# Preparing the Danish electricity grid for 50% wind power by 2020

**Energiewende - Gut vernetzt?**

Öko-Institut e.V., KfW Bankengruppe, Berlin

13 September 2012

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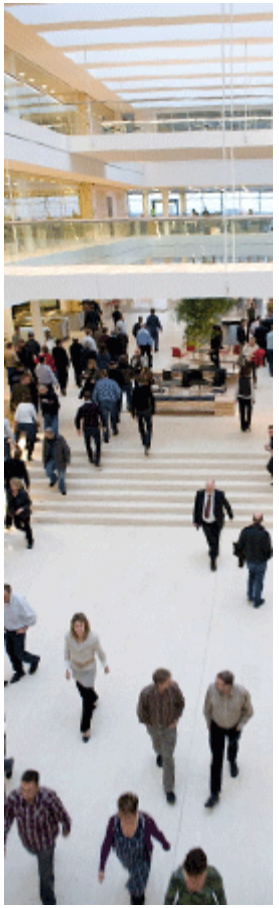
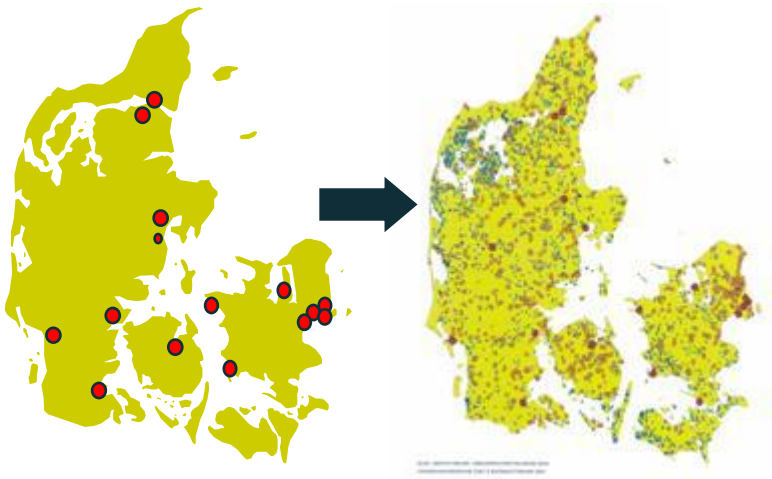
# Facts about Energinet.dk

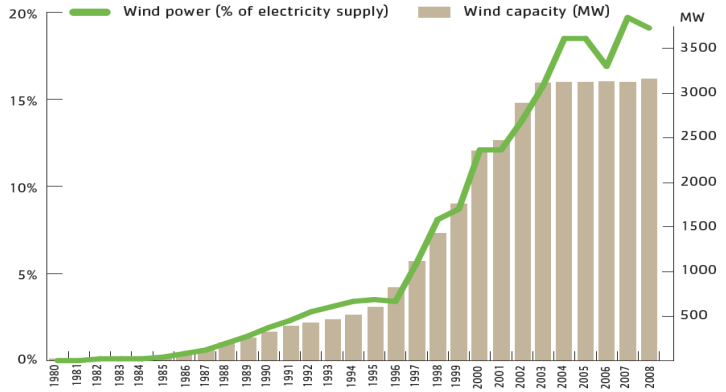
- Danish Transmission System Operator for electricity and gas
- Responsible for security of supply and market functioning
- Owns and operates the transmission systems for electricity and gas and a natural gas storage
- Co-owns Nord Pool Spot, Nord Pool Gas and the European Market Coupling Company
- Approx. 600 employees
- Annual revenue approx.: € 1 billion
- Independent public enterprise under the Danish Ministry of Climate and Energy
- The consumers contribute to our activities through tariffs charged to their electricity and gas bills
- Our finances are based on a break-even principle



# The Danish electricity system – development and policy



**From primary to local generation**




**28% wind power in 2011**

**Danish Energy Agreement , March 2012:**

- Higher energy efficiency
- Biomass and heat pumps for district heating
- RES conversion in buildings and industry
- Smart Grids and new interconnectors
- Improved framework for biogas
- Electricity and biomass in transportation
- Wind power
  - Offshore: +1,000 MW
  - Near-shore: + 500 MW
  - On-shore: + 500 MW

