CO2Europipe
Project results
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Financing large scale CO_2 transport infrastructure for CCS beyond the demo phase

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Agenda

- Solving the CCS puzzle
- Analysis of test cases WP 4.1 till WP 4.4
- Investments, OPEX and capacity
- Financial value of CO_2 transport for EOR and CCS
- Transport modalities pipelines and shipping
- The challenge of private capital for financing
- CO_2 transport business model
- Conclusions
- Recommendations

CCS puzzle

CO_2 emission Scenarios

Storage planning and abandonment

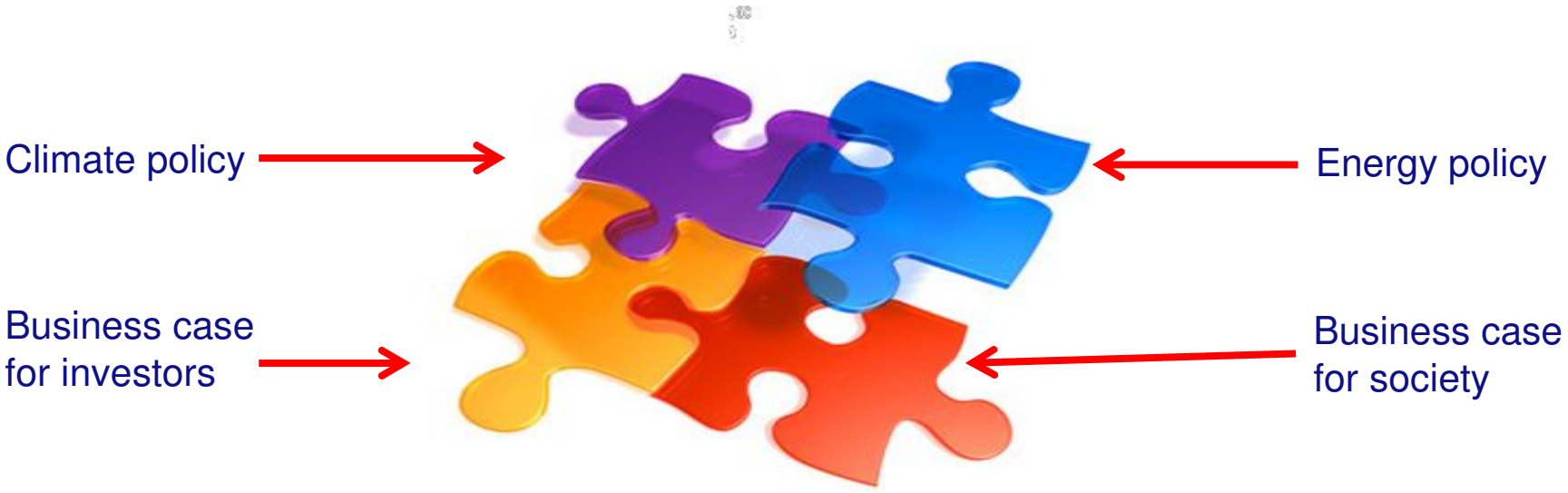
CO_2 EOR demand Scenarios

Financing and guarantees

Coordination investment plans

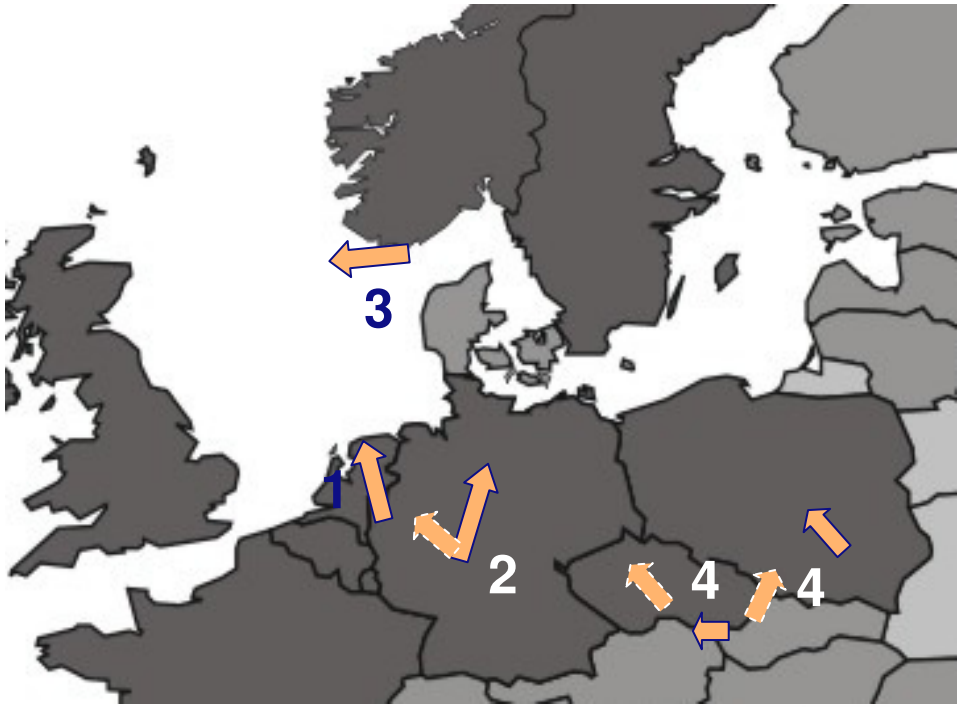
Transport business Model

Aspired high level results



Test cases

1. Rotterdam (with CO_2 import from Belgium and Germany)
   - Storage in North Sea + EOR (cooperation with ECCO)
2. Rhine / Ruhr area, Northern Germany
   - Storage in North Sea, through Emden/Rotterdam
3. Norwegian mainland – North Sea
   - Kårstø offshore CO_2 pipeline
   - Network NL, DE, UK to NO
4. Central Europe
   - Poland, Czech Republic
   - National; cross-border



Investments, OPEX and capacity

- Total foreseen investment **up to 2050** for EU CO_2 transport network with average capacity of 600 M ton CO_2/yr (18 Gton in total)
  - € 50 Billion (when onshore and offshore storages are combined)
  - € 80 Billion (when only offshore storage is applied
