Analysis of potentials and costs of CO_2 storage in the Utsira aquifer

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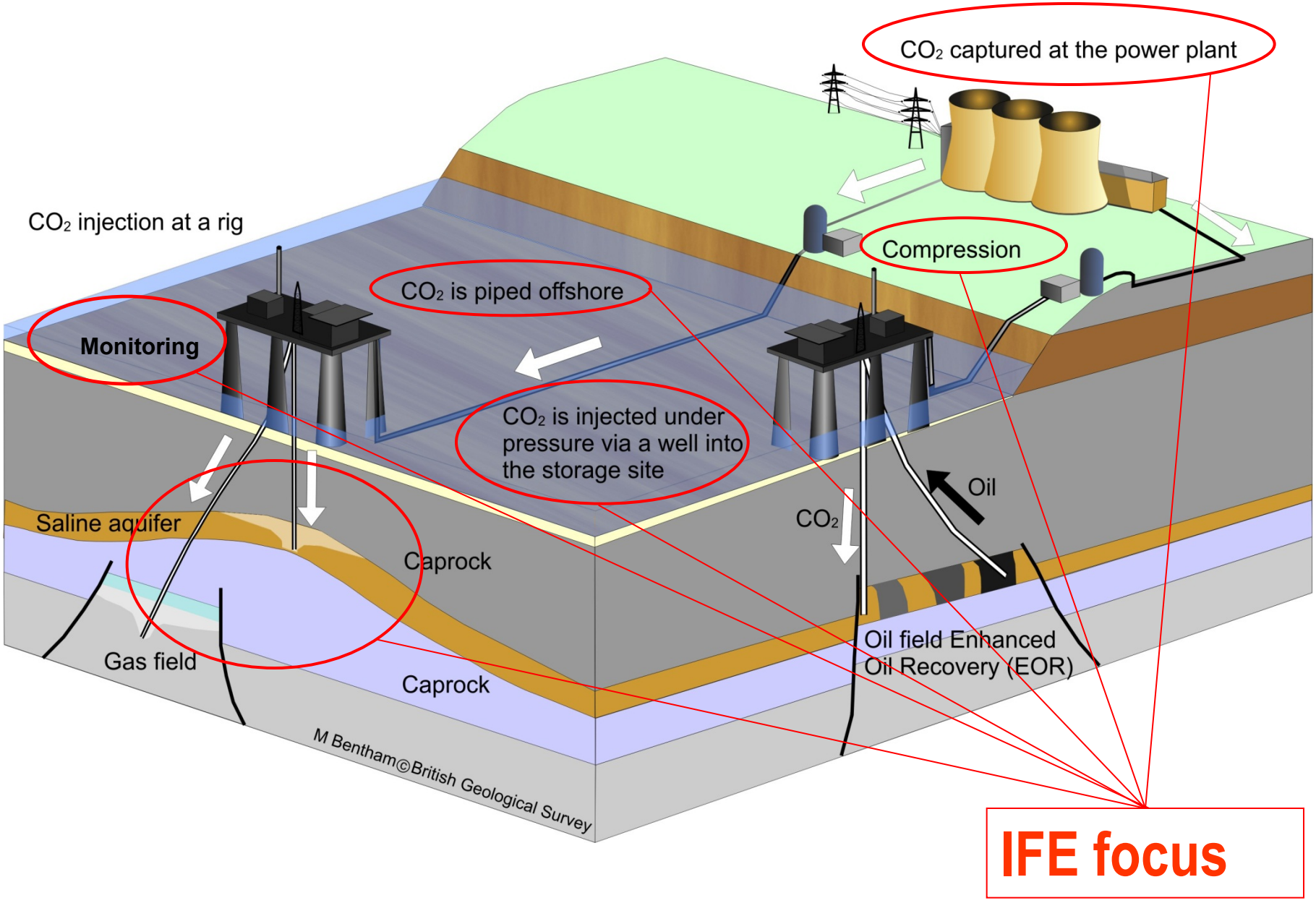
Outline

- Brief overview of Institute for Energy Technology (IFE)
- Project Description
- Assumptions: Utsira formation
- Energy modelling
  - Scenarios
  - Modelling at a country level
  - Modelling at a regional level
- Project Conclusions

