CCS Programme (CCSP), Finland

Nicklas Nordbäck
Geological Survey of Finland

GTK

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Carbon Capture and Storage Program

CCS in Finland?

Mineral carbonation

- Calcium- and magnesium-based silicates react with CO_2 to form environmentally harmless carbonates.
- Mineral fixation of CO_2 studied in Finland since 2000.
  - Aalto University, Åbo Akademi University, VTT (Technical Research Centre of Finland) & GTK (Geological Survey of Finland)
  - Attractive technology for Finland due to large amounts of magnesium silicates (several Gt capacity) and lack of sites for geological CO_2 storage in sedimentary basins.
  - The major hold-up for this technology is the large amounts of material involved and the carbonation reaction kinetics.
    - Serpentinite, a magnesium silicate rock

FINNCAP

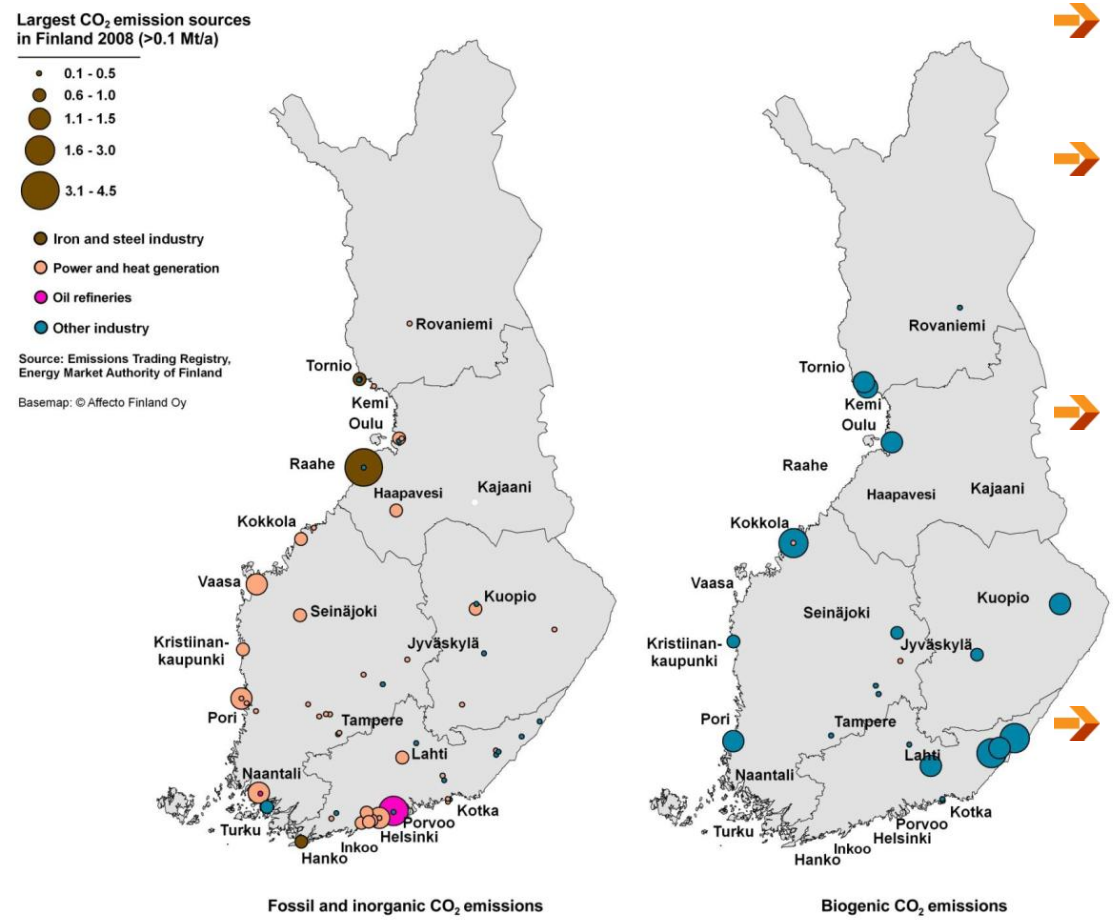
- FINNCAP CCS project initiated in 2008 by Fortum & TVO at Meri Pori power plant
  - Retro-fit Meri-Pori 565 MW coal-fired power plant with CCS technology by 2015.
  - CO_2 ship transportation concept.
  - Investigating possibility of storage in the depleting oil and gas fields of the Danish North Sea.
  - Feasibility studies completed in 2008-2009 with the aim to have Meri-Pori CCS project accepted to the EU CCS demonstration program.
- Cancelled in Autumn 2010 due to changes in company strategies and uncertainty of funding.