  } **50% wind power by 2020**

- Long term goal: **100% renewable by 2050**

**Political vision** (Government platform):

- 100% renewable electricity and heating sectors by 2035

# System balancing today

*Large market area:*

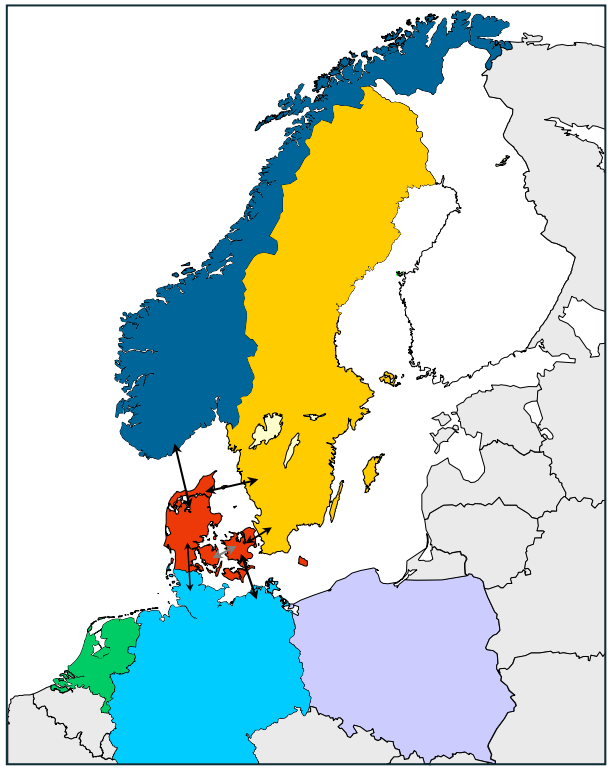
- Robust international transmission grid
- Coherent electricity markets

*Flexible generation system:*

- Coal fired power plants operating down to 10% of rated output
- Combined heat and power plants with heat accumulators and electric boilers
- Grid codes ensure capability of wind farms to support the system

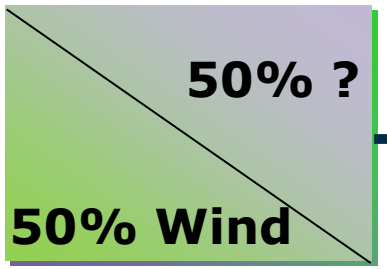
*Efficient system operation procedures and tools:*

- Specialized IT-systems for forecasting, system balancing and handling of distributed generation



