



CO2Europipe  
Project results  
Brussels, September 13

**Financing large scale CO<sub>2</sub> transport  
infrastructure for CCS  
beyond the demo phase**

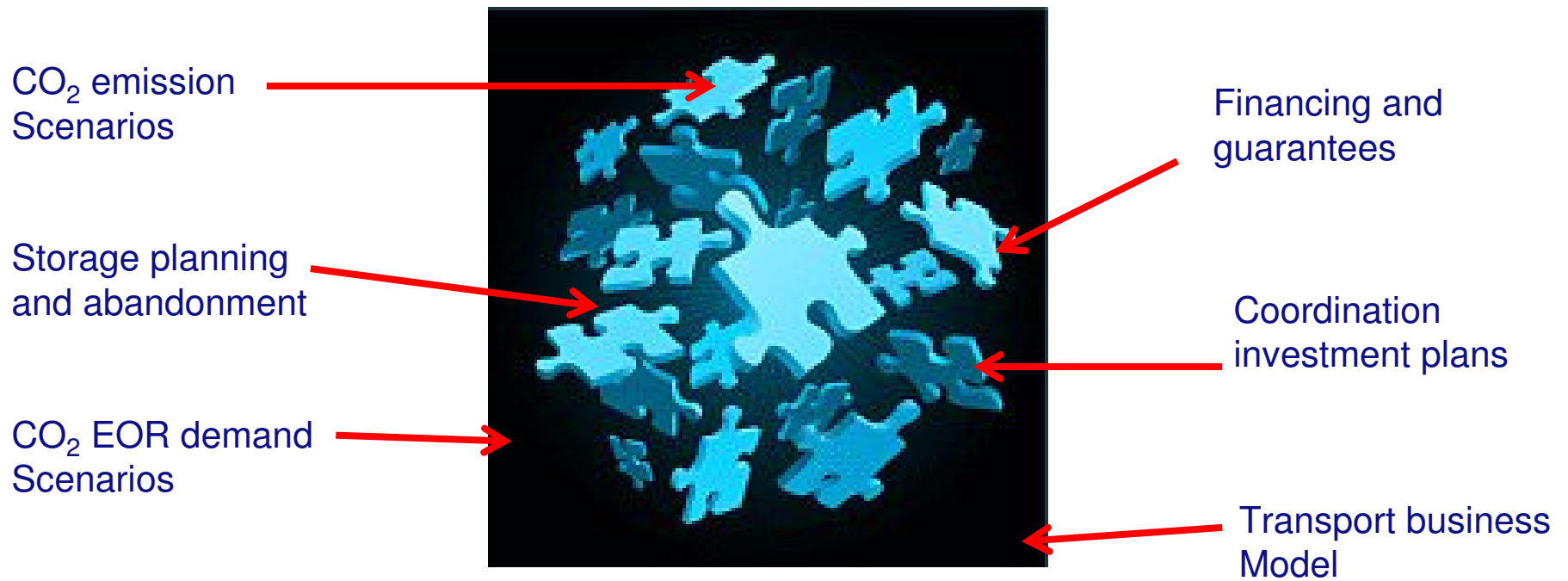
Stijn Santen, CO2-Net B.V.  
stijn.santen@co2-net.com

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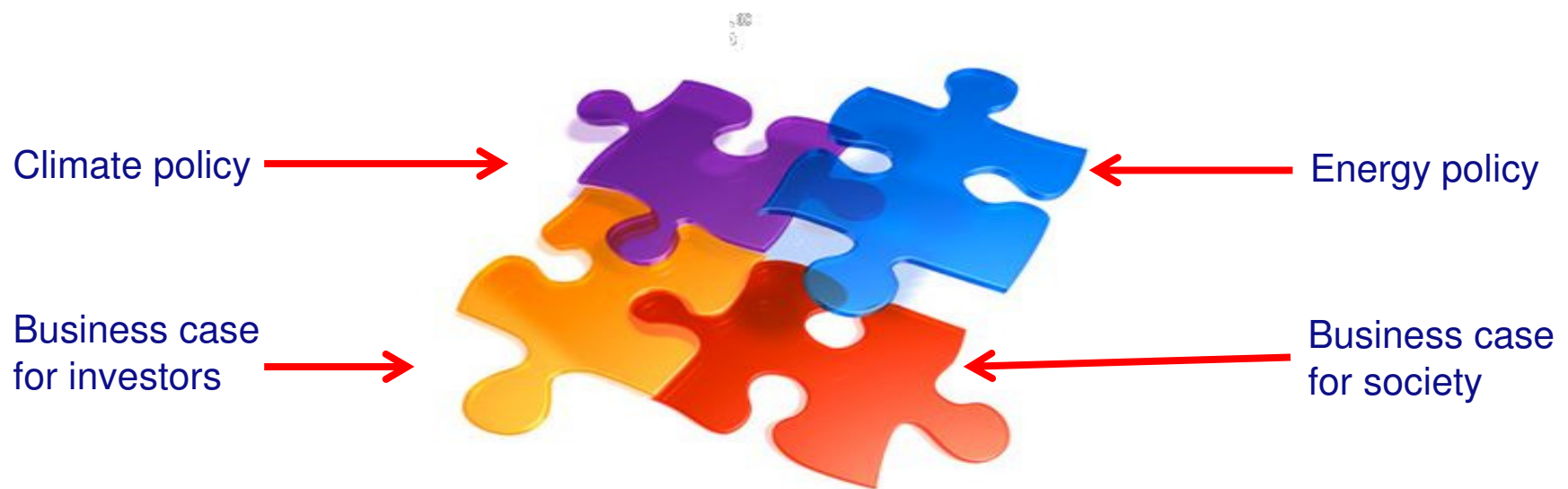
# Agenda

