ECCO
European value Chain for CO$_2$

Contract N°218868

Project coordinator: SINTEF Energy Research
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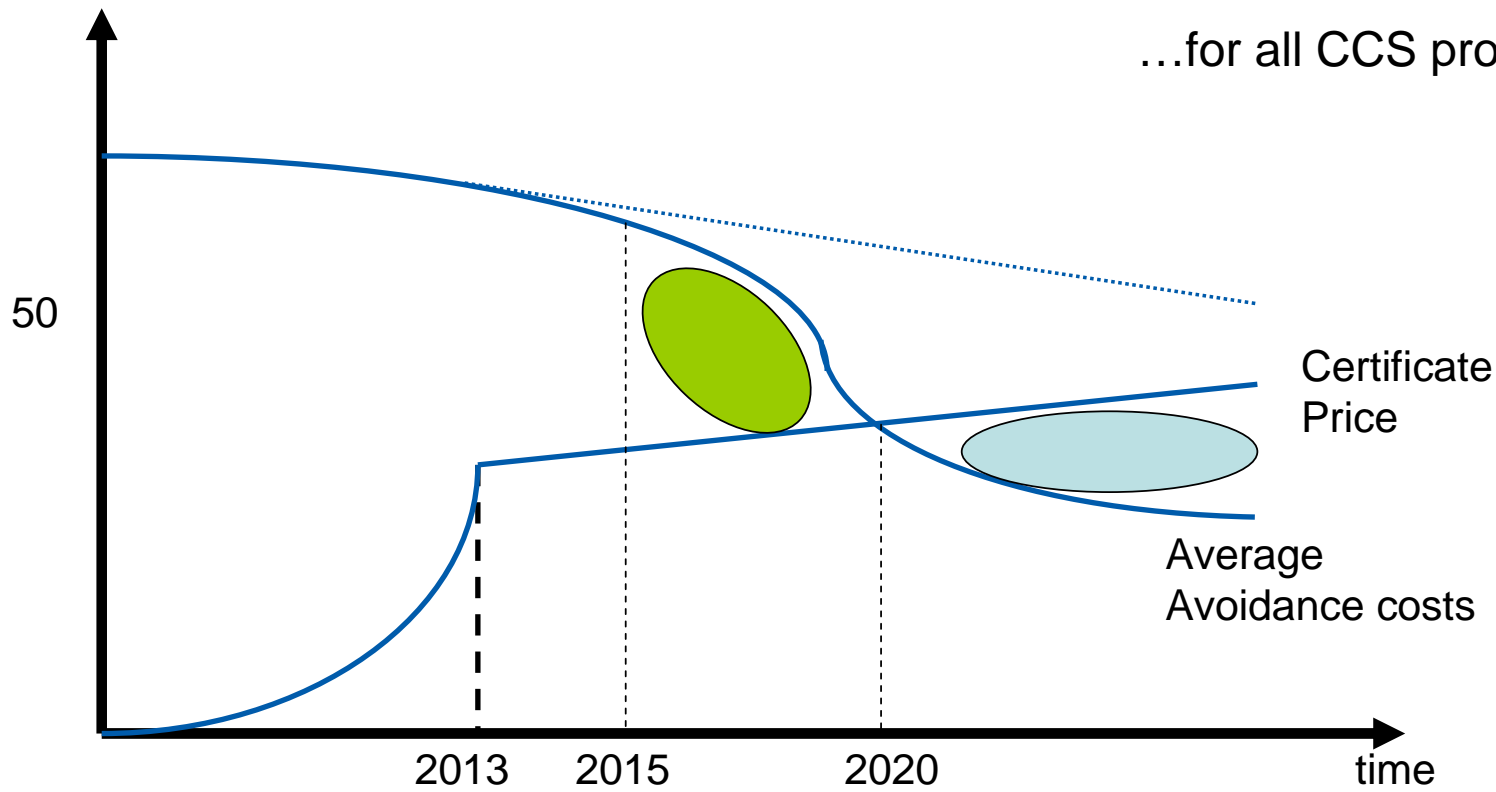**CCS-conference, Oslo, 10th February 2009**

Outline

- ■ ECCO background, objectives and expected impact
- ■ ECCO metrics and structure
- ■ ECCOs approach towards fulfilling the expected impact
  - – Scenarios
  - – Case studies
  - – Modelling
- ■ Some initial work in ECCO (after 5 months…)
- ■ ECCOs main results and expected industry uptake

ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO</u>$_2$
The challenge… as stated by EU