# Instruments to effectively integrate large amounts of fluctuating renewable energy in the power system

## Production




*By 2020*

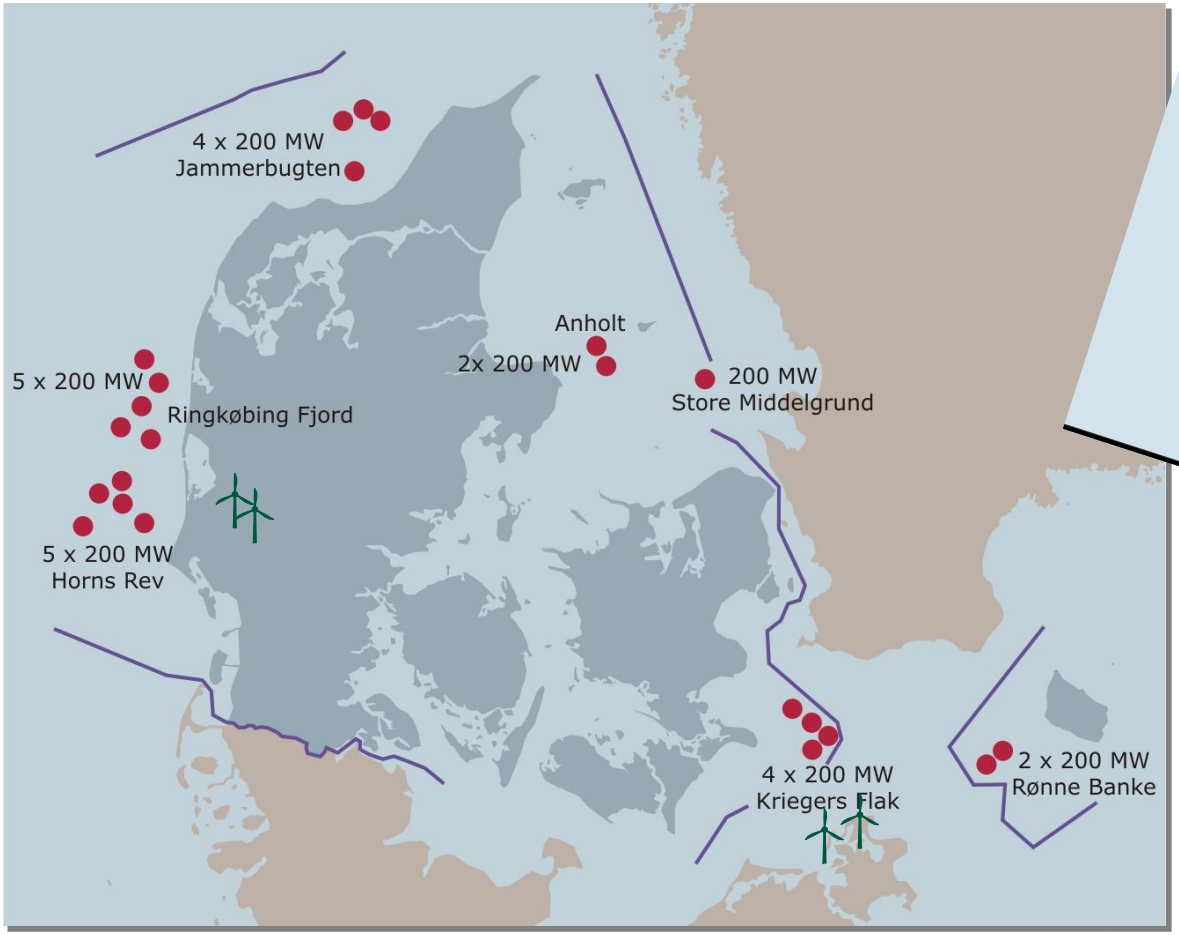
## Instruments

Strong transmission grid and interconnections - and well functioning energy markets

Flexibility in production and consumption. Close integration with the heat, gas and transportation sector

Smart Grid to implement intelligence in the power system

# Grid planning is long term!

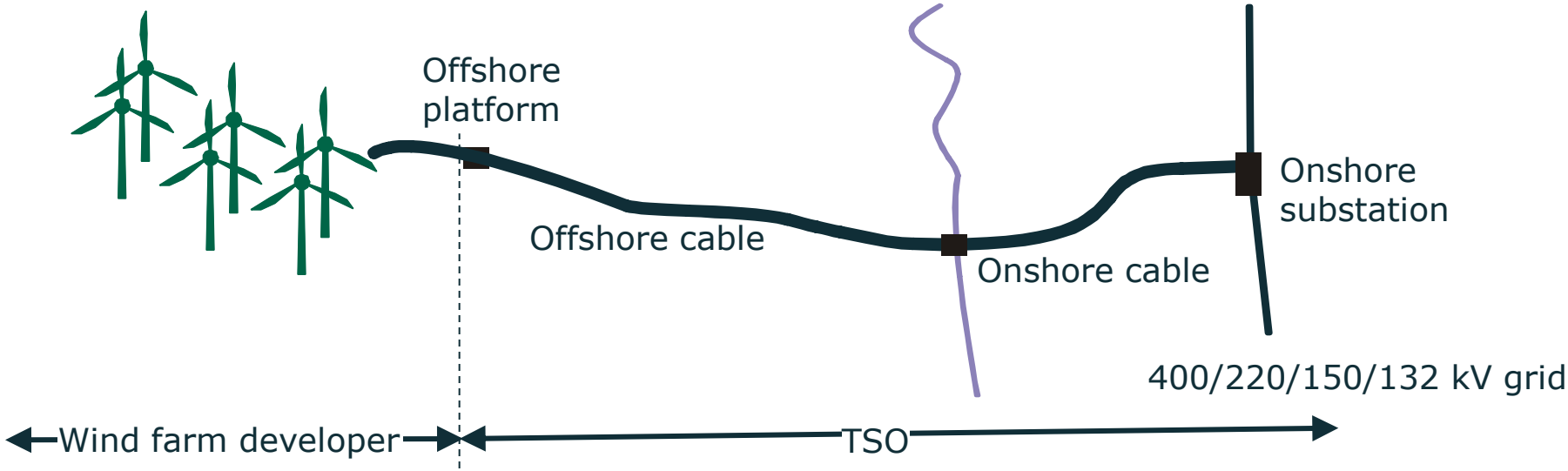




available sites for 4.6 GW offshore wind power

# Offshore wind farms

- Who builds, owns, operates and pays?