- Compare this with the required investment for natural gas and power transport of € 200 Billion **up to 2020 only** *
- The CO_2 network transport/operating costs including compression are
  - based on similar values and assumptions as ZEP report **
  - Between 10 till 15 euro/ton CO_2 transported
  - low compared to equivalanet costs of natural gas and power transport
- New result: OPEX is dominant (> 60 %) in transport costs and this implies that
  - Oversizing pipelines for economy of scale might be justified on cashflow basis
  - Different transport network configurations can be considered on basis of lowest socio-economic costs over CCS value chain
  - Mitigation of risk and easier financing as projects become more bankeable

- * Energy Infrastructure priorities for 2020 and beyond – by EU DG-energy
- ** ZEP: The costs of CO2 Transport (2011)

Financial value of CO2 transport for CCS and for CO2-EOR in the North Sea

- Additional cumulative value of CO_2 EOR in North Sea is 7,5 billion barrels of oil*
- CO_2 demand for EOR up to 100 million ton/yr** exceeds CO_2 volume for CCS (PRIMES) in North Sea (30 million ton CO_2/yr)
- CO_2 "storage only" locations relatively close to major CO_2 -EOR oil fields
- Implications for a shared network:
  - A shared transport network offers financial synergies
  - Timing is crucial
  - Different business drivers CCS and CO_2 -EOR
  - Opportunity to integrate climate policy (reducing CO_2 emissions) and energy policy (to increase energy security by CO_2 -EOR)
  - Timing, political commitment and incentives are also important factors