- Solving the CCS puzzle
- Analysis of test cases WP 4.1 till WP 4.4
- Investments, OPEX and capacity
- Financial value of CO<sub>2</sub> transport for EOR and CCS
- Transport modalities pipelines and shipping
- The challenge of private capital for financing
- CO<sub>2</sub> transport business model
- Conclusions
- Recommendations

# CCS puzzle

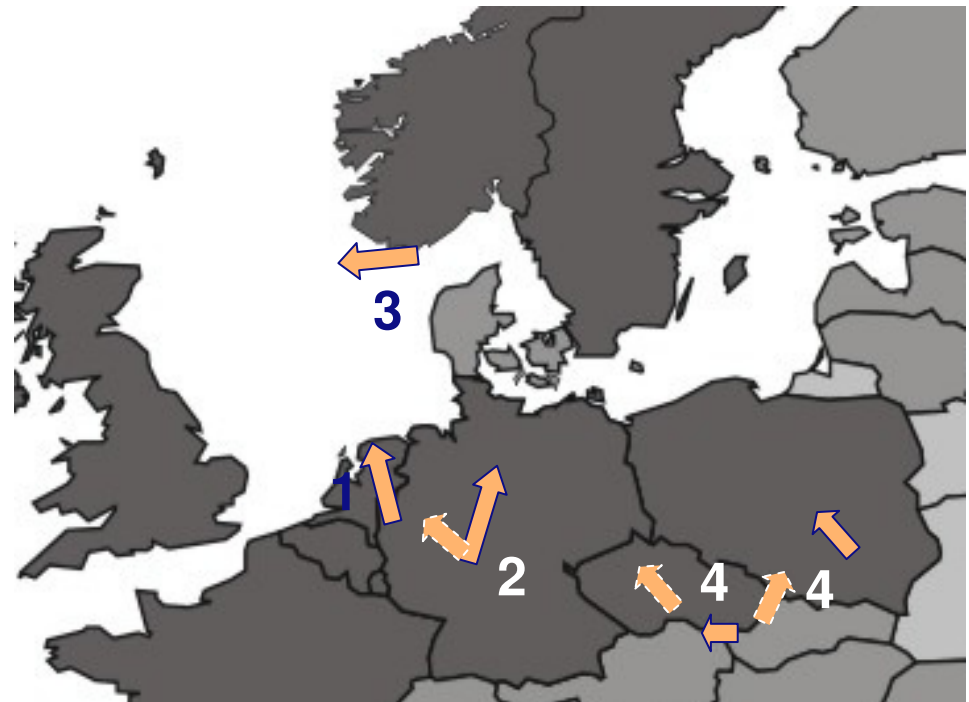


# Aspired high level results



# Test cases

1. Rotterdam (with CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> transport network with average capacity of 600 M ton CO<sub>2</sub>/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<sub>2</sub> network transport/operating costs including compression are
    - based on similar values and assumptions as ZEP report \*\*
    - Between 10 till 15 euro/ton CO<sub>2</sub> transported
    - low compared to equivalent 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 bankable
- \* Energy Infrastructure priorities for 2020 and beyond – by EU DG-energy
- \*\* ZEP: The costs of CO<sub>2</sub> Transport (2011)

# Financial value of CO<sub>2</sub> transport for CCS and for CO<sub>2</sub>-EOR in the North Sea

- Additional cumulative value of CO<sub>2</sub> EOR in North Sea is 7,5 billion barrels of oil\*
- CO<sub>2</sub> demand for EOR up to 100 million ton/yr\*\* exceeds CO<sub>2</sub> volume for CCS (PRIMES) in North Sea (30 million ton CO<sub>2</sub>/yr)
- CO<sub>2</sub> “storage only” locations relatively close to major CO<sub>2</sub>-EOR oil fields
- Implications for a shared network:
  - A shared transport network offers financial synergies
  - Timing is crucial
  - Different business drivers CCS and CO<sub>2</sub>-EOR
  - Opportunity to integrate climate policy (reducing CO<sub>2</sub> emissions) and energy policy (to increase energy security by CO<sub>2</sub>-EOR)
  - Timing, political commitment and incentives are also important factors