Public tender for building and operating OWF

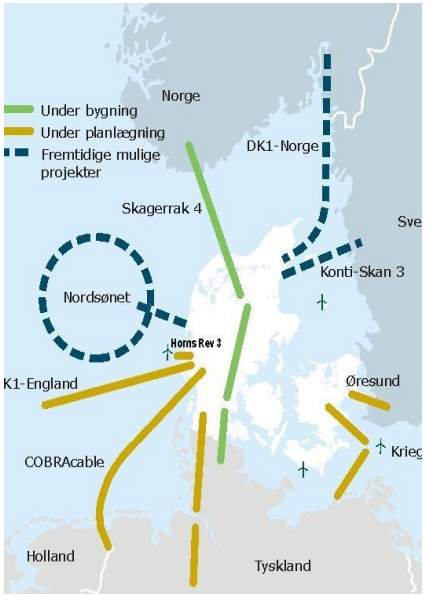
TSO builds, owns, operates and pays grid connection

TSO also carries through the EIA for the OWF

3½ years from tender to operations!

# Development of the transmissions grids

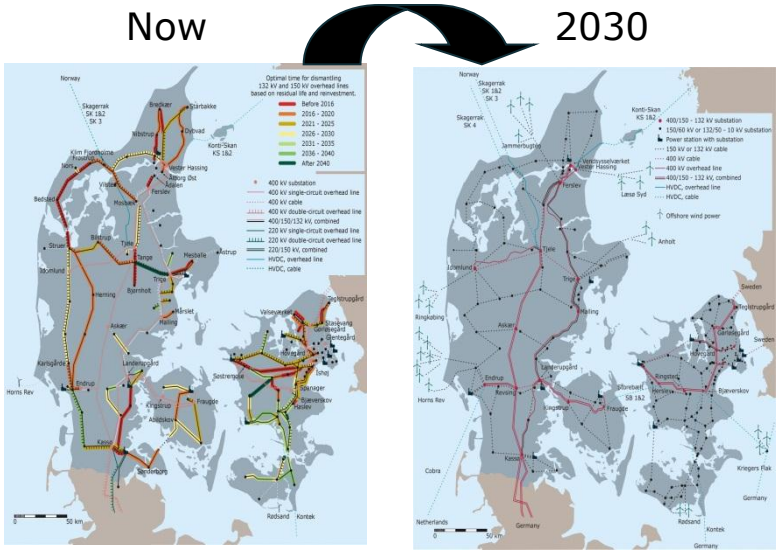
## *Interconnector projects*




***The last OH-project:***

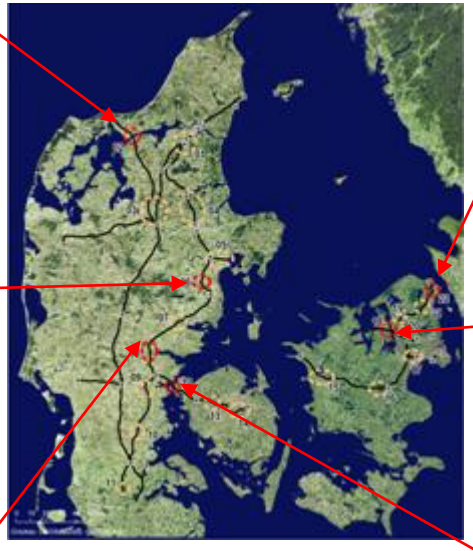
Upgrading of 180 km 400 kV to double line