Additional Cost for
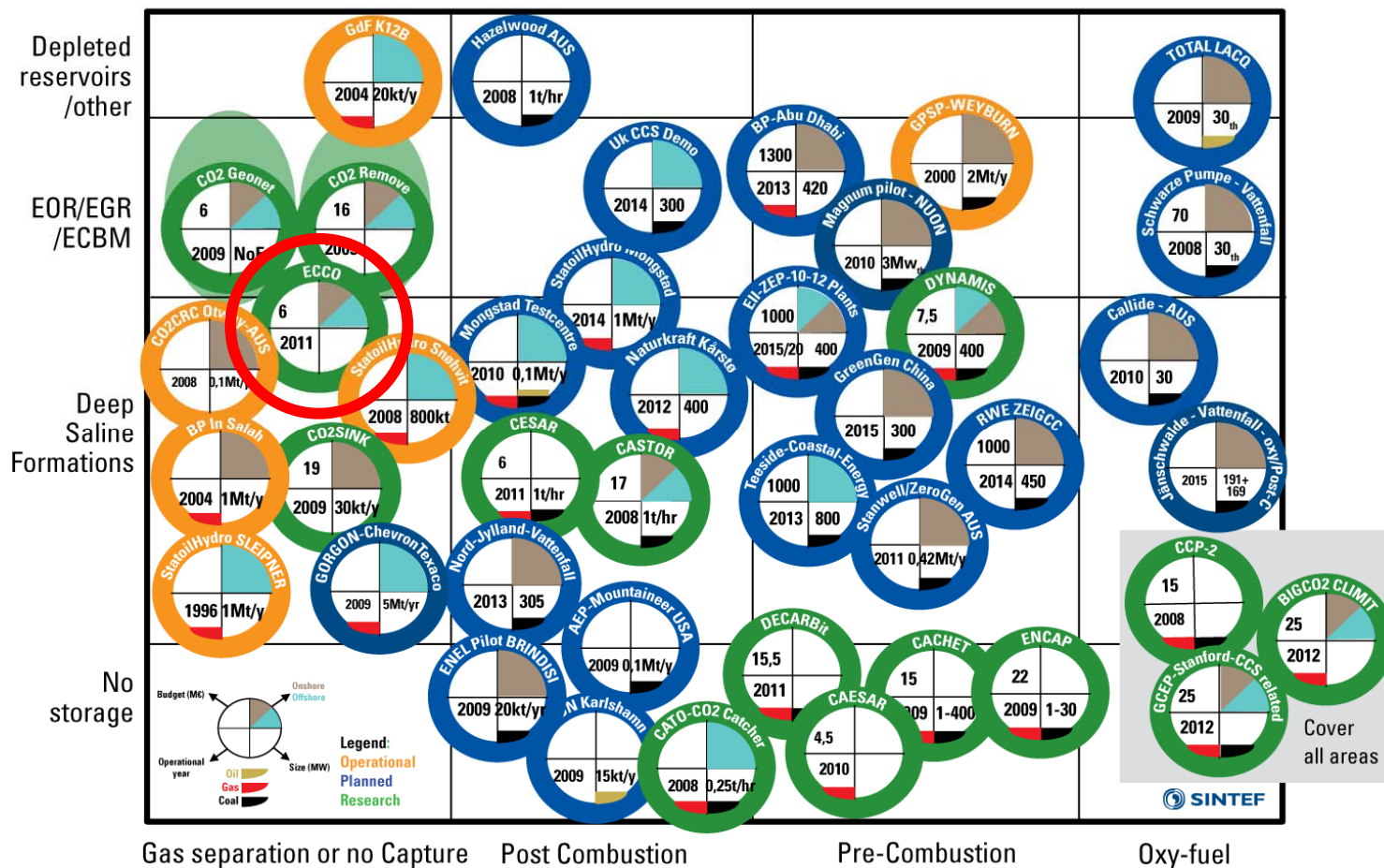CCS, per ton CO2

…for all CCS projects!

50

Certificate
Price

Average
Avoidance costs

2013   2015   2020   time

Illustration; K. Tullius, EU

Directorate-General
for Energy
and Transport

ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO₂</u>
CCS project portfolio (some of it…)

ECCO – Ｅuropean Value Ｃhain for ＣＯ$_2$
Project objectives

The main objective of ECCO is to facilitate robust strategic decision making regarding early and future implementation of CO_2 value chains in the face of uncertainty.

- Provide the basis for, and the recommendations leading to implementation of the most promising EOR and EGR alternatives
- Prepare for analyses and recommendations through the development of a CO_2 value chain analysis tool
- Quantify the potential for enhanced hydrocarbon recovery (EOR/EGR) and CO_2 storage in European petroleum reservoirs and evaluate technological challenges

ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO</u>$_2$
Project expected impacts

- **Underpin the realisation of CO$_2$ value chains** for captured CO$_2$ from large point sources for CO$_2$ injection in petroleum reservoirs (EOR/EGR) and CO$_2$ storage.