Application of CCS in Finland (CCS Finland)

- The CCS Finland project 1.1.2008-28.2.2010
  - Goal: Roadmap for application of CCS in Finland
  - R&D partners:
    - VTT (Technical Research Centre of Finland)
    - GTK (Geological Survey of Finland)
  - Industrial partners:
    - Fortum, Foster Wheler, Metso, Pohjolan Voima, Ruukki, Vapo
  - Financing (1.4 M€):
    - TEKES, Industrial partners, VTT, GTK

CCS Finland Outcome - Emissions

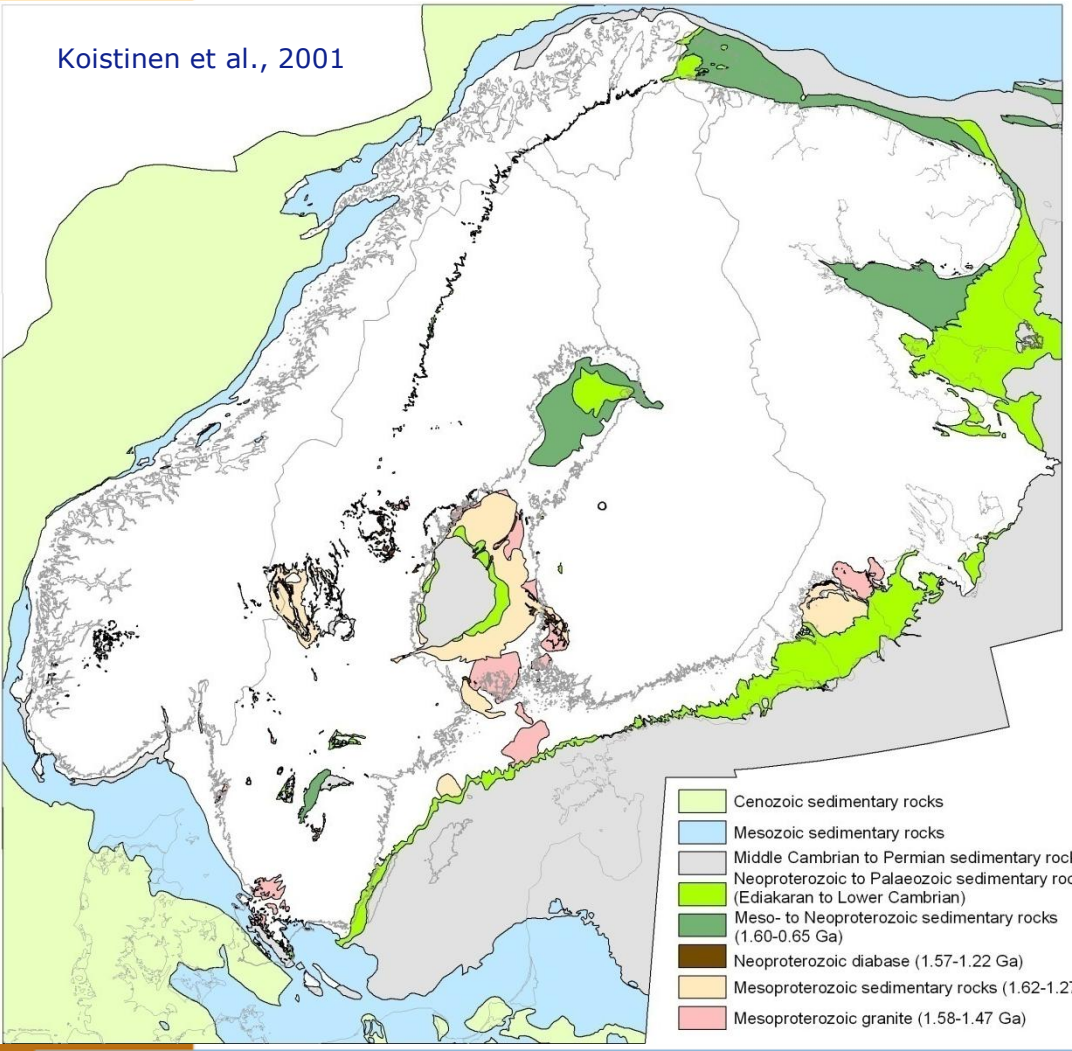
- Finnish carbon dioxide point sources were mapped