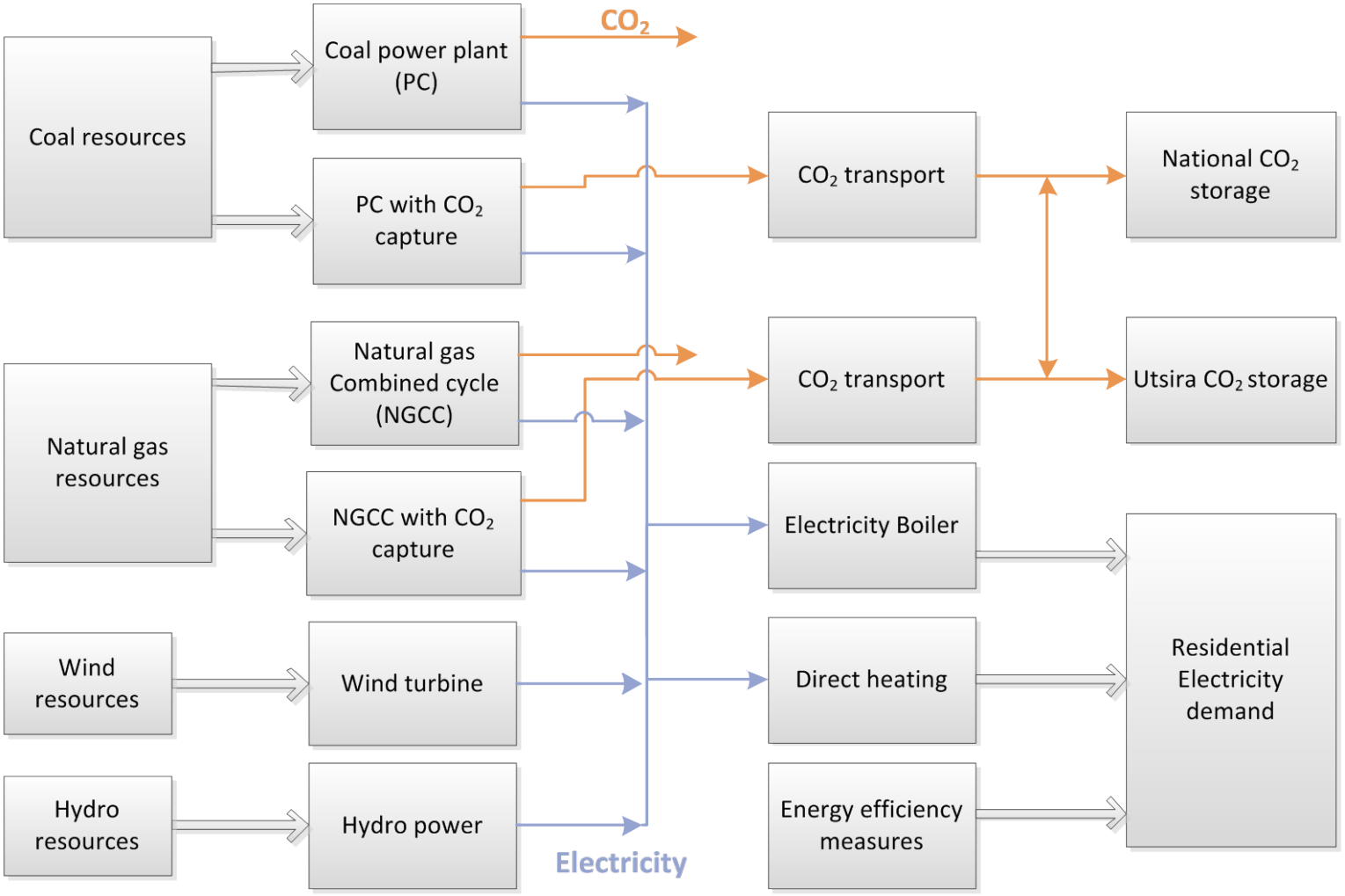
Institute for Energy Technology

- Independent foundation established in 1948
- 650 employees
- Turnover: MNOK 750 (US$ 130 mill)
- Contract Research
- Internationally oriented
- Energy research lab

JEEP II research reactor, Kjeller


CO_2 captured at the power plant
CO_2 injection at a rig
Compression
CO_2 is piped offshore
Monitoring
CO_2 is injected under pressure via a well into the storage site
Oil
CO_2
Saline aquifer
Caprock
Gas field
Caprock
Oil field Enhanced Oil Recovery (EOR)
M Bentham©British Geological Survey
IFE focus

