Operating grids with high levels of variable renewable energy: Can you do it?

Integrating Variable Renewable Energy into Power Grids
UN City, Copenhagen
21 October 2014

Peter Jørgensen
Vice President
Energinet.dk

Yes, but not the
”grids” we have today!

Agenda

- Introduction to Energinet.dk
- The Danish electricity system today - 33% wind power in 2013
- Further steps towards a fossil free energy system
- What does it take?

Facts about Energinet.dk

- Transmission System Operator for electricity and gas
- Independent public enterprise under the Danish Ministry of Climate , Energy and Building
- The consumers contribute to our activities through tariffs
- Our finances are based on a break-even principle – non-profit!
- Investment decisions are based on socio-economic welfare criteria

Core tasks for Energinet.dk

- Ensure short- and long-term security of supply for electricity and gas
- Ensure well-functioning markets for electricity and gas
- Own, operate and develop the gas and electricity transmission grids

Parallel developments

- towards renewable energy and open markets

From primary coal fired to local CHP and wind power

2000

From vertically integrated monopoly to competitive electricity market

Generation

Transmission

Distribution

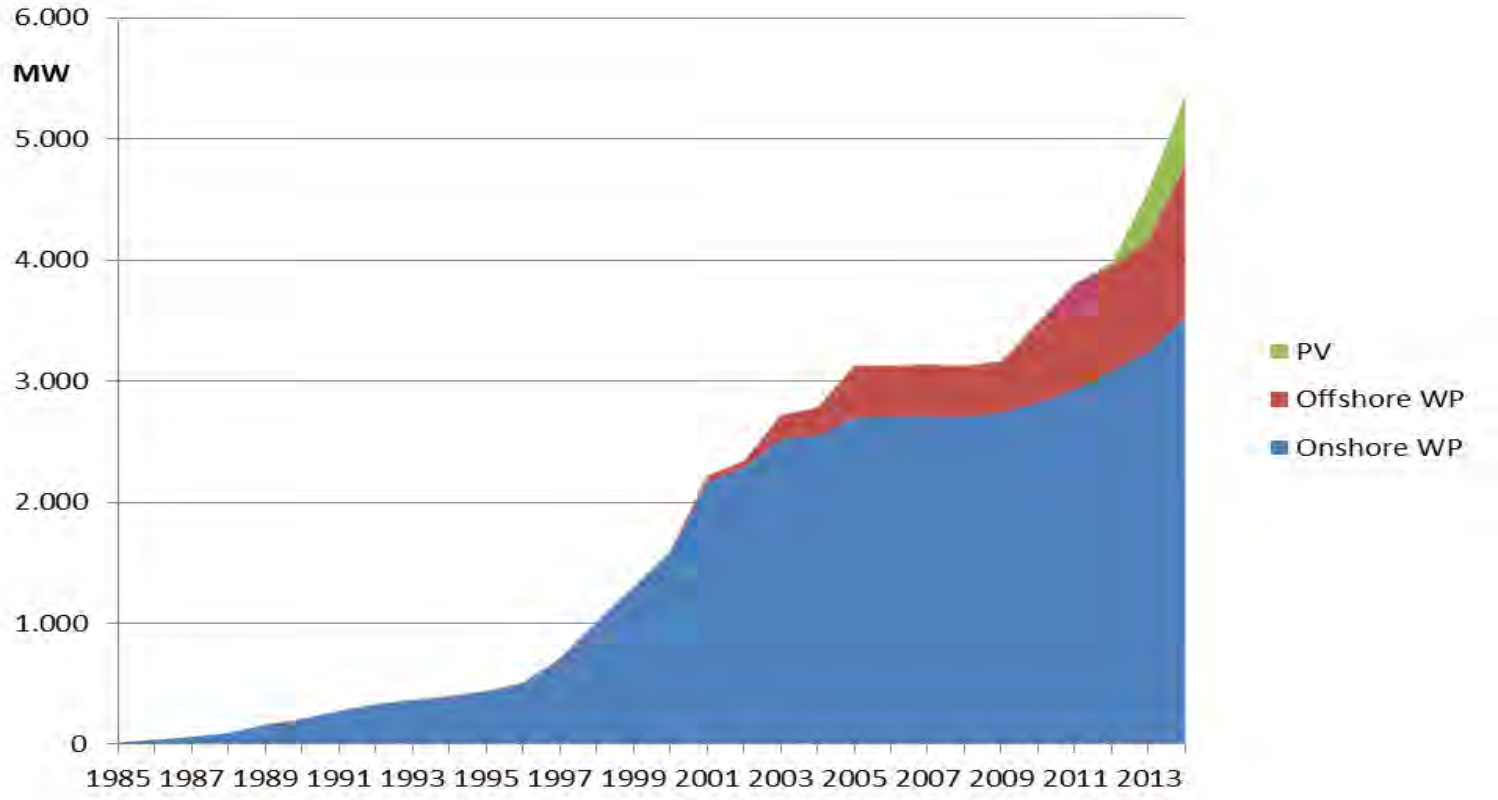
Generation

Trade

Transmission System Operator

Distribution

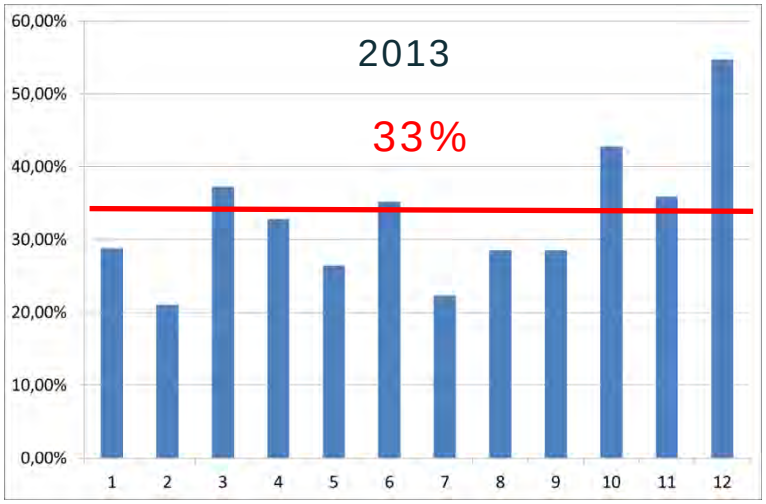
Development of Wind Power and PV in Denmark

