NTNU – Trondheim
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Science and Technology

Introduction to group work: Energy systems integration activities as a new challenge for Europe

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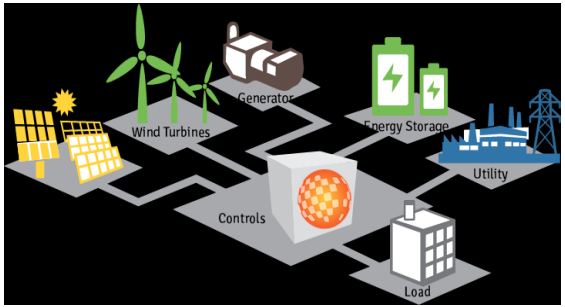
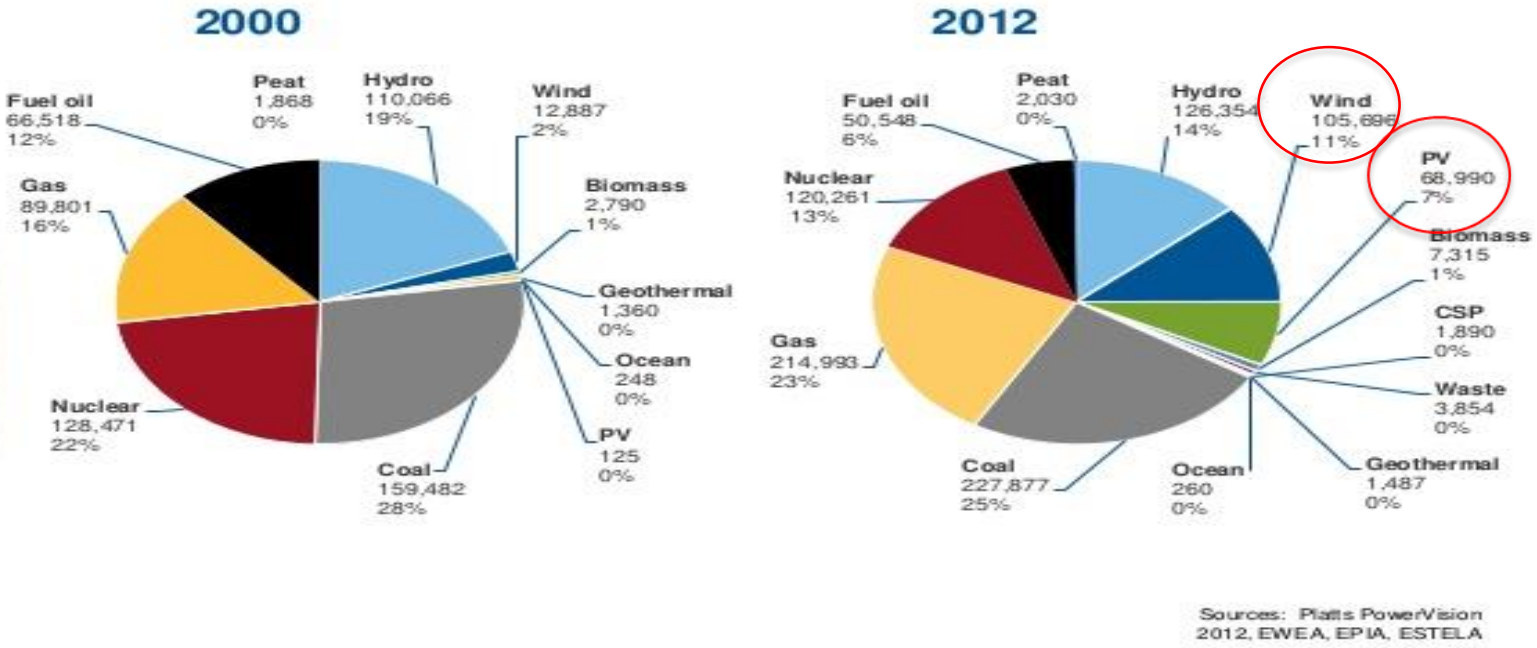
ESI: Characteristics



- Energy systems evolved from individual energy devices to systems characterized by:
  - Coupling between energy vectors across spatial and temporal scales
  - Multiple energy carriers as electricity, oil and gas
  - The role of hydrogen
  - Intermittent generation (wind, PV, waves)
  - Flexibility provided by storage with different time horizons
  - Demand-side aspects (flexible consumption – prosumer)
  - Large systems
  - Wide range of time constants