Example: Energy system perseptive

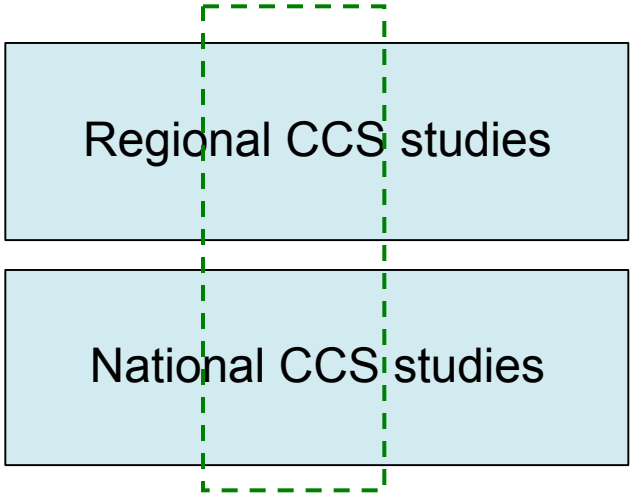


Project description

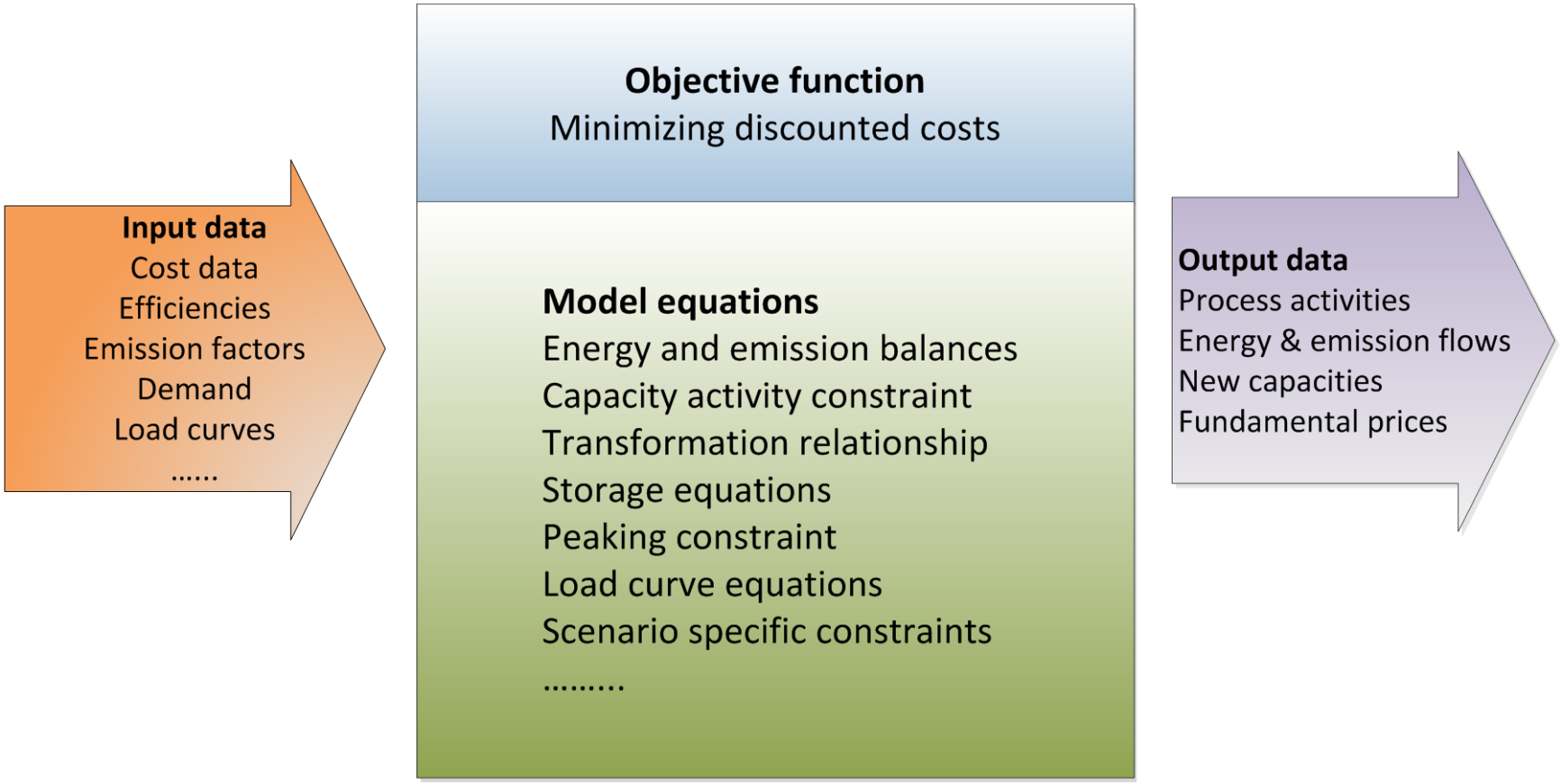
- A joint research project
  - Coordinator: Institute for Energy Technology IFE (NO)
  - Utrecht University (NL)
  - University College London (UK)
  - Risø DTU (DK)
  - Stuttgart University IER (DE)

Project description

- Analysis of CCS focusing on storage in the Utsira formation for the countries around the North Sea (UK, NL, DE, DK, NO) towards 2050
- National and regional analysis with least cost bottom up energy system models (MARKAL and TIMES)
- Analysis of barriers, policies for a CO_2-infrastructure in the North Sea