- Improve security of supply by enabling **sustainable use of fossil fuels**, protracting increases in fuel imports by making **better use of existing resources** and **shortening time to market** for promising CCS related technologies.

- **Strengthen the competitiveness of the European economy** by maintaining and reinforcing the leading position in CCS technologies and by sharing and building on the existing EOR experience in Central and Eastern Europe and on-going activities in the North Sea.

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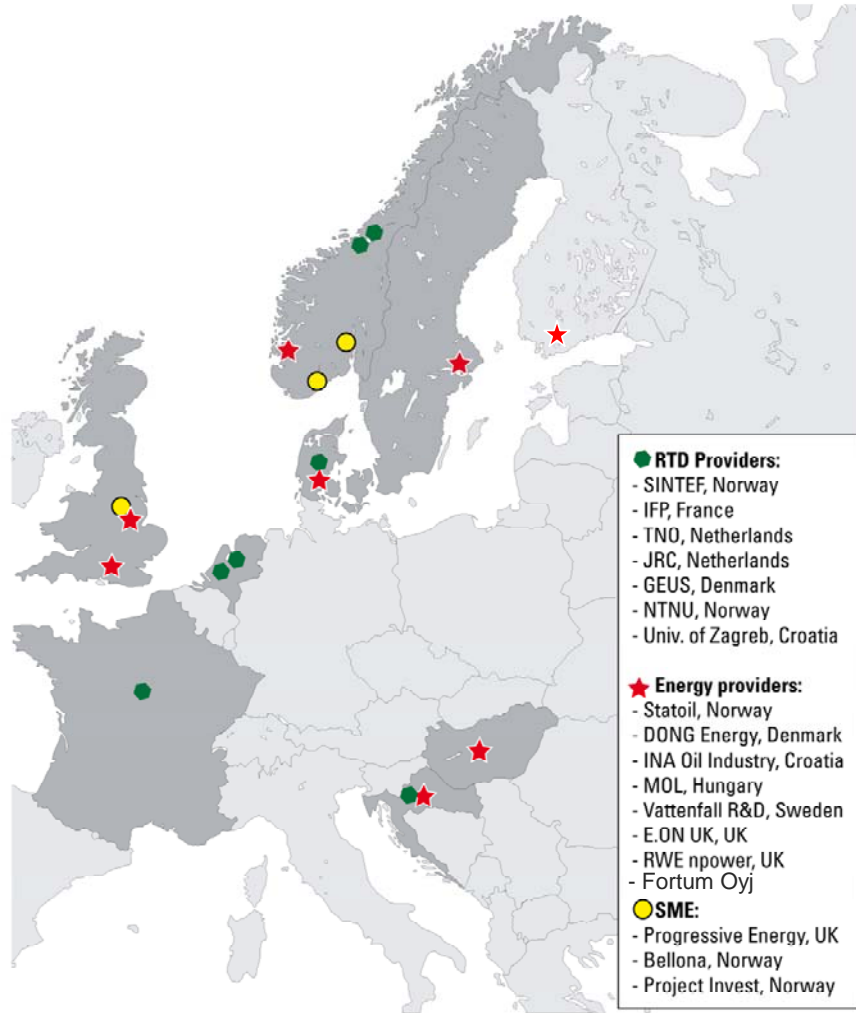# ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO</u>$_2$
Project metrics

- Duration : 3 yrs – started 1st September 2008
- Budget: 5.355 M€ ~3.853 M€ in grant
- Partners: 18 legal entities (+1);
  - 7 (+1) energy providers (oil & gas companies and utilities)
  - 2 engineering companies
  - 1 NGO
  - 8 highly ranked RTD providers
- Coordinator: SINTEF Energy Research

- It's not a shoe – it's an EU-project!

ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO</u>$_2$
The Consortium

RTD Providers:
- SINTEF, Norway
- IFP, France
- TNO, Netherlands
- JRC, Netherlands
- GEUS, Denmark
- NTNU, Norway
- Univ. of Zagreb, Croatia

Energy providers:
- Statoil, Norway
- DONG Energy, Denmark
- INA Oil Industry, Croatia
- MOL, Hungary
- Vattenfall R&D, Sweden
- E.ON UK, UK
- RWE npower, UK
- Fortum Oyj

SME:
- Progressive Energy, UK
- Bellona, Norway
- Project Invest, Norway

ENERGY PROVIDER

ENGINEER

RWE
The energy to lead

DONG energy

Fortum Oyj

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ECCO – Europeam Value Chain for CO_2 Strategy – key questions

ECCO should provide **methodology and tool** for evaluation of various CO_2 chain options and so **enabling making qualified decisions**.