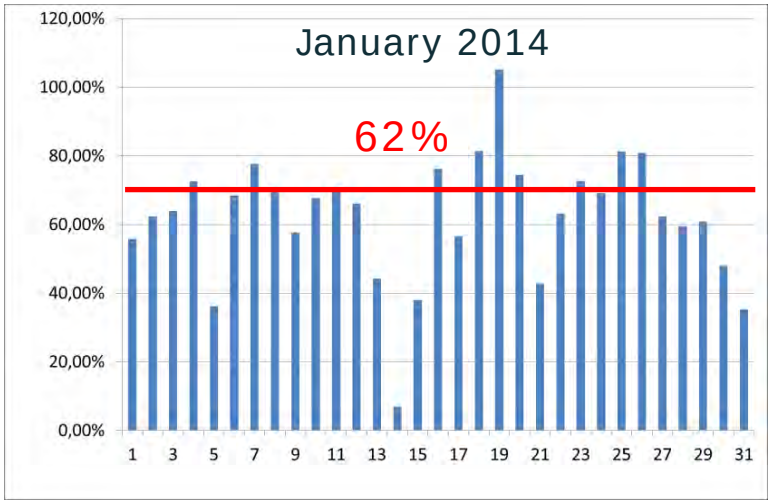


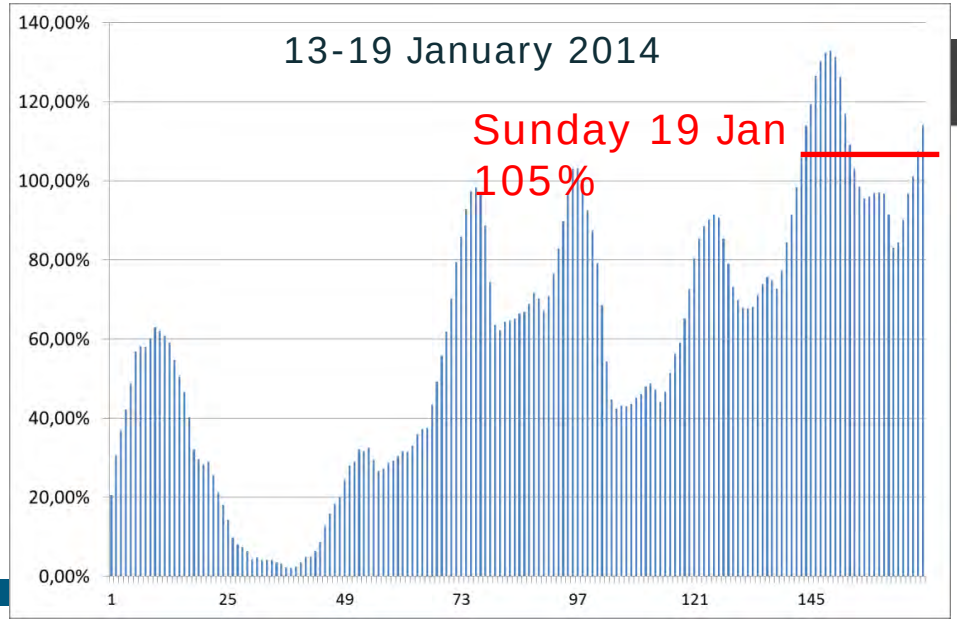
Incentives for VRE investments:

- *Attractive feed in tariffs/premiums*
- *Favorable grid connection conditions*

Wind Power Share in Denmark





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ENVIRONMENT & SCIENCE

Denmark's Wind Power Output Rises to Record in First Half

No Other Country Has Larger Capacity in Proportion to Power Consumption

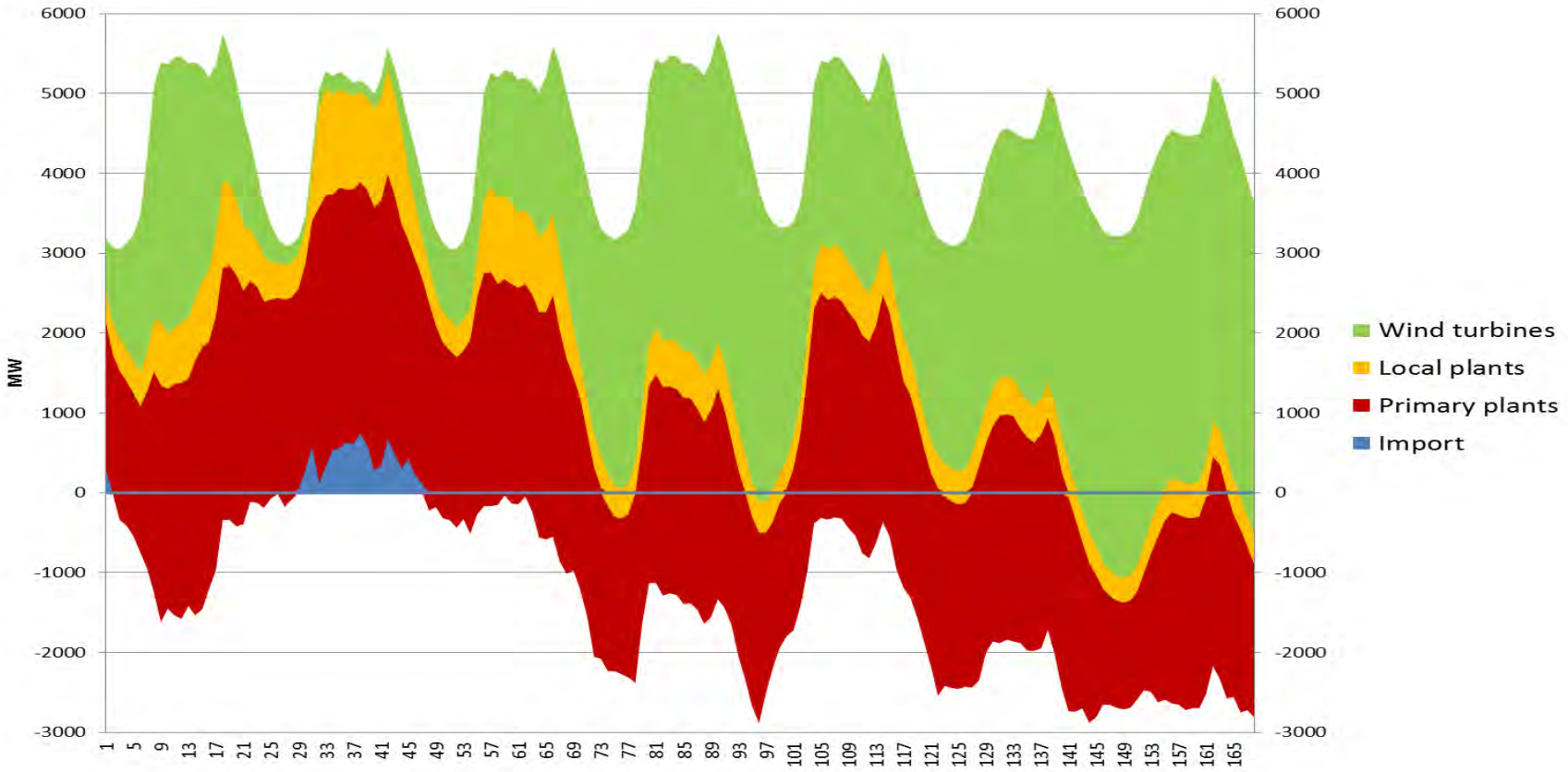
By KJETIL MALKENES HOVLAND

Sept. 3, 2014 9:22 a.m. ET

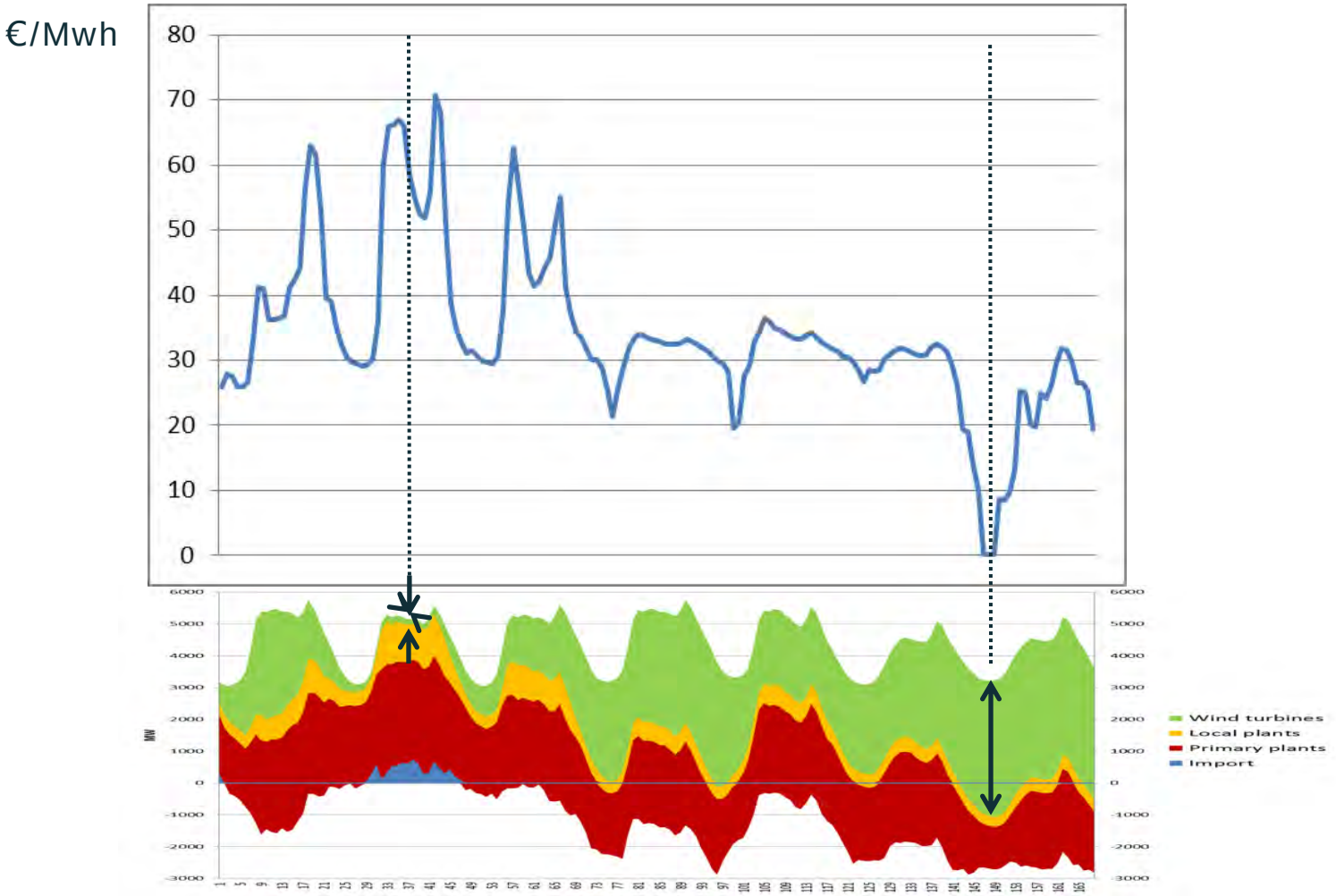
Wind power provided a record 41.2% of Denmark's electricity consumption in the first half of 2014, power grid operator Energinet.dk said in its half-year report published Tuesday.

Flexibility in the electricity system

- hourly dispatch 13 – 19 January 2014



Spot price, wind power and market dynamics



The energy system is changing

Denmark is in the middle of a historic transition of the energy system

- By 2020, wind power will constitute 50% of the electricity consumption (Energy Agreement)
- By 2035 fossil fuel independent electricity and heating (Government goal)
- By 2050, Denmark must be 100% fossil fuel independent (Broad political vision)

What are the challenges ?

Variability

- Real-time harvesting of VRE as it comes
- Limited grid support from VRE

Cost structure

- Large upfront investments and almost zero marginal energy costs

Location

- From large scale offshore wind power far away from consumption centers to household connected photo voltaic

How to develop the energy systems to maximize the value of VRE generation as it comes - and still ensure the security of supply?

What are the means ?

Grid

- Strong and robust transmission system to balance VRE in a large area
- Competitive electricity markets/merit order dispatch to optimize system utilization

Flexibility

- Grid codes to ensure technical capabilities of all generation and demand to support the system
- Clear price signals reflecting system balance to incentivize dynamic response
- State-of-art forecasting tools for VRE to enable efficient system balancing
- Specialized operational procedures and tools to ensure efficient system operation and security of supply
- From SmartGrids to SmartEnergy to optimize RES utilization across energy sectors and support price flexibility

What does it take ?