Energy system model



Energy system model

- **Model assumptions: Utsira aquifer**
  - Storage capacity: 42 Gt
  - Maximum annual injection rate:150 Mt/y
  - Investment cost: 22 M€ per 1 Mt/y

- **The use of Utsira would depend on**
  - Capacity of storage
  - Mitigation strategies
  - Technical development of CCS
  - Public acceptance
  - Legal and policy conditions

Energy system model

- National models and regional model is harmonized
  - Energy, Electricity & CO_2 prices
  - Electricity trade
  - Discount rate
  - Power plants and CO_2 capture technologies
  - CO_2 transport costs
  - Utsira storage option
- National, onshore and offshore, storage options is mapped

Scenarios

- Two core scenarios
  - 20% CO_2 reduction by 2020 and maintained towards 2050 (C-20) in EU+
  - 20% CO_2 reduction by 2020 and reduced to 80% by 2050 (C-80) in EU+
- Sensitivities
  - No CCS
  - High Utsira capacity, with a maximum injection rate at 500 Mt CO_2 per year
  - No onshore storage
  - Lower fossil fuel prices

Modelling at a country level

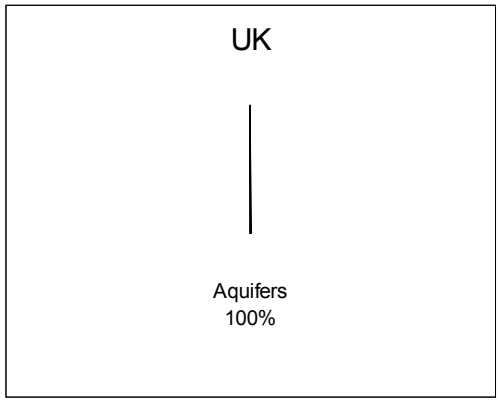
- Optimising on a national level
- Each country can invest in a pipeline to Utsira
- What is the role of CCS in 2050 with 80 % CO_2 reduction?

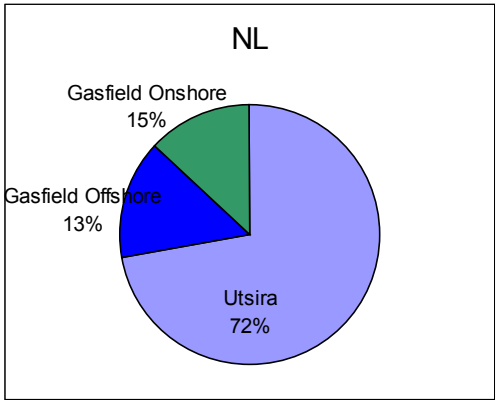
  CCS in the electricity production mix:
  - UK: Coal: 12 %
  - NL: Coal/ Bio: 70 % & Gas: 10 %
  - DE: Coal: 34 %, Total CCS: 40 %
  - DK: Coal CCS plays a minor role
  - NO: CCS plays a minor role, mainly capture from industry

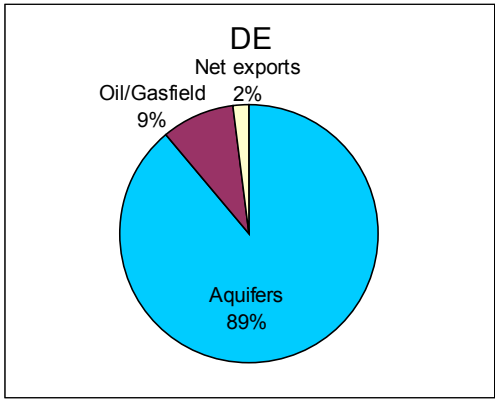
Modelling at a country level

Where is CO_2 stored in 2050?