- 58 Mt in 2008, 64 Mt in 2010.
- 14 of the biggest point sources stand for about half of Finland's emissions.
- The largest point sources are power plants, oil refineries and heavy industry, which are all situated in the coastal region.
- Large biogenic emissions, BioCCS?

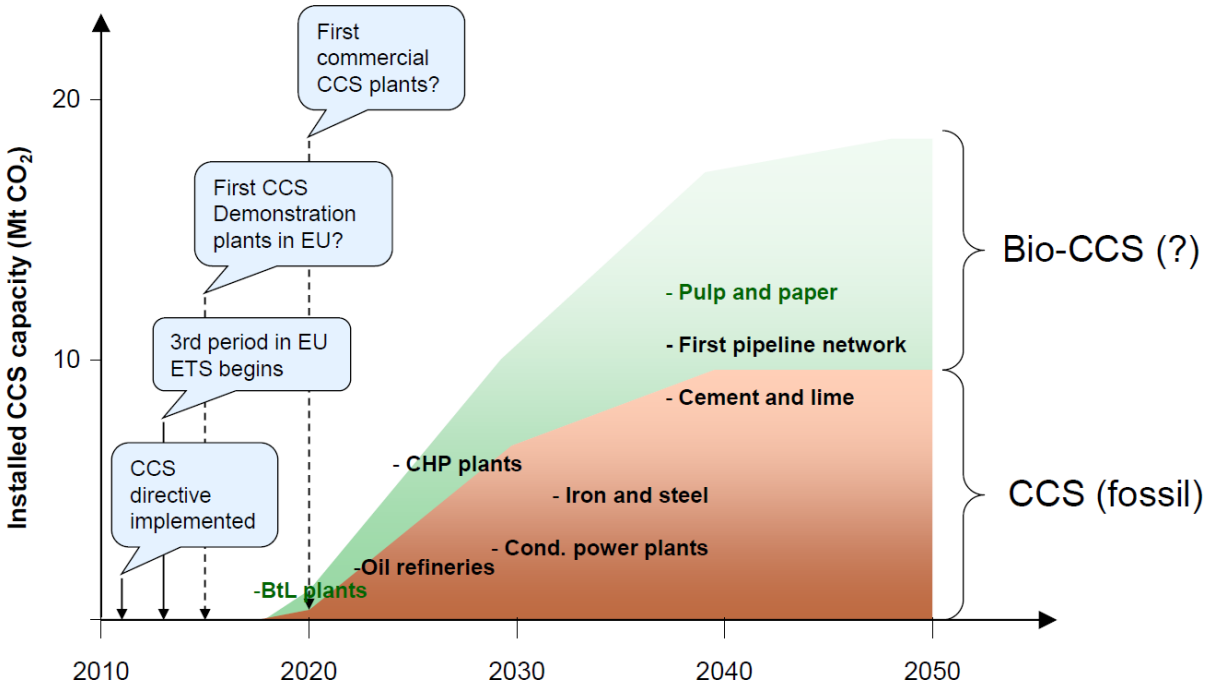
CCS Finland Outcome - Storage

- Storage options in Finland were investigated. No suitable geological formation for long-term storage of CO_2 exist.



- No hydrocarbon reservoirs.
- Sedimentary rocks are uncommon and don't fulfill any of the criteria for geological CO_2 storage.
- Bedrock may be suitable for intermediate storage of CO_2.
- High availability of rocks suitable for mineral carbonation with CO_2.
  - Carbonation technology not (yet) feasible for storage.

Roadmap for application of CCS in Finland



- Finland's carbon dioxide emissions could be reduced by 10–30% by 2050 using CCS technology.
  - The emission reductions could be achieved by applying CCS to a few large facilities.