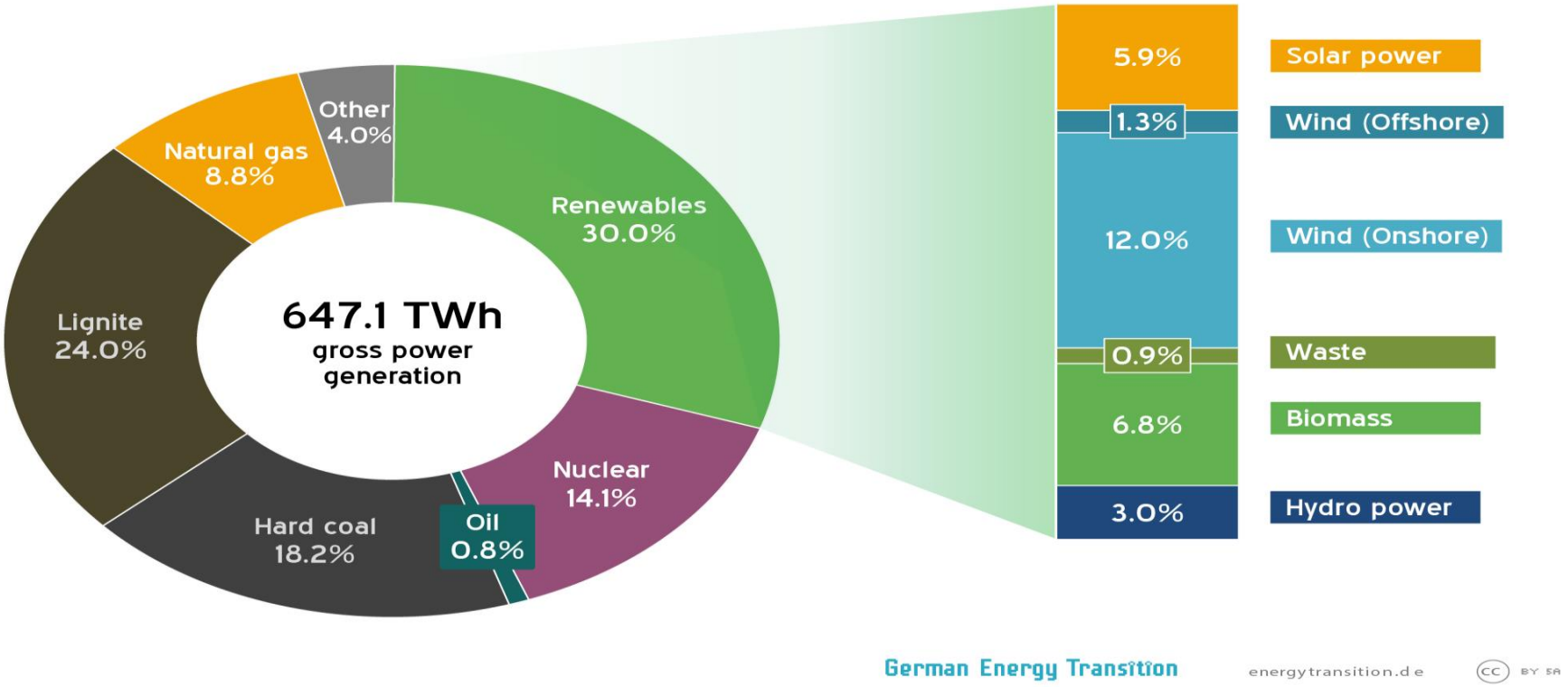
EU power capacity mix



Germany reaches 30 percent renewable power in 2015

Gross power generation mix

Source: AGEB



ESI:
Challenges and opportunities

- Size and time horizon requires careful modelling
- Aggregation and equivalent representation of energy systems a challenge
- Forecasting – Scenario building
- Long term planning – Operational issues
- Multiple energy carriers give flexibility
- Large-scale optimization reduce risk of sub-optimal solution

STRATEGIC RESEARCH AREAS 2014–2023

NTNU
Norwegian University of Science and Technology

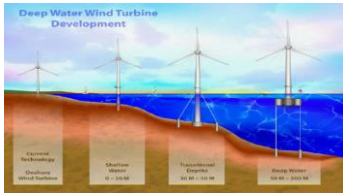
ENERGY

HEALTH

OCEANS

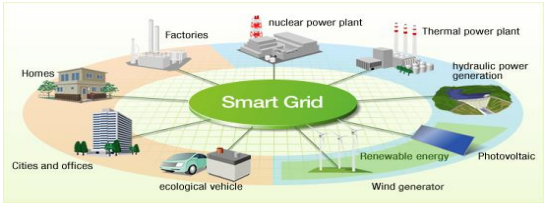
SUSTAINABILITY

Overview - Focused activities

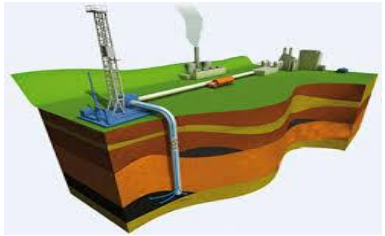


Off-shore Wind

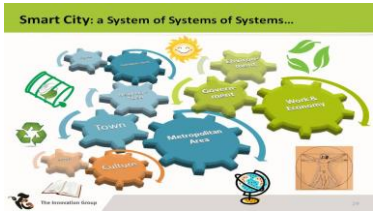
Hydro Power



Smart Energy Systems / Smartgrid



Carbon Capture and Storage (CCS)