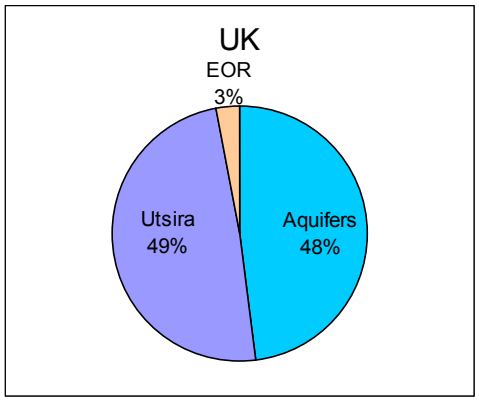
C-80

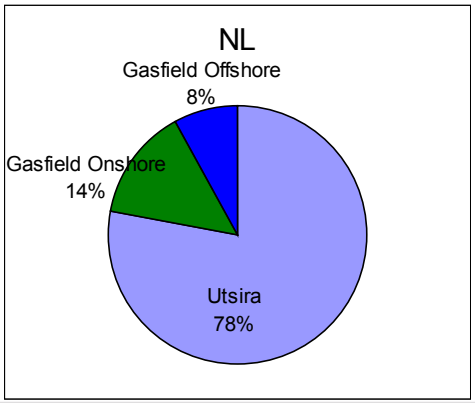


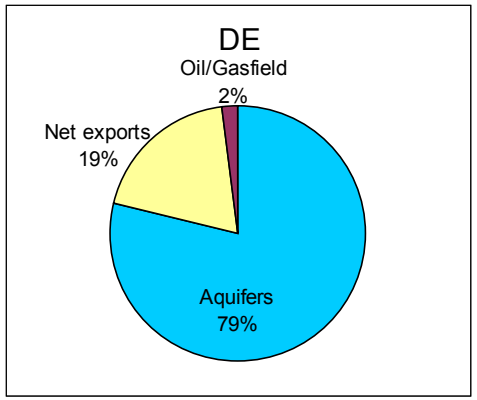




C-80 with lower fossil fuel prices

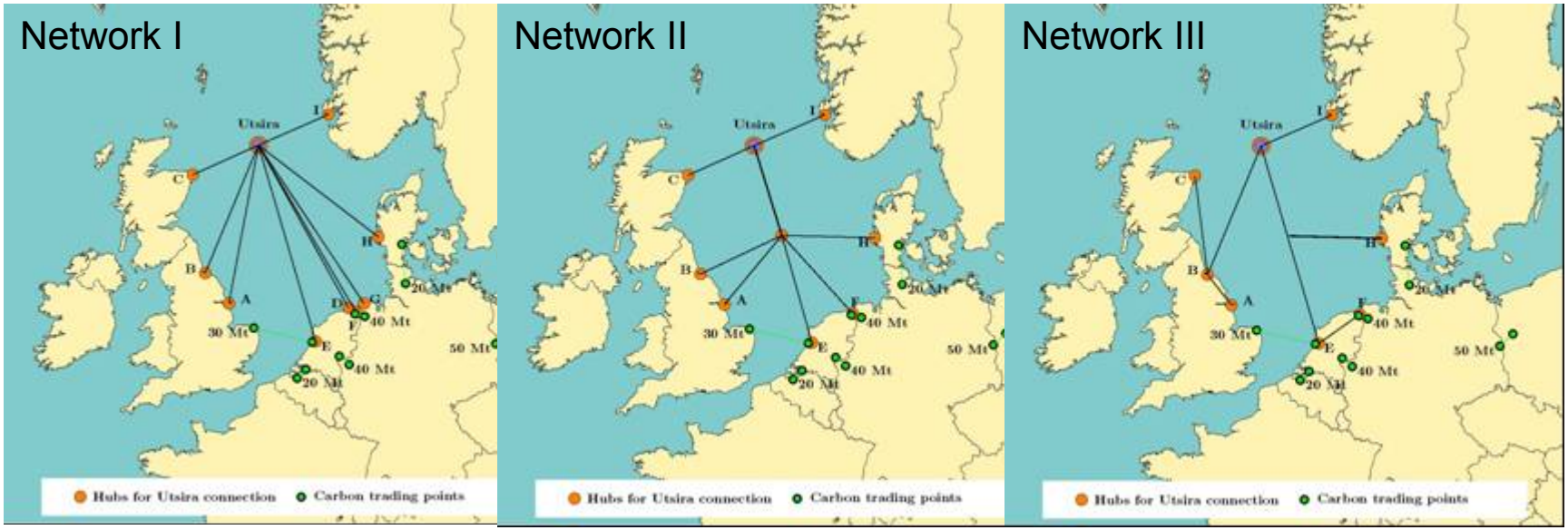






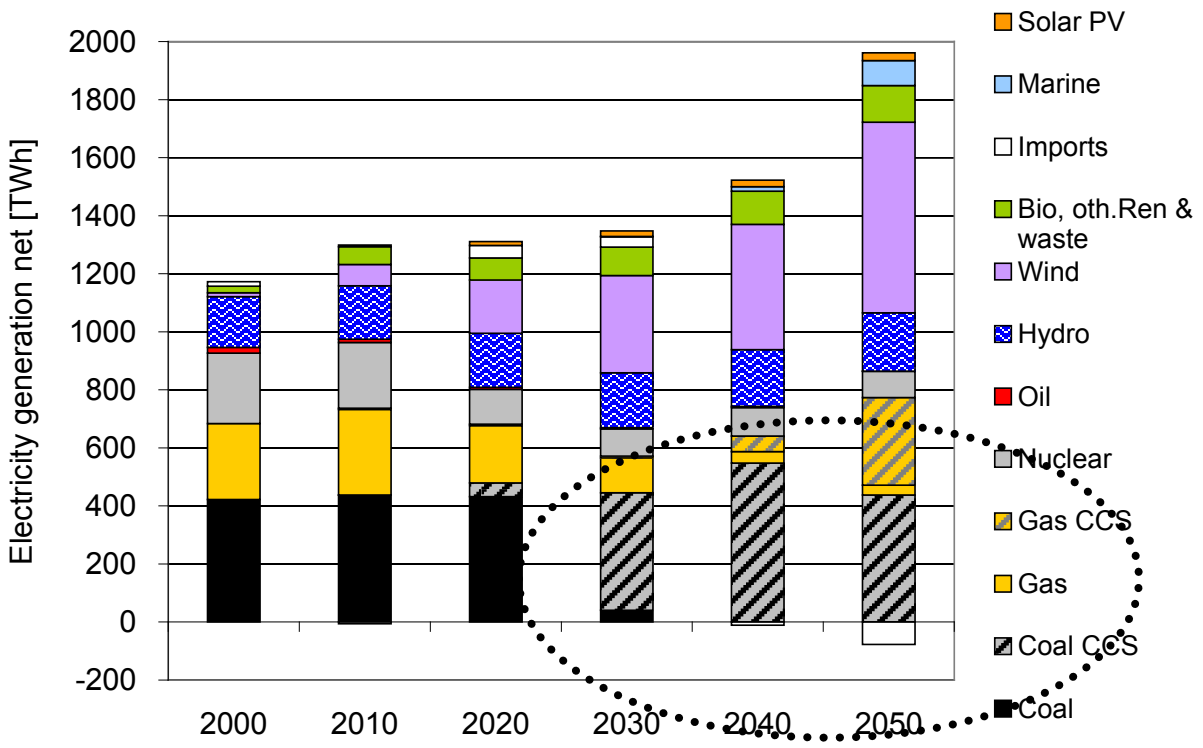
Modelling at a regional level