Political commitment and a stable regulatory framework

- Binding goals and long-term visions to set direction and milestones
- Stable regulatory framework to incentivize timely investments and optimal operation

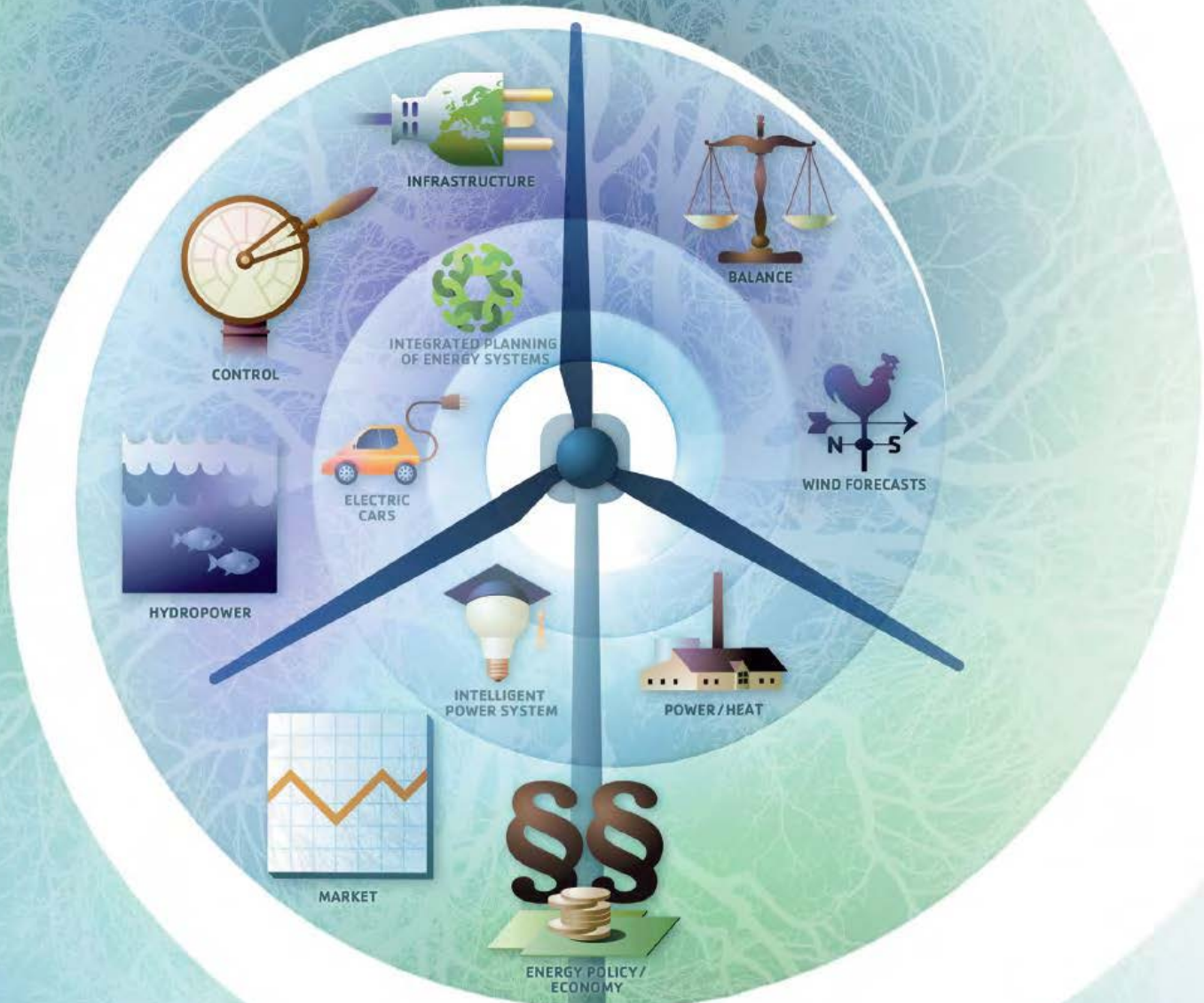
Long term grid planning and coherent energy systems

- Grid planning process to ensure coordination and timely realization
- Cross sector energy planning to ensure optimal utilization of RES in all sectors

Innovative system operation

- Pricing mechanisms to incentivize flexibility in generation and demand
- New procedures and tools to ensure efficient system balancing and security of supply

➔ *Minimize costs, maximize value of variable renewable energy and ensure security of supply*



Thank you for your attention!

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