***Cable action plan for 132/150 kV grid***



# Embellishment of existing 400 kV OH-grid



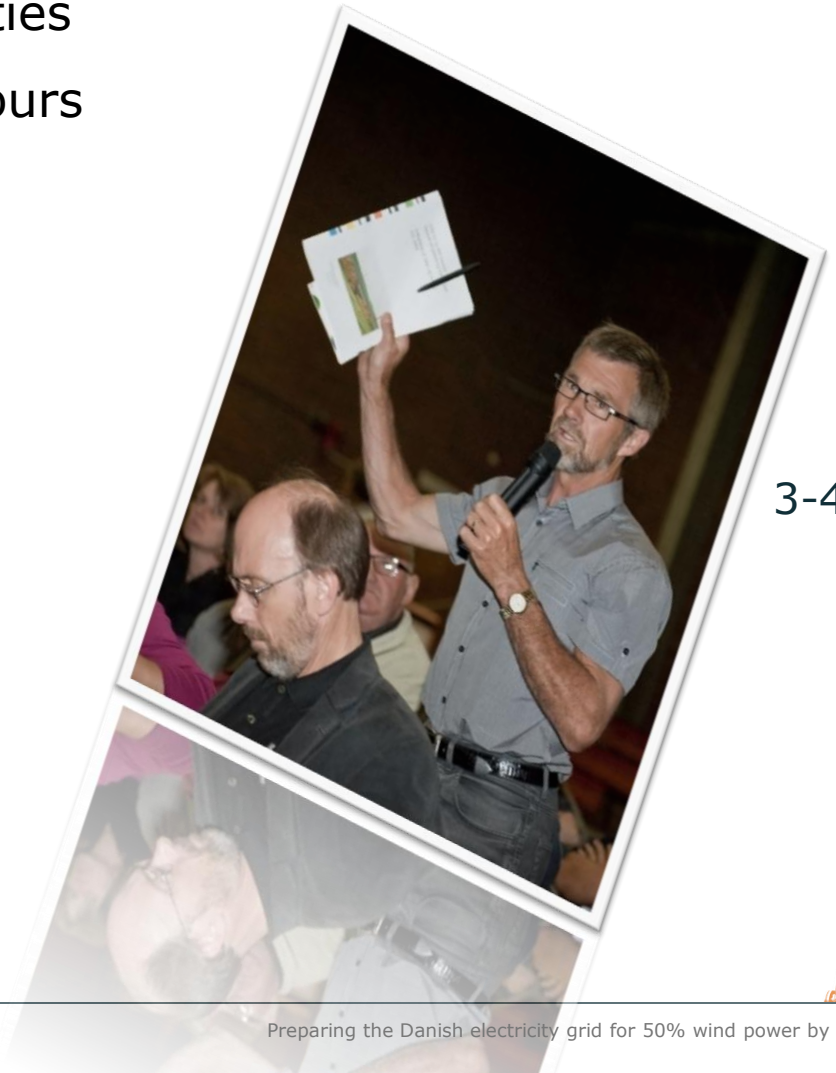



Total costs: € 100–160 mill.