Possible transport networks



- Total amount of CO_2 captured in North Europe is indifferent with network layout
- CO_2 quantities to Utsira differ slightly
  - Network III: 8 Mt/y more to Utsira from 2040, mainly from NL

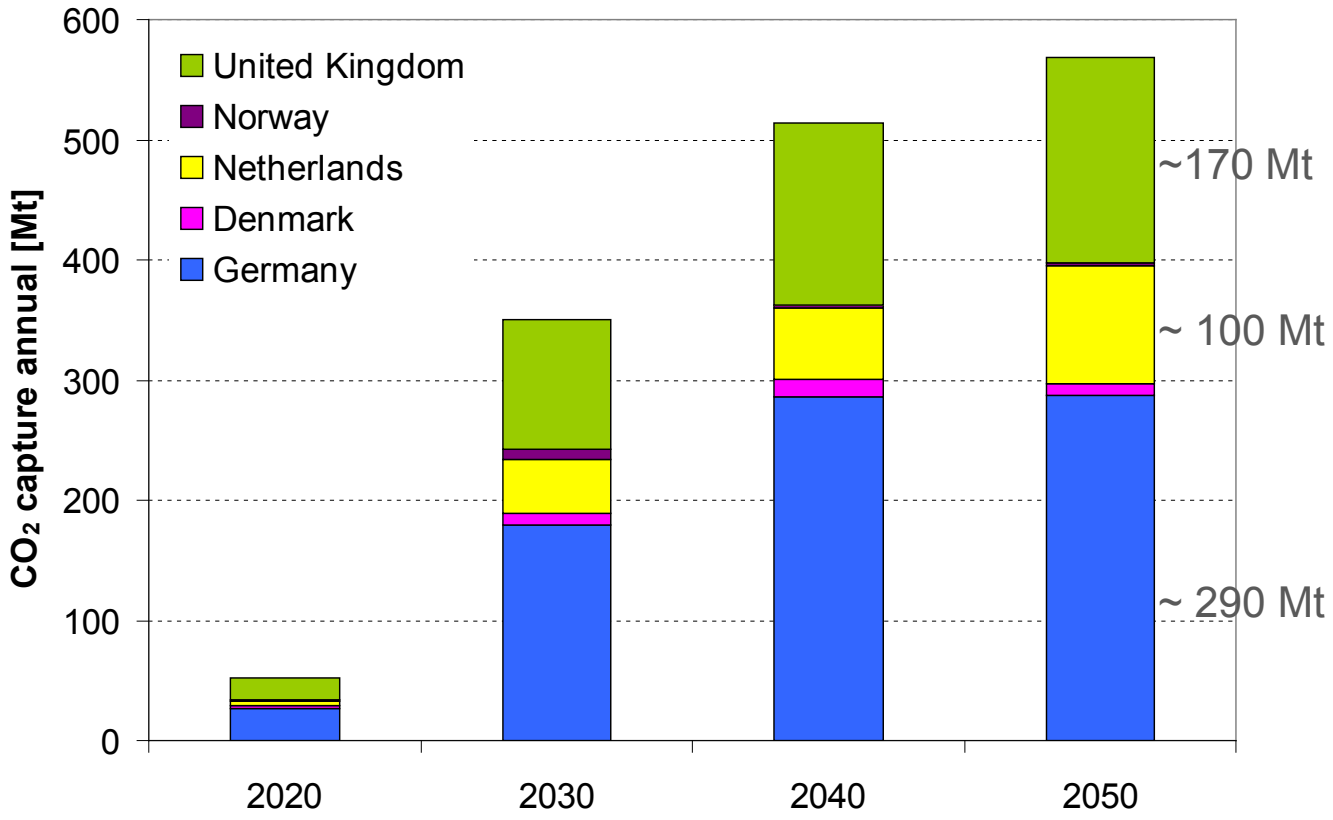
Electricity production North Sea Countries