- **What might be the future "CO_2 world"?**

- **How to identify feasible CO_2 chain options?**

- **How to evaluate the CO_2 chain options and choose the most promising solutions for CCS?**

ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO</u>$_2$ Strategy – key questions

- **What might be the future CO$_2$ world?**
  - **Scenario analysis –> 2-3 scenarios**
    - Exist infrastructure?
    - Who owns infrastructure?
    - How will parameters affecting oil/gas/el market develop?
    - What are the incentives/regulations for CCS?
  - IMPORTANT – best guess - qualified experts opinion

- **How to identify feasible CO$_2$ chain options?**
  - **Formulation & analysis of cases**
    - Relevant questions/problem formulation
    - Cases reflecting the scenarios
    - Cases illustrating the effect and importance of various parameters – sensitivity analysis
    - **Integrated multiple source/sink systems**
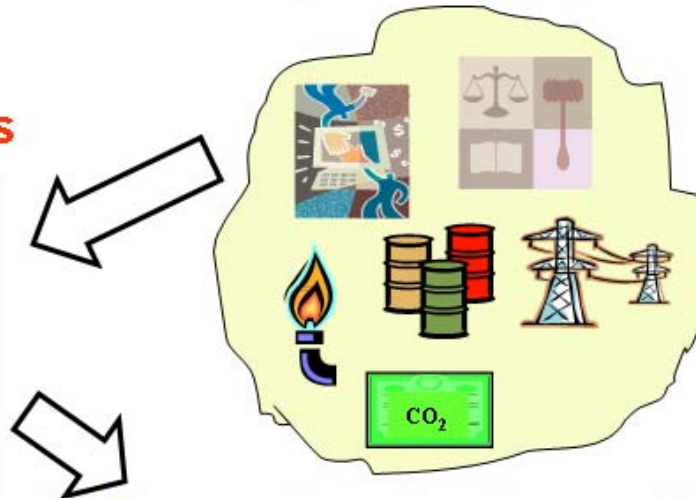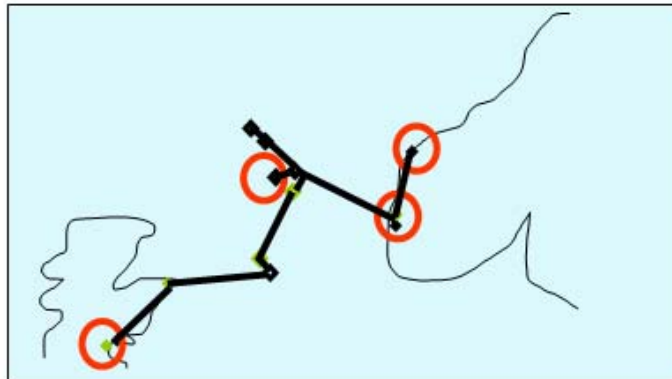 - IMPORTANT – relevant cases - "smart use of tool"

- **How to evaluate the CO$_2$ chain options and choose the most promising solutions for CCS?**
  - Tool for economic analysis of CO$_2$ chain
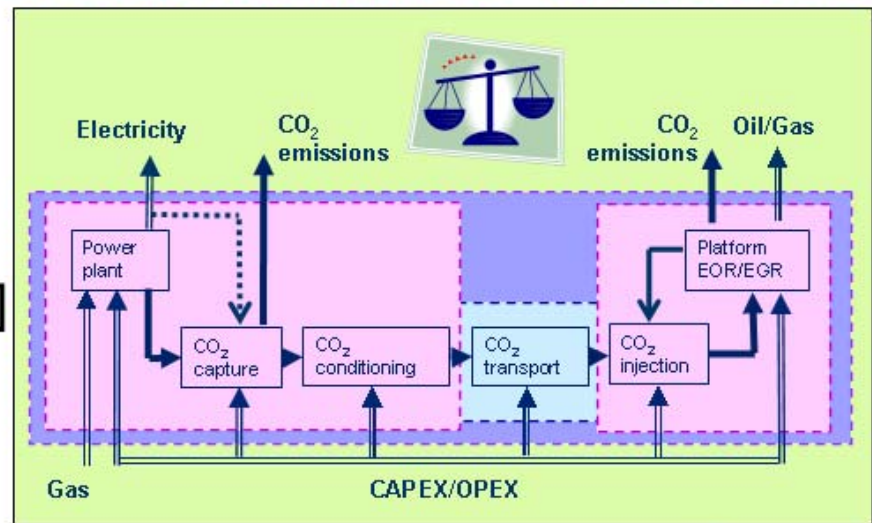 - IMPORTANT – simple BUT high quality input data & consistent implementation

