of a strategic approach to organising educational programmes.
- Share best practices for modularised continued education

	Short term	Medium term	Long term
High criticality	/	Developing a strategic wind programme (master & phd)	Retraining existing wind force
			Secure a number (tbc) of students move into industry (local & global)
Medium criticality	/	Develop specific skillsets	Generating knowledge across topics (energy mechanics, electrical engineering)
		Joint academia-industry educational programmes	
Low criticality	/	/	/

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Visualisation of the priorities (indicative)

Technology Roadmap

PILLAR NAME

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Non technical barriers

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Challenge 1

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Challenge 2

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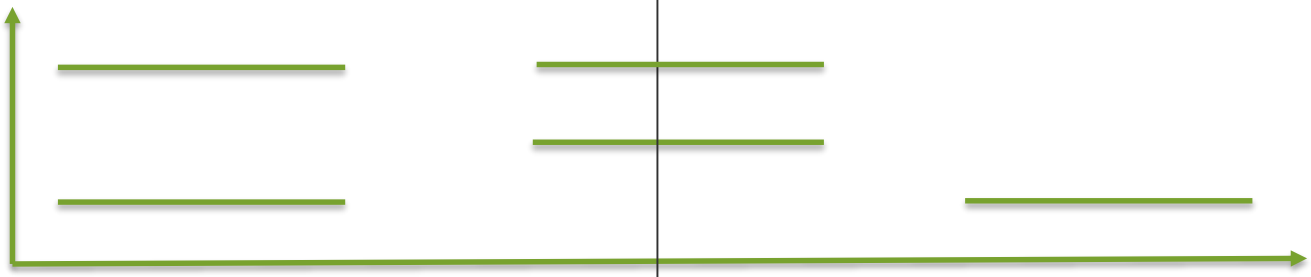

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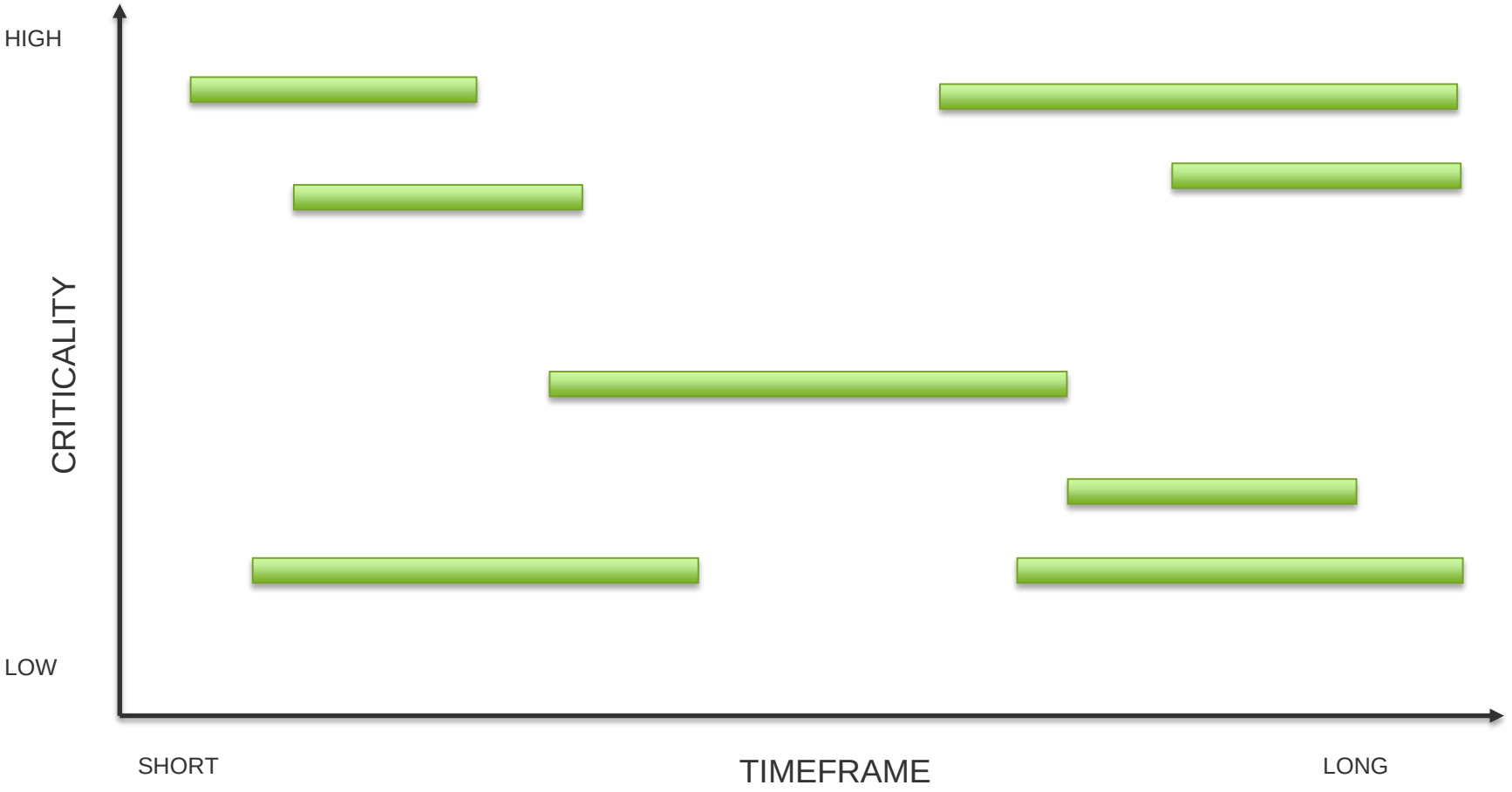

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Help required	TITLE	TIMING Short/medium/long	CRITICALITY Low/medium/high

DESCRIPTION OF THE PRIORITY

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MILESTONES

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Help required

IMPACT CRITERIUM 1	IMPACT CRITERIUM 2	IMPACT CRITERIUM 3	FUNDING More private/more public	WHO LEADS Industry/academia/other

Technology Roadmap - example

Disruptive technologies	Long term	Low

DESCRIPTION OF THE PRIORITY

The wind energy sector is continuously looking to develop more efficient and cost effective systems that harvest wind energy sector. Researching out of the box technical solutions in rotors, generators and even the entire wind turbine concept should be a continuous. Whilst research in this field will not lead to immediate cost reductions, their long term benefits are undeniable.

Identifying the winning technologies of the future today is extremely difficult but we following technologies deserve particular attention:

- New bearings
- Superconducting generators
- Airborne wind systems

MILESTONES

10 peer reviewed papers on radical wind energy innovations

3 prototypes developed

1 commercial pilot project

COST REDUCTION	GRID INTEGRATION	EU LEADERSHIP	FUNDING	WHO LEADS
				

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