# Planning phase

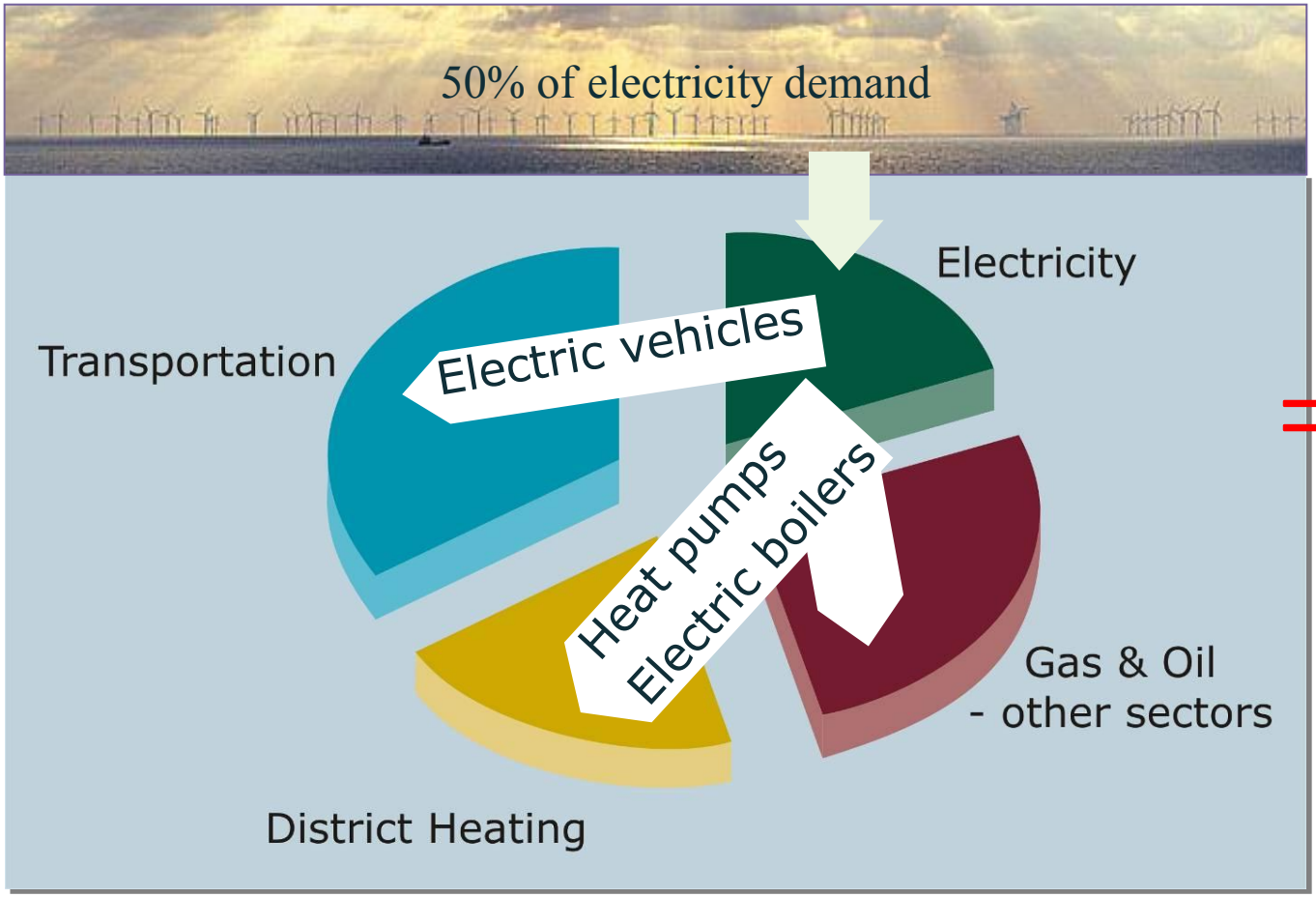
Dialogue involving all relevant stakeholders

