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SRA

WG 2 Wind Power Systems

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(Chairman WG 2)

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TPWind Workshop

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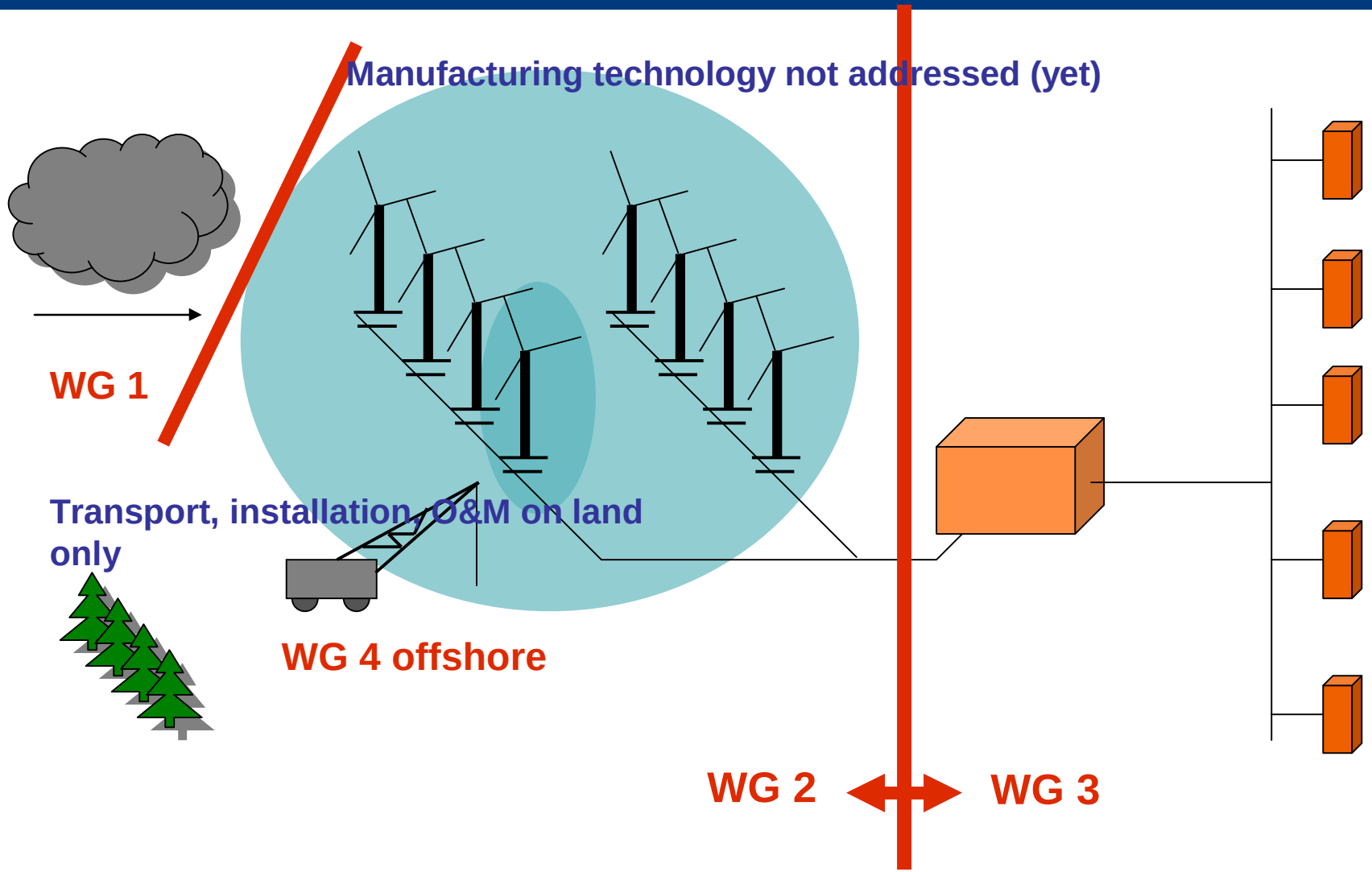
System boundaries WG 2