\* EU 21895

\*\* ECCO report

# Transport modalities: pipelines and shipping

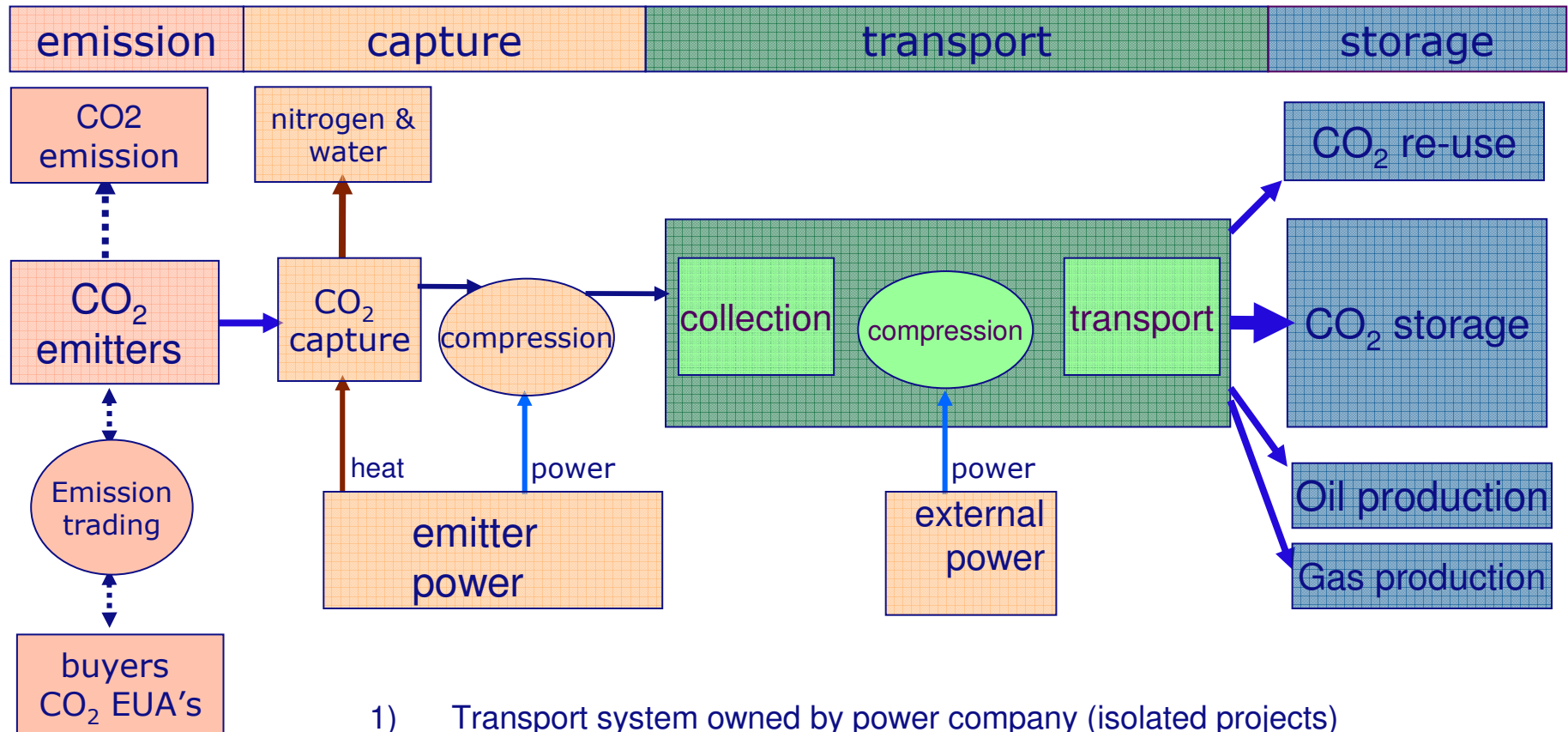
- The financial “break-even” point for ship v’s pipeline transportation is around 200 km distance with 3 to 4 million ton CO<sub>2</sub>/yr throughput
- The two alternative options provide different risk and investment profiles that will attract different sources of private equity capital
- New result: optimal integration of CO<sub>2</sub> transport by ships and pipelines for large transport network offshore leads to:
  - Flexibility in routing CO<sub>2</sub> hub to sinks
  - Accommodates changes in CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> transport

(from isolated projects to network system)



- 1) Transport system owned by power company (isolated projects)
- 2) Independent transport network owner (model for CO<sub>2</sub> hubs like current gas and power transport businesses) will invite lenders

# Conclusions

- Business model of independent transport network owner CO<sub>2</sub> 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<sub>2</sub> are much lower than for power and natural gas; hence a pan-European CO<sub>2</sub> 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 CO<sub>2</sub> Transport & Storage System requires high level coordination via a supranational entity
- A Master Plan for CO<sub>2</sub> 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 CO<sub>2</sub> Transportation Infrastructure
  - Reduce the socio-economic impact of achieving the EU targets for CO<sub>2</sub> 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