The iteration process…

1. Scenario – "predicting" future CO_2 world

2. Case study – defining options
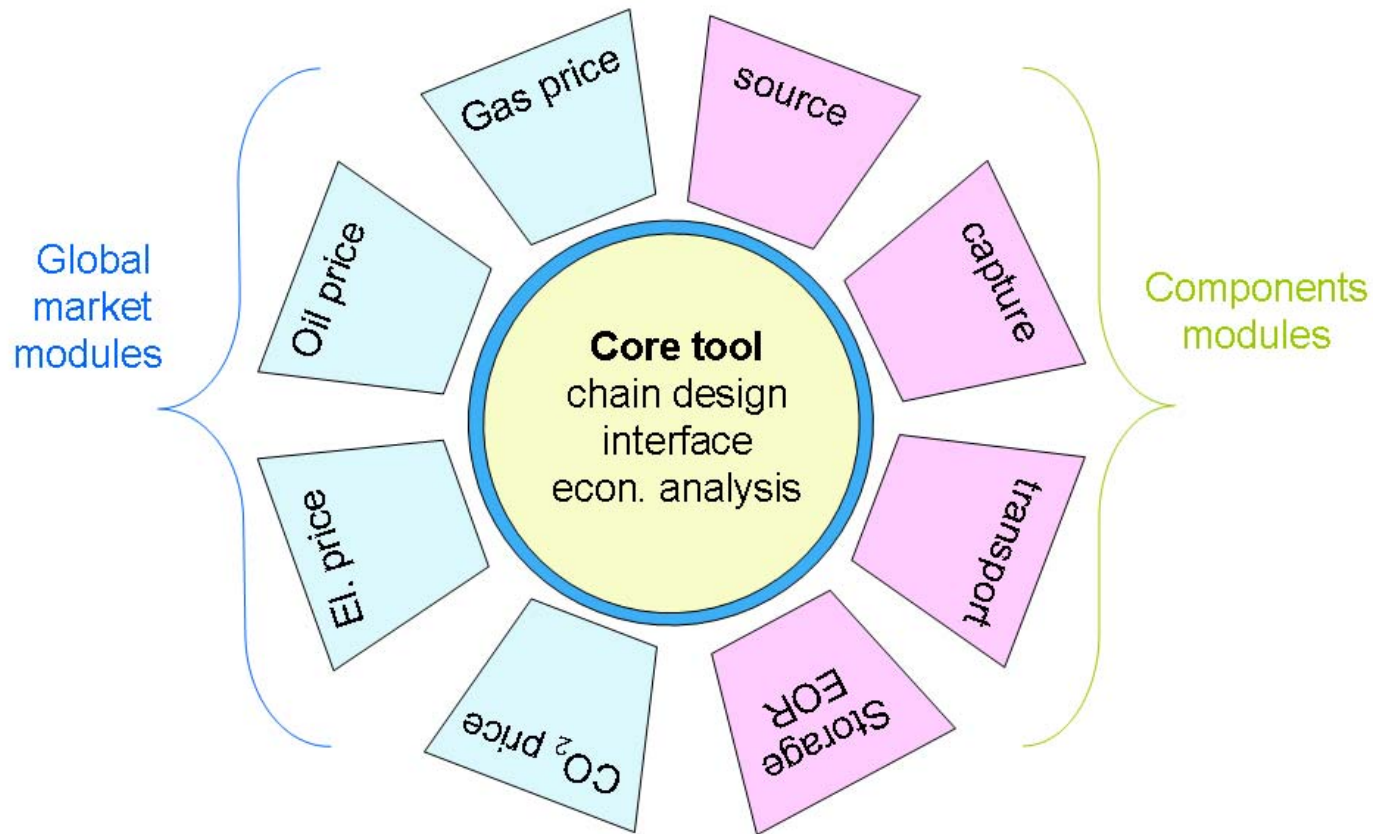
3. Economic analysis – profit vs. costs

4. Case study – evaluating options & recommendations

J. P. Jakobsen SINTEF

ECCO – European Value Chain for CO_2
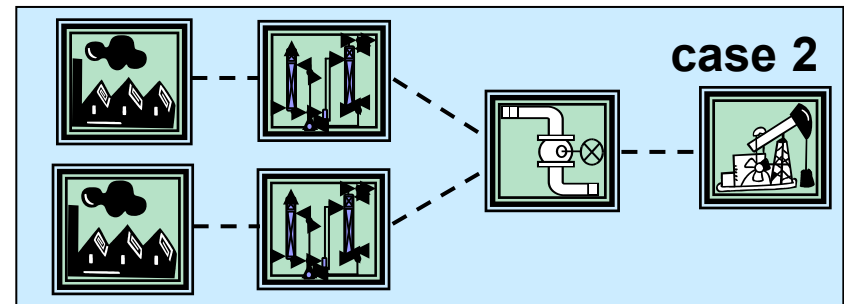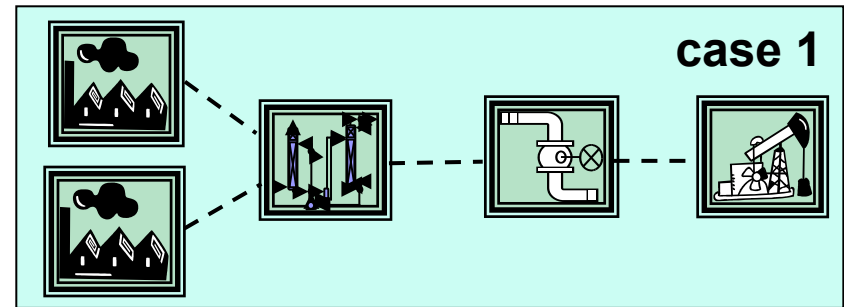# Object oriented code