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Objective WG 2

Meeting the challenge of both maximising **reliability** and realising **technology break through** for meeting the ambitious wind energy objectives by the European industry

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Evolution & innovation (revolution)

Reaching EU targets has enormous consequences for sector in terms of:

- Manufacturing capacity (up to 20 GW/year): 4 turbine/hour & 12 blades/hour & 50 switches/hour & several 100 sensors/hour, etc.
- Availability of resources (people, concrete, steel, copper etc.)
- Reliability
- Grid connection speed
- Development of sites

To meet targets we need to realise the consequences for manufacturing, reliability, innovations.

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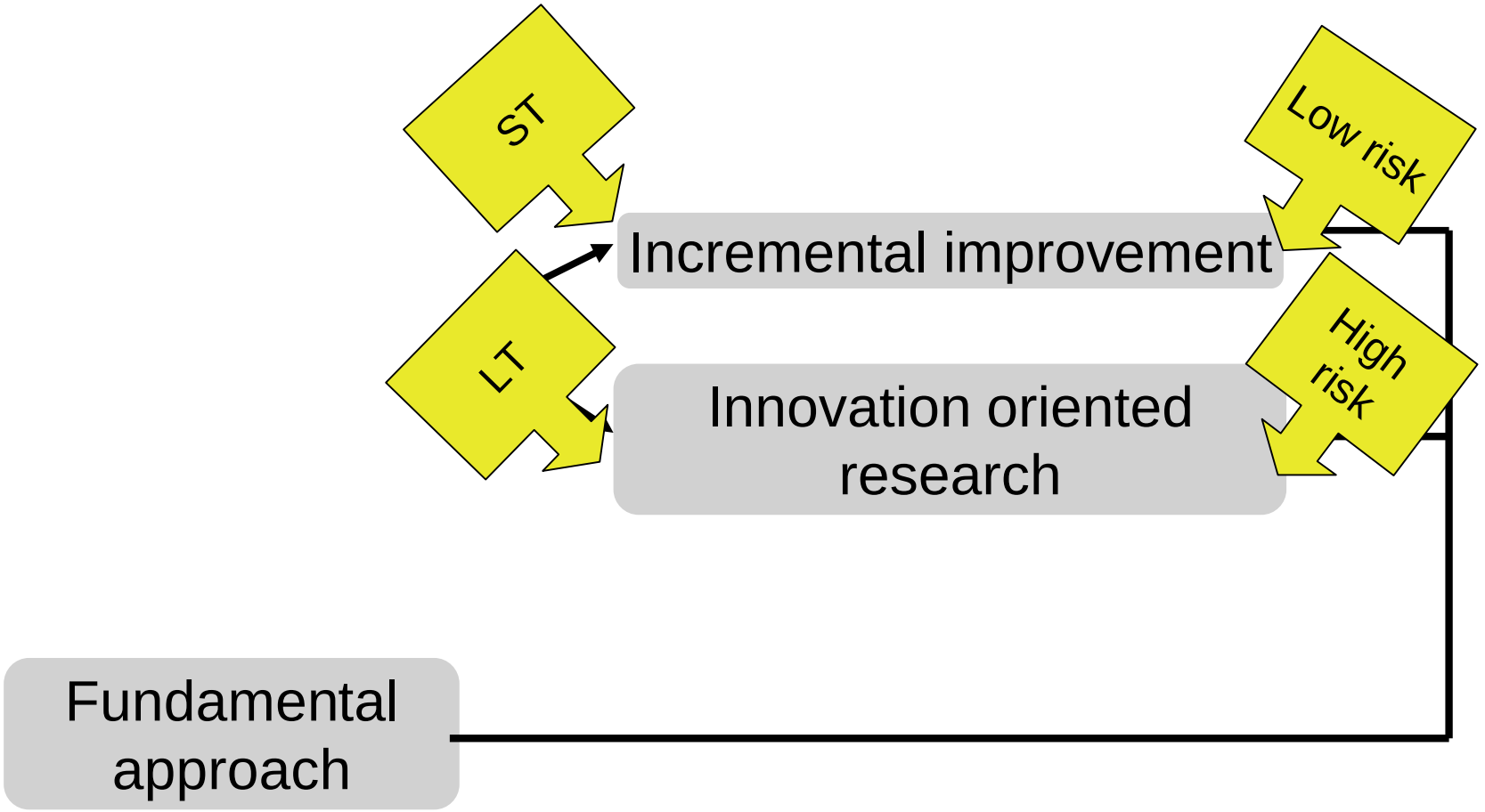
R&D