- Captured CO_2 has to be transported abroad for storage.
  - Marine transportation could in the beginning be a cheaper solution compared to pipe transport.
    - Possibilities for geological intermediate storage.

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16 INDUSTRIAL PARTNERS
9 RESEARCH PARTNERS
5 YEARS ~20M€
PROGRAM MANAGER:
Antti.Arasto@cleen.fi

2011-2015

The key-technology areas:

- CCS in combined heat and power (CHP) systems
- CCS technology related to multi-fuel and bio-CCS
- CCS solutions for oil and gas and for iron and steel industry
- Acceptability of CCS

Long term breakthroughs:

- CLC (Chemical Looping Combustion)
- Mineral carbonation

Industrial partners 54,5%
Fortum Oyj 27%, Vibrometric Oy 9%, Ramboll Finland Oy 9%, Ruukki Metals Oy 8%, Helsingin Energia 8%, Neste Oil Oyj 8%, Gasum Oy 7%, Stora Enso Oyj 6%, Neste Jacobs Oyj 6%, ÅF Consult 3%, Foster Wheeler Energia Oy 3%, Nordkalk Oyj 2%, Oulun Energia 2%, Tapojärvi Oy 1%, Andritz Oy 1%, Outotec Oyj 1%

The overall objective of the Program is to develop CCS related technologies and concepts that would lead to essential pilots and demonstrations starting by the end of the Program i.e. ca. 2014-2015 targeting then to commercial concepts available from ca. 2020 onwards

Pilot SHOK programme for international collaboration

Research partners 45,5%
Technical Research Centre of Finland (VTT) 37%, Aalto University (TKK) 19%, Lappeenranta University of Technology 11%, Geological Survey of Finland (GTK) 10%, Tampere University of Technology 7%, University of Tampere 5%, University of Oulu 4%, Åbo Akademi University 4%, Finnish Environment Institute (SYKE) 3%

Tekes

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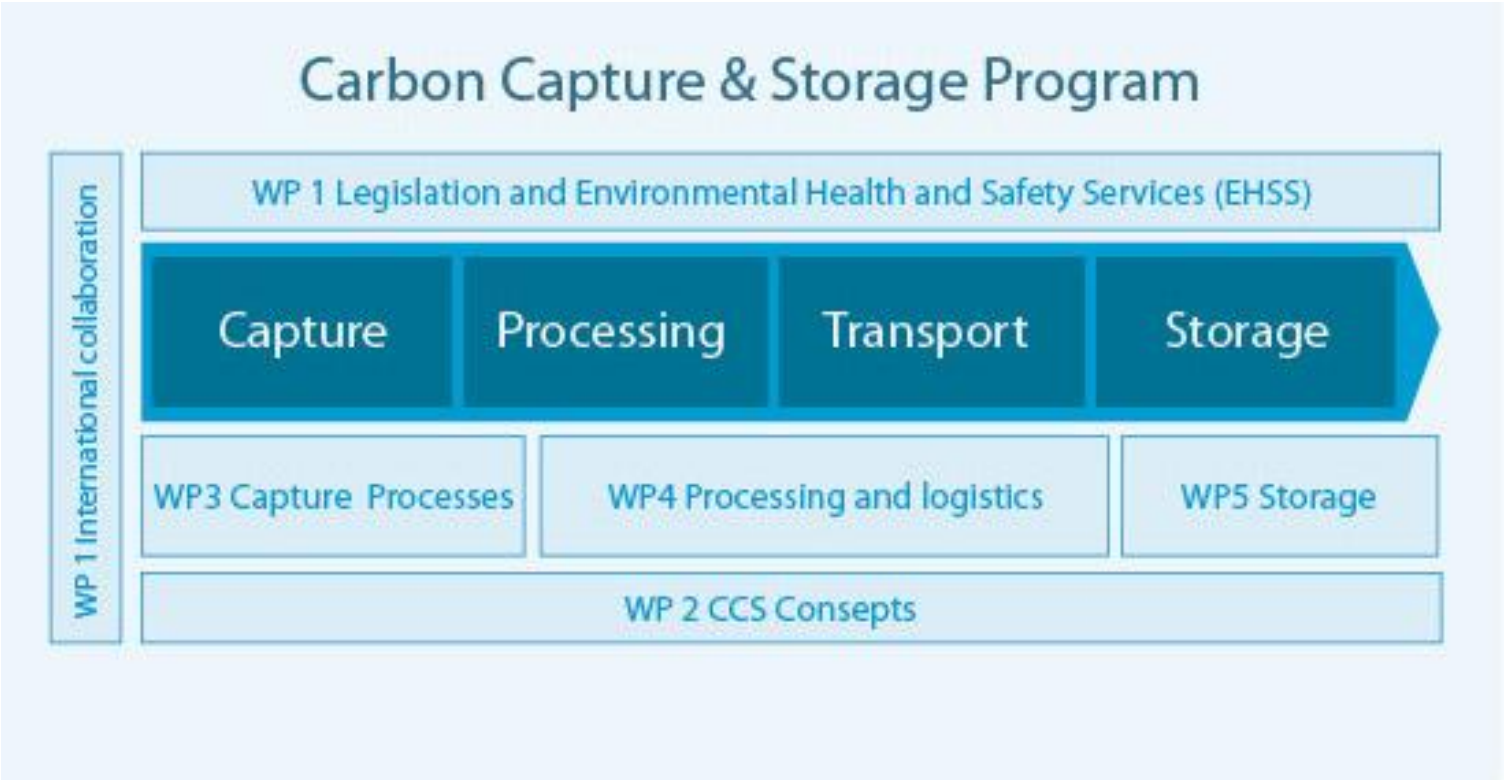
- Whole chain approach to the potential and implemantation of CCS technology