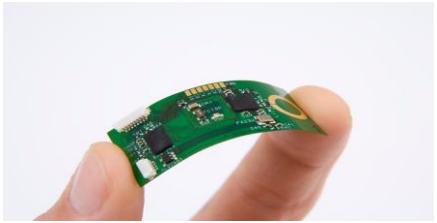


Smart Cities / ZEN

Energy Efficiency

Overview – Focused Activities

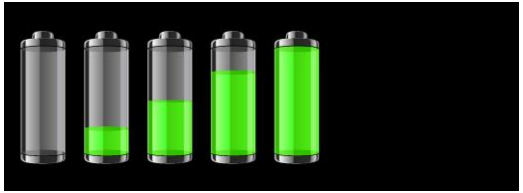
Solar Power (PV)



Nano Technology

Energy Efficiency
Marine Transport syst.

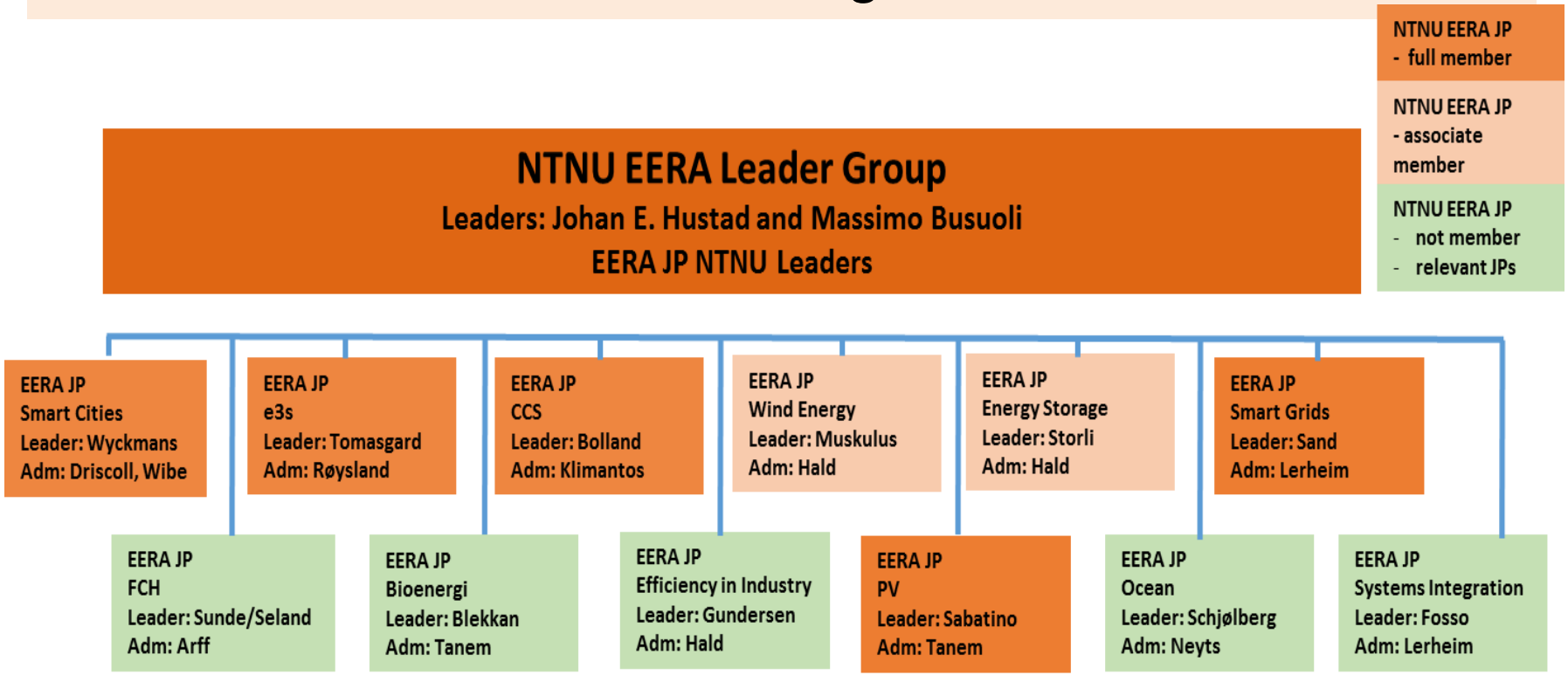
Politics, innovation
public engagement -
sustainable energy



Energy Storage/
Fuel-cells

Petroleum Research

European Energy Research Alliance EERA
NTNU Mirror Organization



Concluding remarks

- Energy system integration aspects of increasing importance due to different primary energy sources and carriers
- System size and complexity give huge optimization models
  - Aggregation / model coupling
  - Multi-disciplinarity
- NTNU covers a wide range of disciplines and system optimization techniques
- Aims high for further participation in European research consortia

THANKS FOR YOUR ATTENTION

Information: **http://www.ntnu.edu/energy**

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