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Impact: cost of energy + more

$$COE = \frac{(FCR \times ICC) + AOE}{AEP_{Net}}$$

COE	=	Levelized Cost of Energy (DKK/kWh)
ICC	=	Initial Capital Cost of project (DKK)
AEP_{Net}	=	Net Annual Energy Production (kWh/yr)
FCR	=	Fixed Charge Rate (1/yr)
AOE	=	Annual Operating Expenses (O&M, replacement, land)

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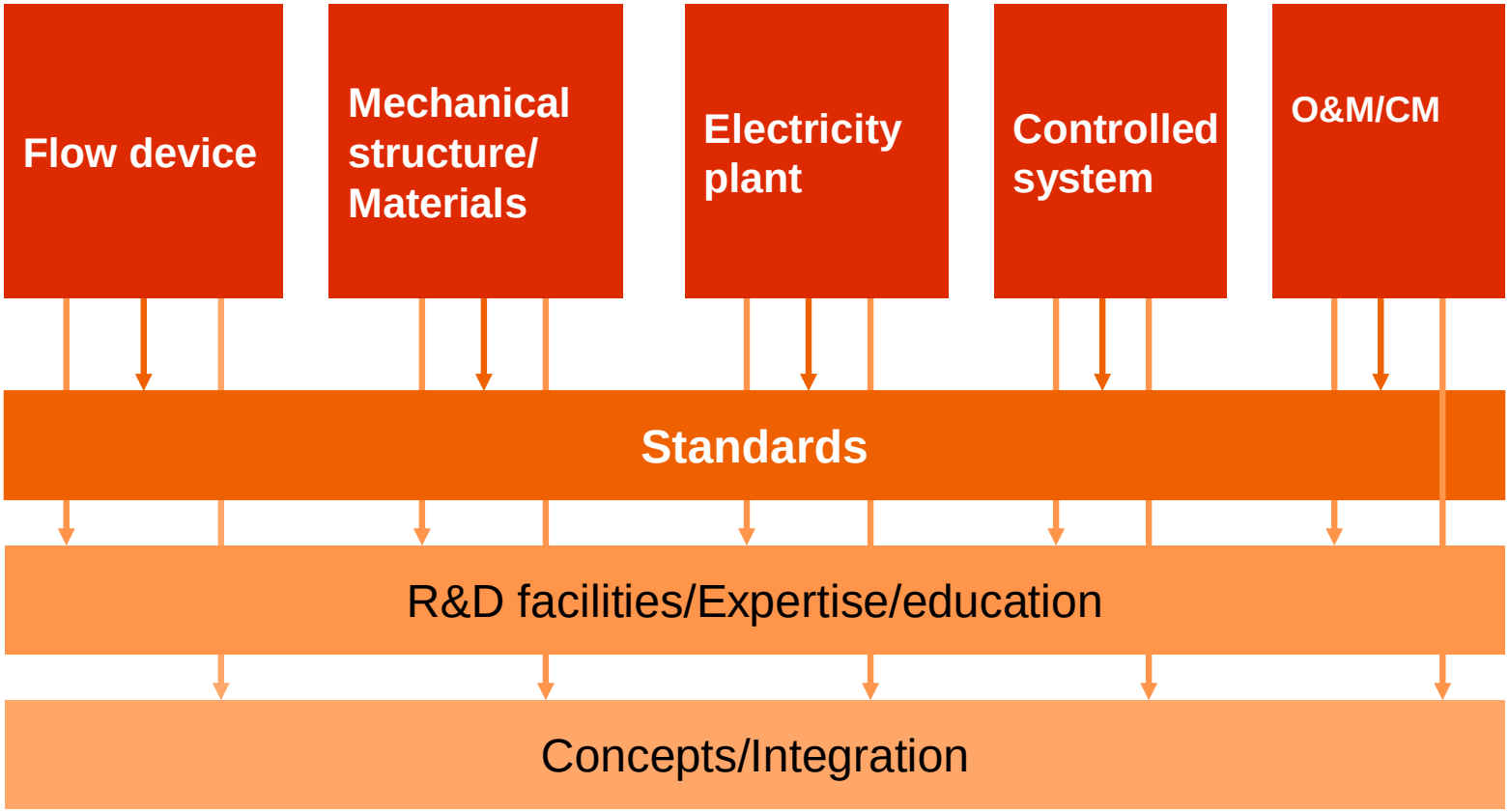
Structuring R&D into priority areas