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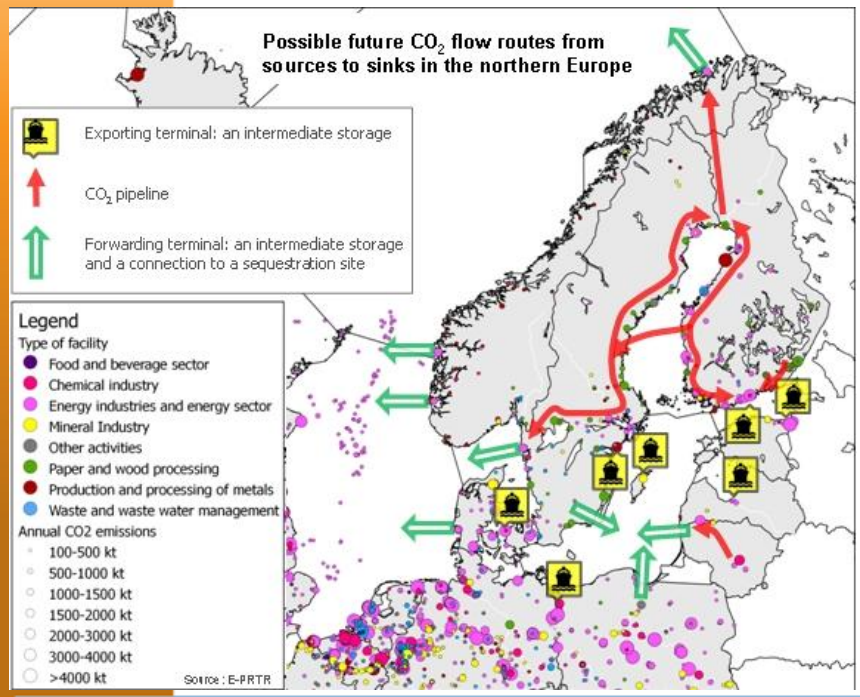
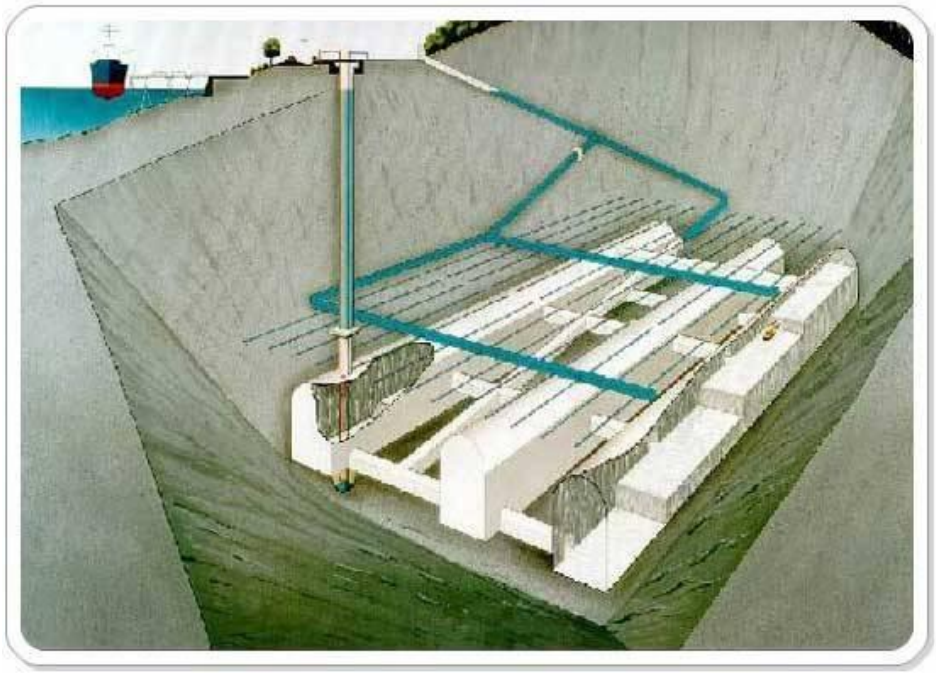
WP4: Processing and logistics of captured CO_2