* EU 21895

** ECCO report

Transport modalities: pipelines and shipping

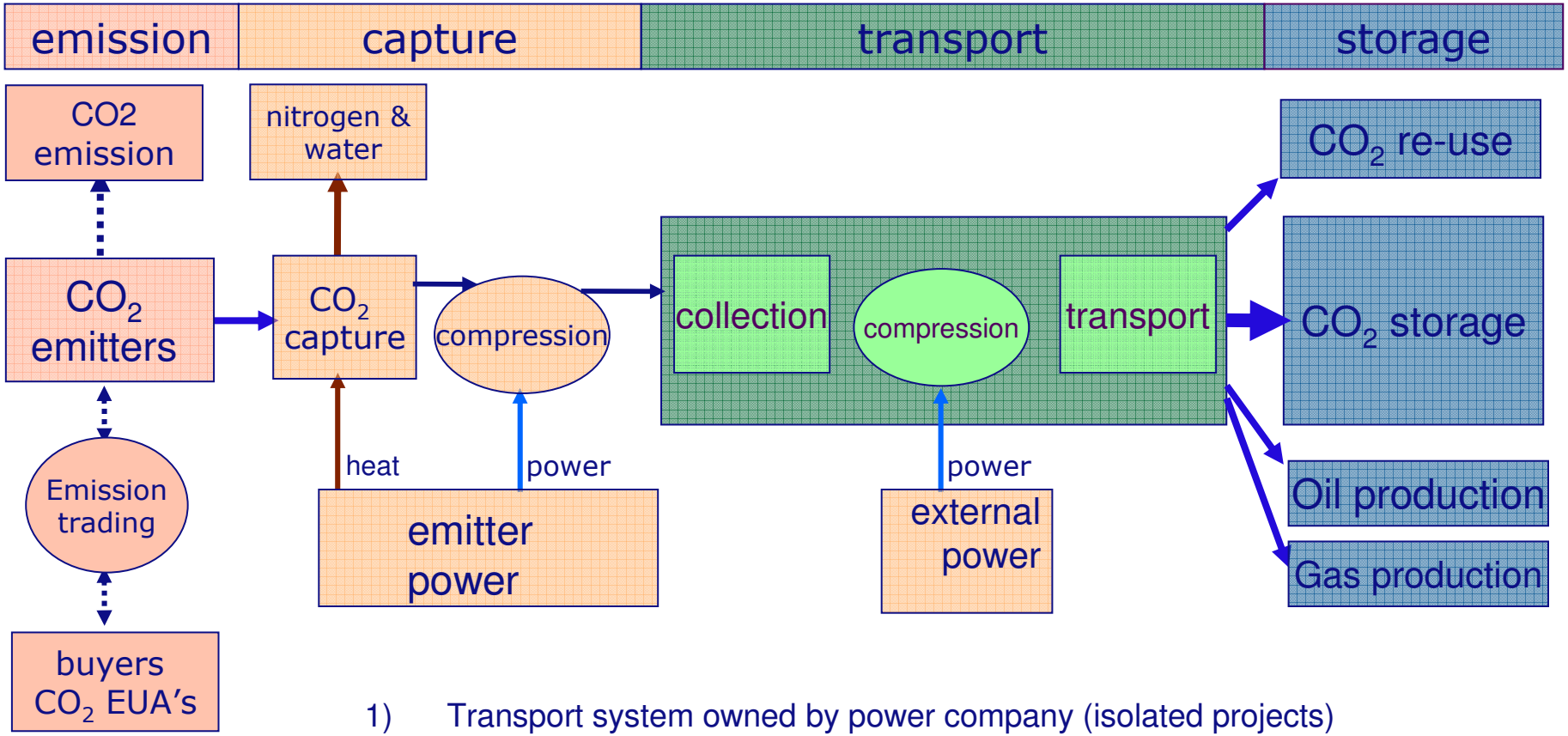
- The financial “break-even” point for ship v’s pipeline transportation is around 200 km distance with 3 to 4 million ton CO_2 /yr throughput
- The two alternative options provide different risk and investment profiles that will attract different sources of private equity capital
- New result: optimal integration of CO_2 transport by ships and pipelines for large transport network offshore leads to:
  - Flexibility in routing CO_2 hub to sinks
  - Accomodates changes in CO_2 supply (robustness)
  - Reduced investment risk for large pipelines
  - Reduced investment risk for offshore platform/field investments for storage and EOR
  - Enabler and catalyst for transition from demo projects to large scale network

Attracting private capital for financing

- It is foreseen that CO_2 transport network ownership and operations can be a similar business activity like gas and power transportation within the EU
- Financial benchmarking of these businesses shows:
  - Nett profit margin on average 25 % to 30 %
  - Dividend Yield 3% - 7%
  - Return on Capital 6% - 8%
  - Return on Equity 15% -30%
- The largest uncertainty that is currently preventing influx of private capital is political RISK!
  - Which businessmodels will convince the banks to provide the loans?

Businessmodels for CO_2 transport

(from isolated projects to network system)



1) Transport system owned by power company (isolated projects)
2) Independent transport network owner (model for CO_2 hubs like current gas and power transport businesses) will invite lenders

Conclusions

- Business model of independent transport network owner CO_2 transport
  - Similar to gas and power transport
  - Unbundling leads to lowest financing costs
  - Favored for large industrial clusters and storage locations (Netherlands, Germany, UK, Norway etc.)
- Business model vertical integration might initially be favored for large power companies outside large clusters in e.g. Poland and Czech republic
- Financial benchmarking demonstrates that private capital can be attracted for network investments when the independent transport business model is used (provided that government give financial guarantees and take the political risks)
- Transport costs (€/ton) for CO_2 are much lower than for power and natural gas; hence a pan-European CO_2 transport network should be feasible
- A multi-source multi-sink large diameter pipeline network is favored (more cost-effective and robust) than a collection of small point to point connections
- Shipping can act as enabler and accelerator for transition from demo to large scale CCS and EOR due to its flexibility

Recommendations

- Implementation of a large-scale CO2 Transport & Storage System requires high level coordination via a supranational entity
- A Master Plan for CO2 Transport & Storage should be part of the energy infrastructure roadmap being prepared by DG Energy
- The Master Plan will;
  - Identify significant economies-of-scale to reduce the overall investment and operating costs for a pan-European CO2 Transportation Infrastructure
  - Reduce the socio-economic impact of achieving the EU targets for CO2 reductions and Climate Change Policy
- Leadership from within the EU Member States is required to support implementation of the Master Plan
- Governments will need to provide cost-effective fiscal / tax incentives and financial guarantees (via EIB?) to attract sufficient private capital for investment in the projects