Consider a wind turbine system as a:



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Flow device

Structuring R&D into priority areas

With the **increasing size** and **complexity** of wind turbines the need develops for:

- A **full understanding of the aerodynamic phenomena**, including external conditions.
- Significant improvement of the corresponding design and analysis tools.

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Structuring R&D into priority areas

Mechanical structure/ materials

- Uncertainties need to be substantially decreased to provide (component) manufacturers with appropriate **specifications for designing and manufacturing**.
- Continued **characterisation** of both existing and new materials to reduce design safety factors and reduce cost.
- Less uncertainties in materials characterisation also requires improved **measuring and evaluation methods**
- **New materials** for many components such as blades and towers.
- Improvement of condition monitoring and system control by **incorporating sensors into the materials**.
- **Recycling** of materials so that the quality of the materials are maintained at **original levels**.

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Structuring R&D into priority areas

Electricity plant

- Improved **high voltage power electronics** to increase efficiency and decrease costs.
- Improved power converters to **maximise system efficiency, controllability and power quality**.
- **Light weighted, low speed and low maintenance generators, possibly including high temperature super conductors** (LT).

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Structuring R&D into priority areas

Controlled system

- Development of **sensors** to realise multi parameter and adaptive control strategies, leading to optimised operation.
- **Continuous control** based on critical parameters, charactersing efficiency, capacity factor, safety, power quality, structural and electric stability, while external conditions and turbine properties may vary.

(Implementing these strategies would guarantee low O&M cost during the specified life time.)

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O&M
CM

Structuring R&D into priority areas

- Improving reliability by improving wind farm management, reliability of wind turbine components, and improve standardisation.
- Minimising O&M by cost applying **preventive maintenance strategies** and tools developed on the basis of low cost and **extremely reliable condition monitoring methods**.

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Concepts Integration

Structuring R&D into priority areas

- Fully integrated methods (Design methods should include all sub design routines such as those for blades, power electronic stems, mechanical transmission, support structures, transport and installation loads, etc. After having been developed they need thorough verification and have to be introduced into the standard design and certification processes.) (ref.: UpWind)
- **New concepts** will arise from innovations in materials and components and from the needs of the offshore project operators/owners. (Given the huge challenges on the present and medium term market, caused by the gap between demand and supply, improving present wind turbine concepts has to be addressed first and **should not suffer from conceiving 'disruptive' technologies)**.

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Standards

Structuring R&D into priority areas

- Standardisation is the **final stage of a development trajectory**; it freezes the state of the art knowledge.
- In order to avoid that standards become a barrier to technical innovation, the standards need to be subject to a **stepwise updating process**.
- All earlier mentioned aspects of technology development will form inputs for the standardisation process.

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R&D Facilities

Structuring R&D into priority areas

- Joint efforts to realise facilities and to make them accessible to the international R&D community and the wind turbine and component manufacturers. (As wind turbines form large structures most of the research infrastructure needs to be large and costly as well. This particularly applies to wind tunnels, blade fatigue testing facilities, drive train testing, wind turbine test stations and facilities to evaluate wind farm control).
- Need **operational verification** (demonstration) of new risk full concepts such as **new installation and transport concepts**.
- Full scale **(comparative) testing of wind turbines under extreme climatological conditions** provides extra security for financiers planning large investments. A joint operated test site at extreme site would meet the need for such a facility.