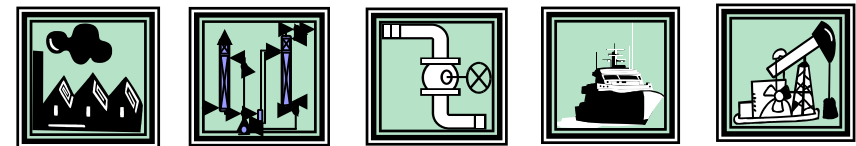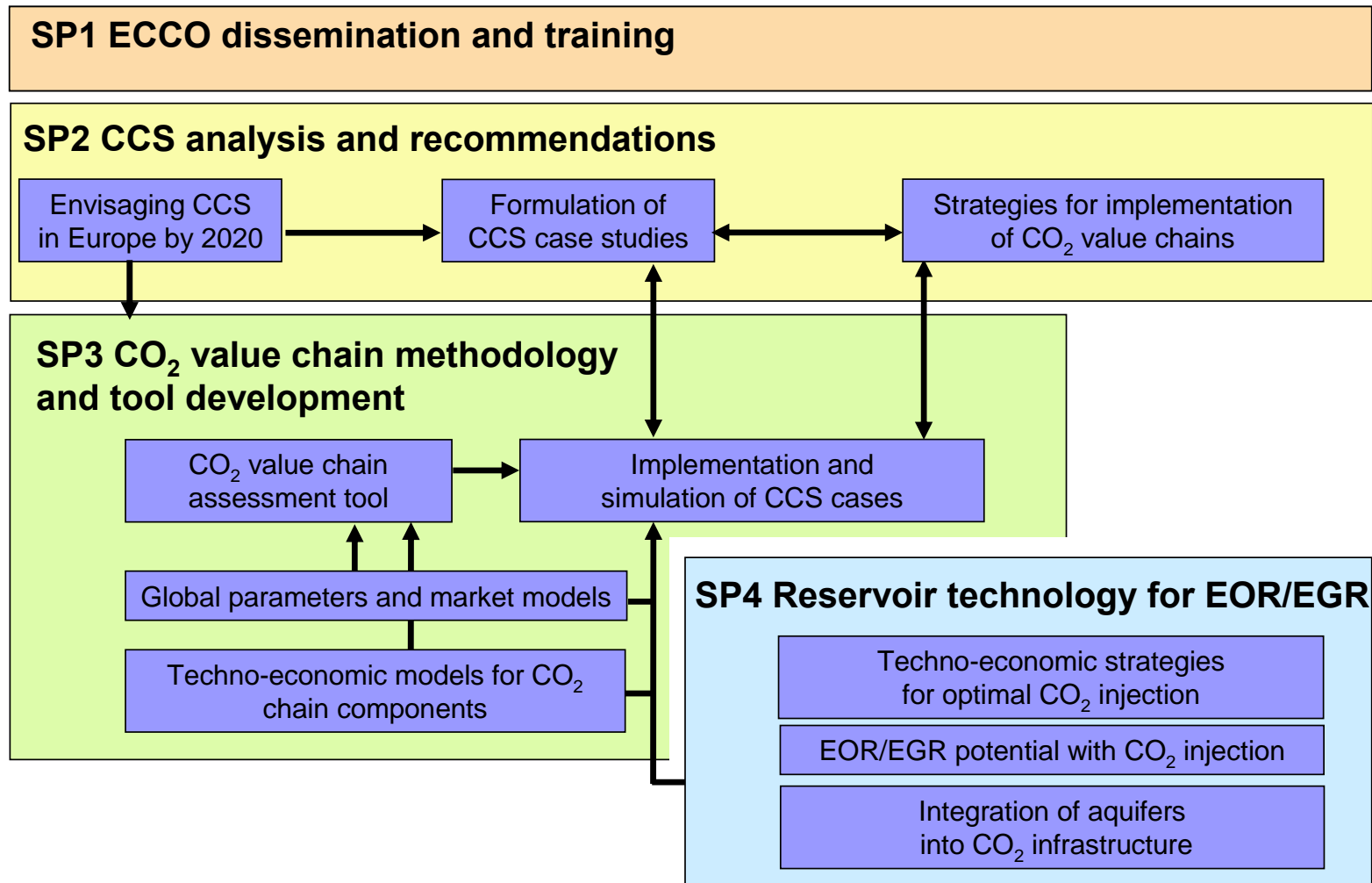J. P. Jakobsen SINTEF

ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO</u>$_2$
Tool design

- **Overall structure**
  - Modular –multiple modules chain (Drag and drop)

- **Global parameters**
  - Oil price
  - Gas price
  - El price
  - CO_2 quote price

- **Local parameters**
  - CO_2 capture efficiency
  - Characteristic costs for capture
  - Pipe length
  - Infrastructure
  - …
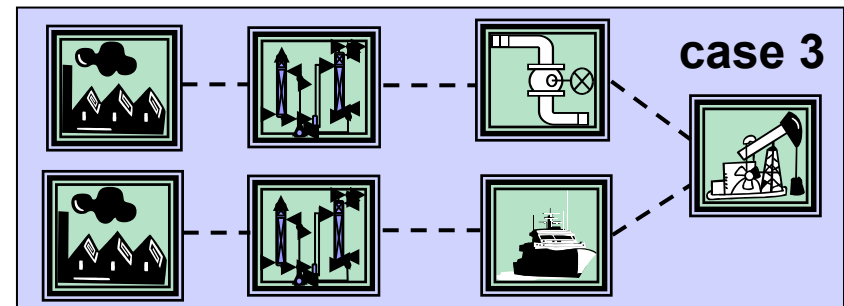
ECCO – <u>E</u>uropean value <u>C</u>hain for <u>CO</u>$_2$ Implementation

SP1 ECCO dissemination and training

SP2 CCS analysis and recommendations

| Envisaging CCS in Europe by 2020 | Formulation of CCS case studies | Strategies for implementation of CO_2 value chains |

SP3 CO_2 value chain methodology and tool development

| CO_2 value chain assessment tool | Implementation and simulation of CCS cases |

Global parameters and market models

Techno-economic models for CO_2 chain components

SP4 Reservoir technology for EOR/EGR

Techno-economic strategies for optimal CO_2 injection

EOR/EGR potential with CO_2 injection

Integration of aquifers into CO_2 infrastructure

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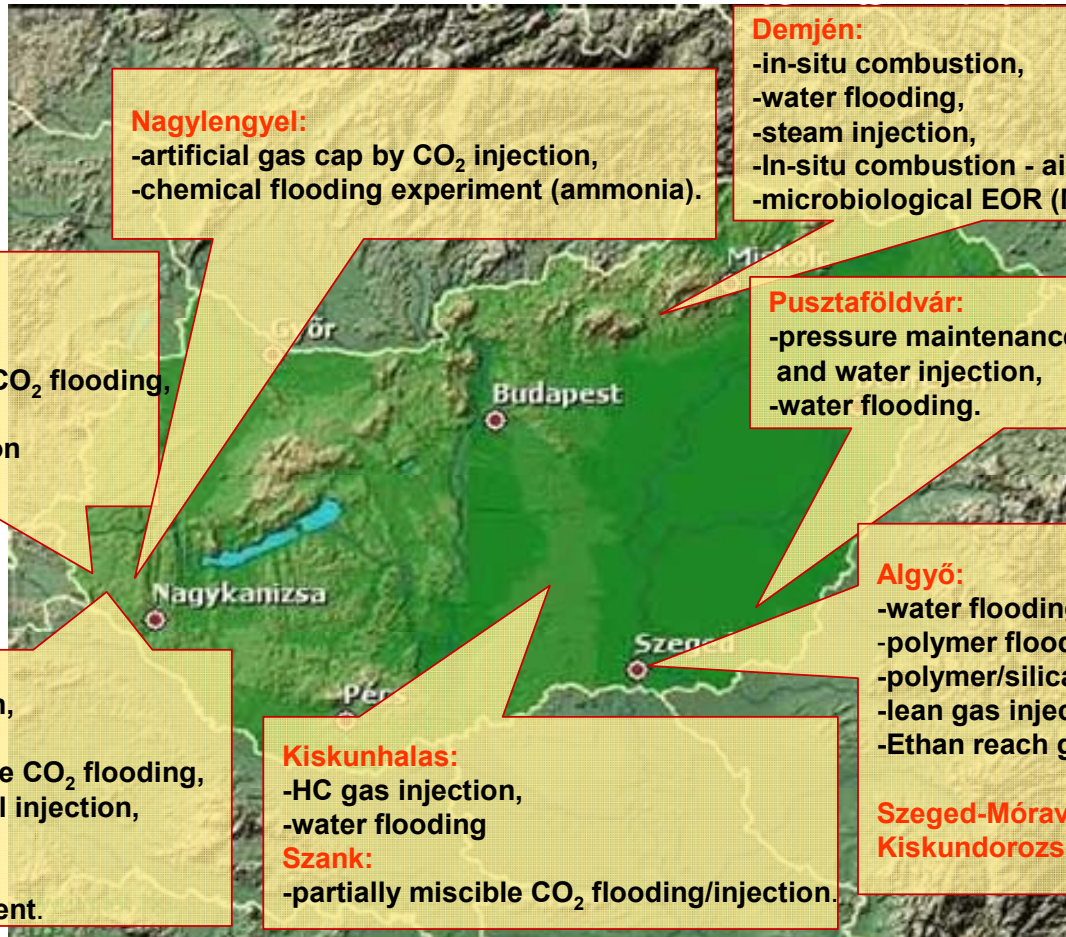# Some initial work (after 5 months…)