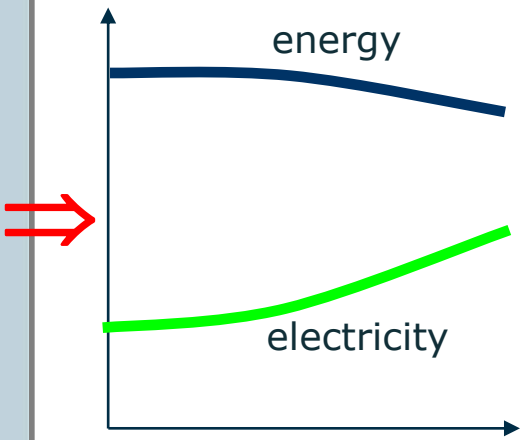
- Authorities
- Neighbours
- Citizens



3-4 public meetings per project

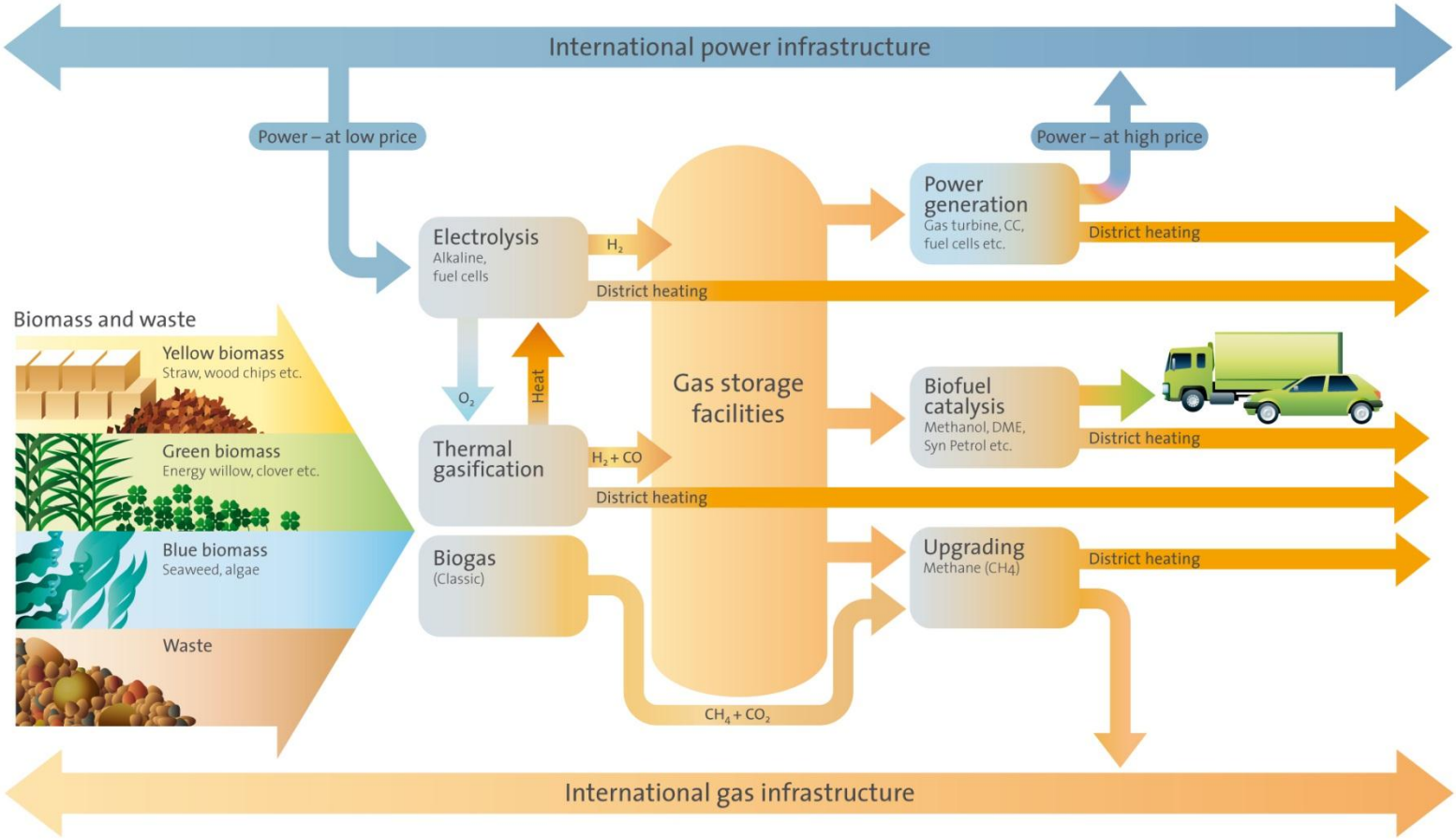
# Coherent and flexible energy systems



# Integration of energy systems

– synergy between gas and electricity




- Substantial storage capacity in the gas system
- Competitive peak-load capacity from RE-Gas
- Optimal use of bio resources

# EcoGrid EU – a prototype for the future energy system

- Demonstration of an electricity system with more than 50% wind power and demand flexibility to optimize the utilization of RES
- Bornholm is a unique place for testing
- 2.000 costumers will participate
- Test of a 5-minute local markets
- Test of new market products
- Co-operation with other Smart Grid projects on the island
- Local support – Bright Green Island vision

# Conclusions

## Efficient integration of large-scale wind power through:

- **A strong international transmission grid**
  - to trade and balance in a wide geographical area
- **Efficient international electricity markets**
  - with clear price signals and trading close to real-time
- **Coherent energy systems**
  - electricity, gas, heating and transportation - to increase flexibility and economic efficiency and reduce environmental impact
- **High flexibility in generation and demand**
  - with technical connection requirements for all resources – Grid Codes
- **A revised power system control architecture**
  - improved control and observability of distributed resources - SmartGrids

Efficient solutions through international coordination!