• Joint CO2 infrastructure would make pipelines a favorable mode of transportation. Low level of co-operation would result in shipping being preferred.

• Shipping requires development of terminals, ships, intermediate storages and legislation concerning cross boarder transportation

• Intermediate storage could be in the form of steel tanks or cryogenic rock caverns. Rock caverns could give cost reductions with increasing storage size. Other technical advantages of rock cavern storage are: limited need for space on the surface, faster loading and unloading.

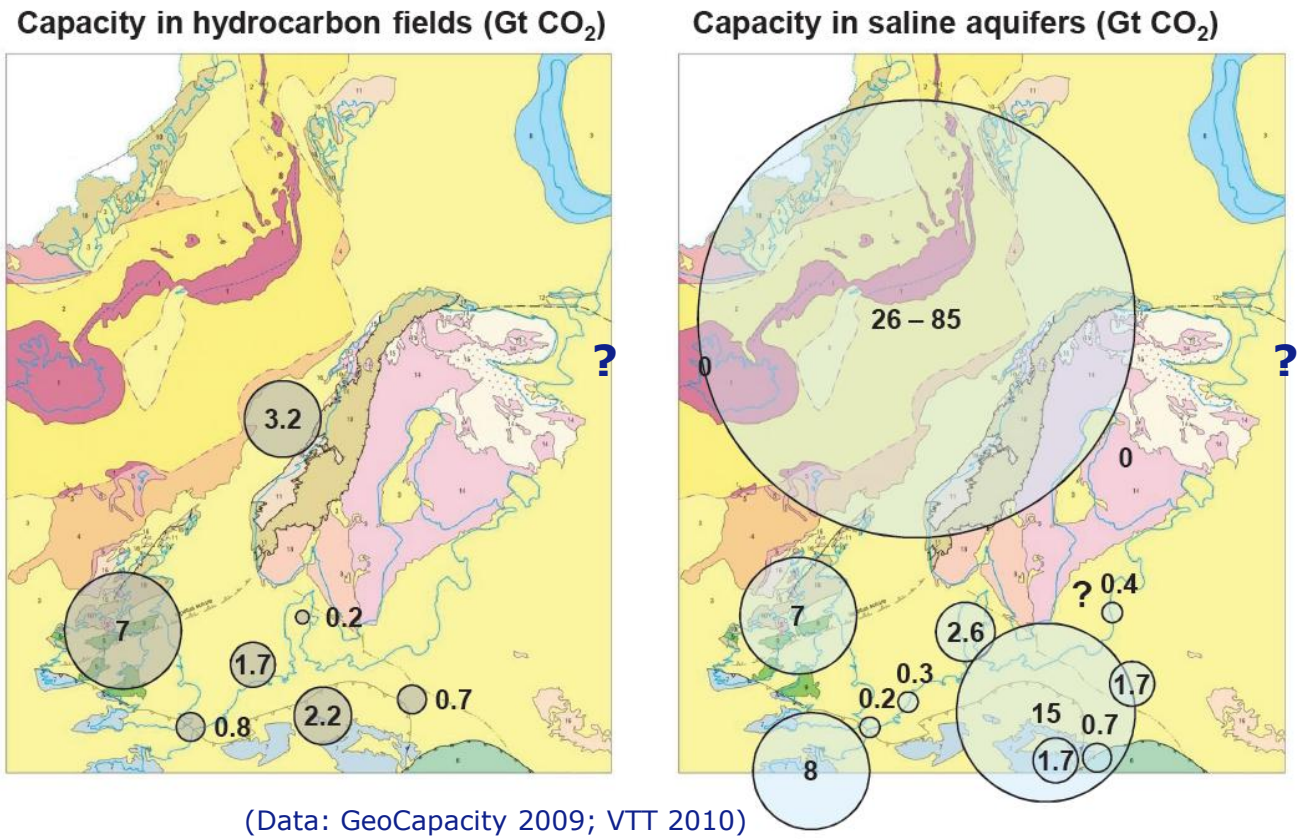




WP5: Storage of CO_2

- Identifying the most feasible storage options from the Finnish point of view is essential for realization of CCS.

- The focus of the program is on areas close to Finland.



(Data: GeoCapacity 2009; VTT 2010)

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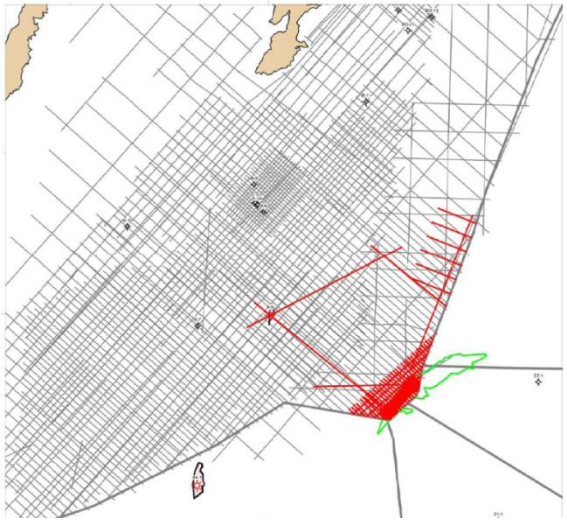