CCS technologies

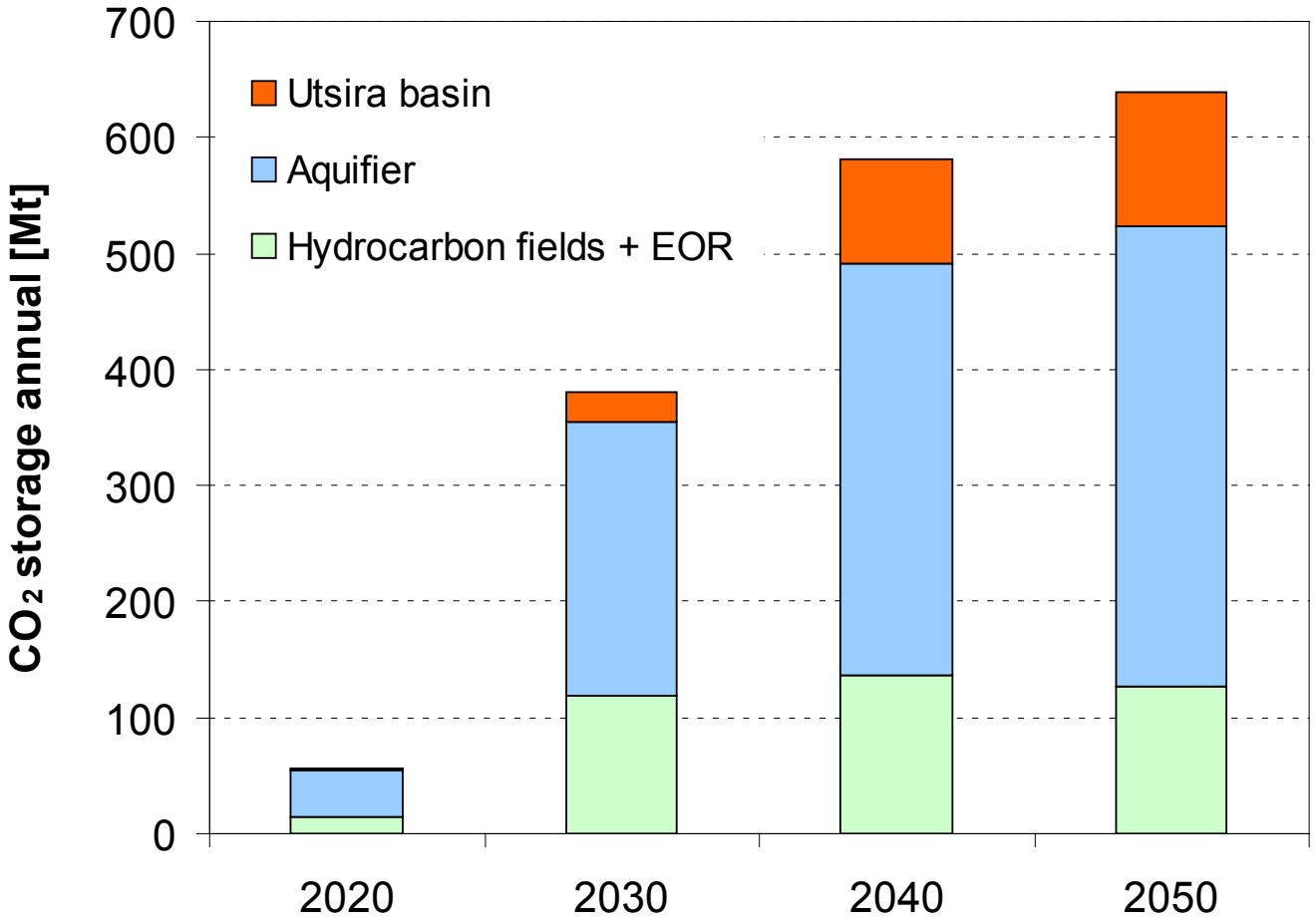
2050: 38 % CCS and 56 % renewable technologies