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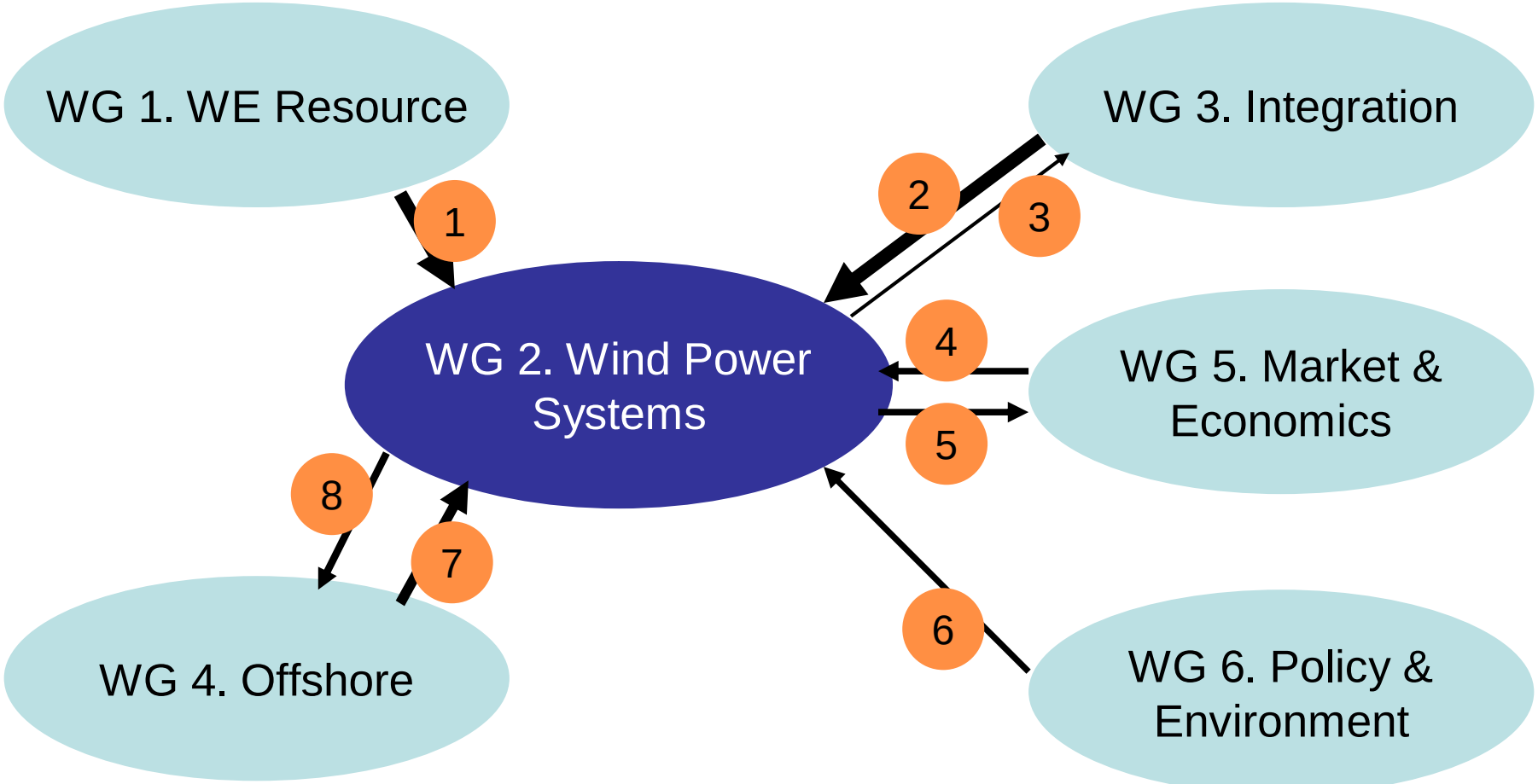
Interactions with other WG s



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Thank you !