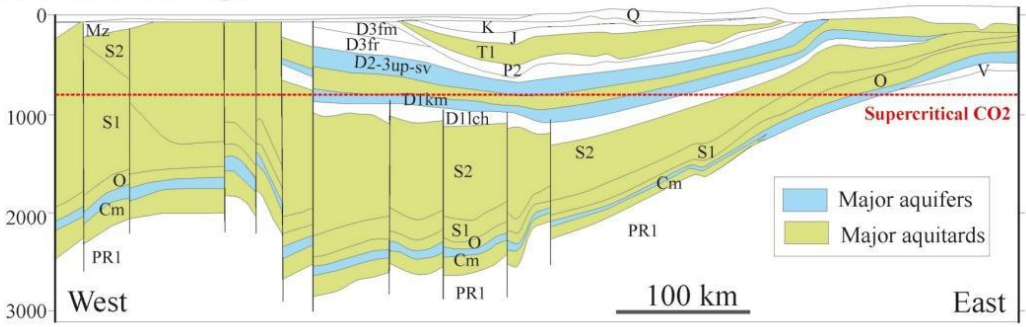
B A S T O R – Baltic Sea Storage of CO2



- Project started by the Finnish CCSP programme and Swedish CCS project consortium and all Baltic Sea countries are invited to join the project.
- Saline aquifers in Cambrian monocline formations below sea bed have best storage potential.
- OPAB seismic surveys 1969-07 – 32000 km seismic lines.
- Establishment of a ”Baltic Sea CCS Cluster” also on the agenda of the Finnish CCSP programme.

Identification of saline aquifers for CO2 storage

Depths of base of the Baltic Basin



Geological cross section west-east

Source: after Sliaupa S., 2009

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Thank you for your attention!

More information:

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http://www.cleen.fi/en/program_overviews/ccsp_carbon_capture_and_storage_program