CO_2-capture North Sea Countries



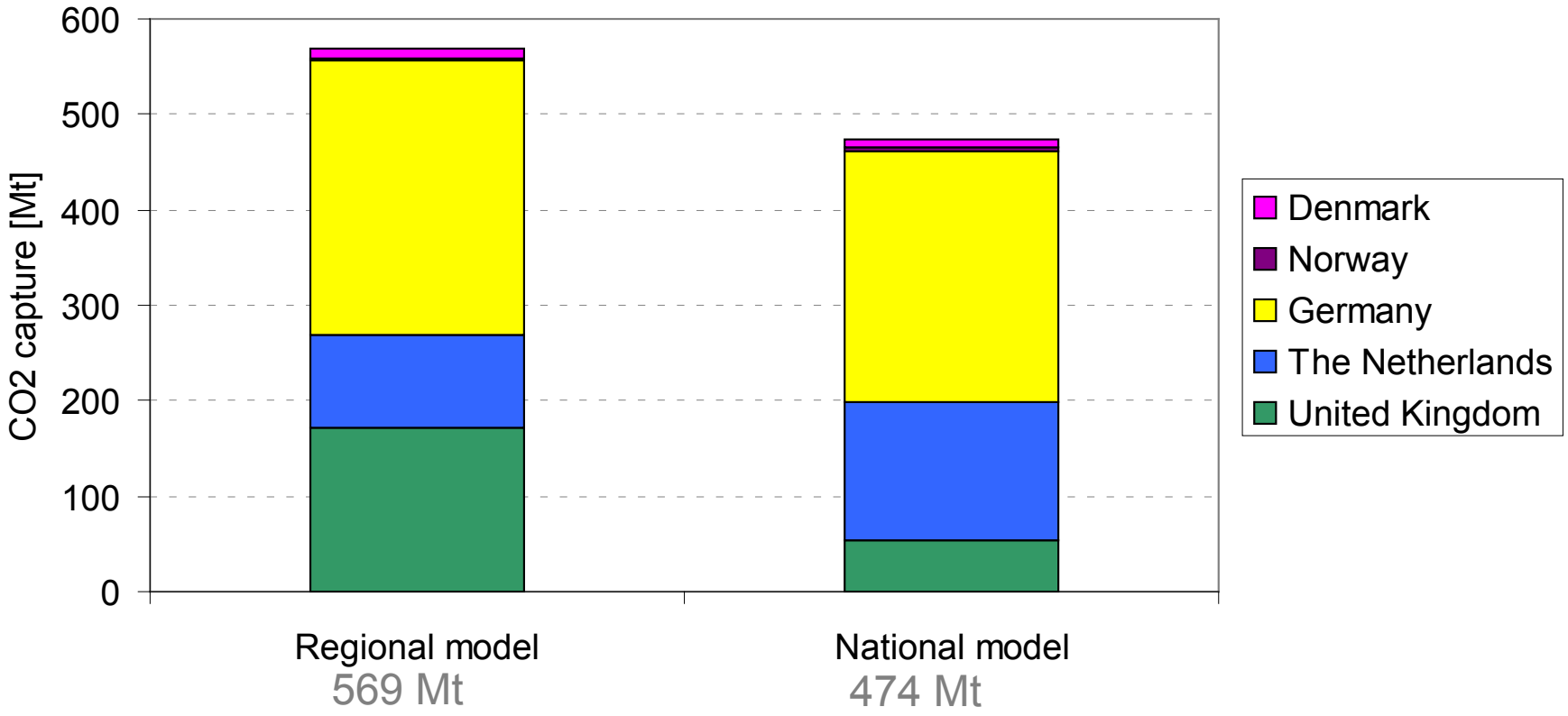
2050: ~ 570 Mt CO_2 captured under stringent emission targets

Storage of CO_2 North Sea Countries



2050: 115 Mt CO_2 stored in the Utsira formation (75 Mt UK, 40 Mt NL)

Total CO_2 captured 2050



Project conclusions

- Under a tight climate policy, CCS appears as cost-effective measure for all countries
- European CO_2 mitigation strategies are vital for the importance of storage in the Utsira formation
- The main limitation for the use Utsira is the maximum annual injection rate for CO_2, not its total storage capacity
- CO_2 transport to Utsira is mainly from the UK and NL
- Different infrastructure layouts primary affect the CO_2 stored in Utsira, not the total amount of CO_2 captured

Thank you for your attention!

Final report:
http://www.fenco-era.net/Storage_Utsira