- Scenario work → what will it be like in 2020? CCS considered?
  - ECCO seeks to identify the early opportunities
  - Need to identify the main factors and actors affecting realization of CCS value chains in Europe (both short and long term perspective need to be considered)
  - *Workshops… group sessions… post-it notes…*

- Value chain tool – supporting tool for decision makers
  - Design and structure
  - Focus on input and output parameters, issues that are modelled and objective of tools – industrial relevance and importance emphasized
  - Based on ECCO partners' internal tools and available literature on other tools

- EOR/EGR as a part of the value chain
  - European experience in Hungary and Croatia (15 years!) – information shared by the relevant partners (next slide as example)
  - *Main source for CO?*
    - *Natural reservoirs!!*

30 years Experience in EOR/IOR technologies

Demján:
-in-situ combustion,
-water flooding,
-steam injection,
-In-situ combustion - air injection
-microbiological EOR (MEOR) experiment.

Nagylengyel:
-artificial gas cap by CO_2 injection,
-chemical flooding experiment (ammonia).

Lovászi:
-HC gas injection,
-water flooding,
-partially miscible CO_2 flooding,
-WAG,
-silicate gel injection
-in-fill wells.

Pusztaföldvár:
-pressure maintenanceby non-miscible CO_2 and water injection,
-water flooding.

Algyő:
-water flooding,
-polymer flooding experiment
-polymer/silicate gel treatment,
-lean gas injection and vaporization,
-Ethan reach gas injection.

Szeged-Móraváros and Kiskundorozsma: water flooding.

Budafa:
-HC gas injection,
-water flooding,
-partially miscible CO_2 flooding,
-WAG silicate gel injection,
-in-fill wells.
Újfalu:
- MEOR experiment.

Kiskunhalas:
-HC gas injection,
-water flooding
Szank:
-partially miscible CO_2 flooding/injection.

▶ **MOL GROUP**
Source: P. Kubus, MOL | **7**

EGGO
European value chain for CO_2

CO-FUNDED BY THE EUROPEAN UNION

SEVENTH FRAMEWORK PROGRAMME

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ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO</u>$_2$
Main results
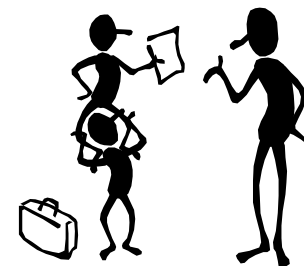
- ECCO is focused towards the complete CO_2 value chain, and will generate results and cause progress beyond state of the art within the following topics;
  - Strategies and recommendations for deployment of CO_2 value chain: Main report: **"ECCO Strategies for CO$_2$ value chain deployment".**
  - **CO$_2$ value chain assessment tool** that enables transparent and robust analysis of CO_2 value chains.
  - **Reservoir technology for EOR and EGR** increasing the ability to predict EOR and EGR profiles and potentials for CO_2 injection into European oil and gas reservoirs.
  - **Methodology for CO$_2$ value chain assessment** by means of establishing scenarios as input for formulation of CCS cases, which further are used in the CCS case analysis.

ECCO – <u>E</u>uropean Value <u>C</u>hain for <u>CO</u>$_2$
Users of results

The main users of ECCO-results

- **CO$_2$ Producers**
- **EC and other supranational bodies**
- **National authorities**
- **CO$_2$ Transporters and sellers**
- **CO$_2$ Storage operators**
- **R&D providers and universities**

Schwarze Pumpe, P.Røkke

- Finally, the increased knowledge of EOR and EGR potential and challenges provided by ECCO might provide the basis for further industrial activities in this front.

Thank you for your attention!

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http://ecco.sintef.no