Potential for CCS in the Baltic Sea Region – sources and sinks

BASREC conference on Carbon Transportation and Storage

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VTT Technical Research Centre of Finland

- Largest R&D organisation in Northern Europe
- Applied research between universities and industry
- Governmental organisation (Ministry of Employment and the Economy)

VTT knowledge clusters
- Bio and process technology
- Energy and pulp & paper
- ICT
- Materials and built environment
- Microtechnologies and sensors
- Industrial systems

VTT Group
- Turnover 292 M€ (2010)
- Personnel 3,167 (1.1.2011)
- Established 1942
- VTT has been granted ISO9001:2008 certificate.

VTT and CCS

- "Application of CCS in Finland"
- "CCS potentials in the Nordic region"
- "NORDICCS – The Nordic CCS Centre"
- **CCSP** (Cleen Oy; national CCS programme 2011-2016)
  (8 research organisations and 18 industrial partners)
- EERA CO_2 Capture and Storage Joint Programme (CCS-JP)

- Oxyfuel R&D ("Flexiburn")
- Development of (static & dynamic models) for oxyfuel and post combustion
- Material R&D for CCS
- Climate change studies
- CO_2 mineralisation

CO_2 emissions in the Baltic Sea region

- In the Baltic Sea region fossil CO_2 emissions are primarily related to (transportation excluded)
  - Energy sector (power plants, oil refinieries)
  - Metal industry
  - Mineral industry

- In addition to fossil CO_2 emissions biogenic CO_2 emissions are significant especially in Finland and Sweden…potential for BioCCS?

- Baltic Sea region has some specific characteristics compared to other European countries
  - "Isolated area"…also from CCS point of view
  - Role of bioenergy, hydro power and nuclear energy

CO_2 emissions in Baltic Sea region

- The largest CO_2 emissions:

Germany - "not isolated only to Baltic Sea"
Poland – mostly from energy sector, coal

Finland – energy sector, steel industry
Denmark – mostly from energy sector; "not isolated to Baltic Sea"
Sweden – metal and mineral industry, energy sector

Estonia – Narva power plants

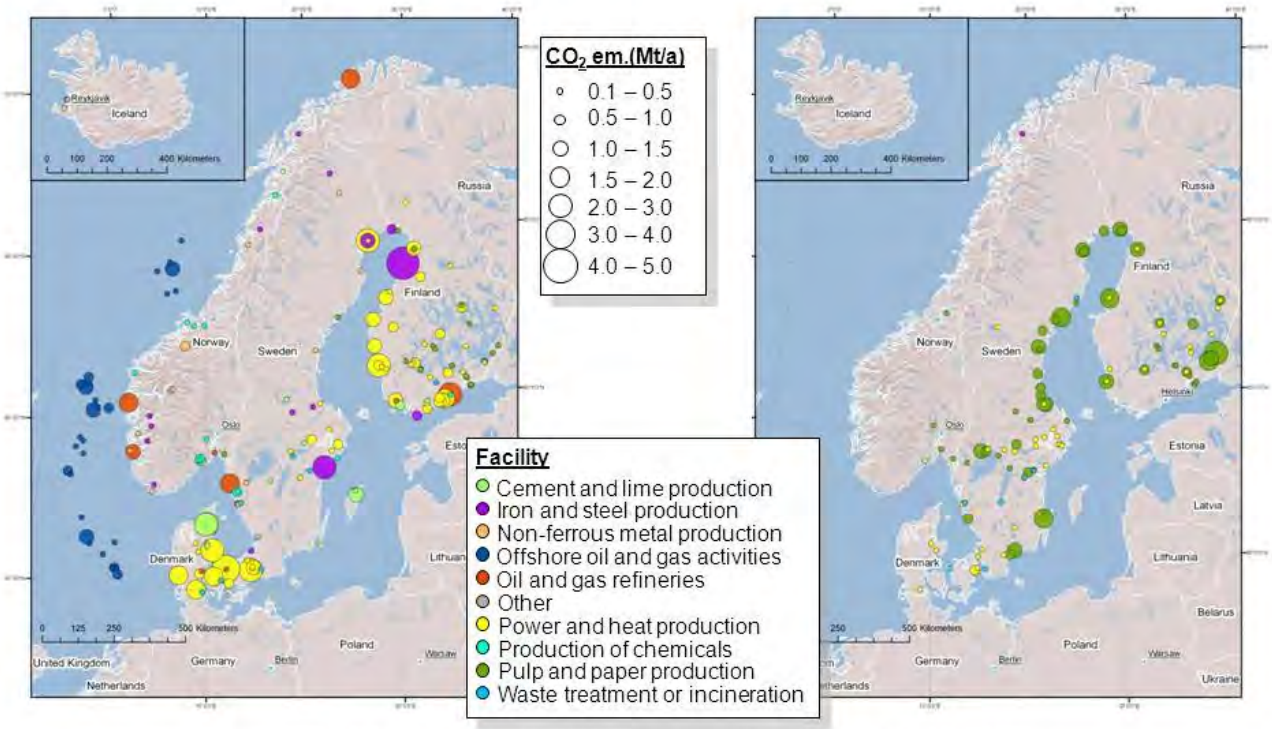
Country	Annual total CO2 emissions (Mt)
Estonia	21
Latvia	4
Lithuania	18
Poland	325
Germany	864
Denmark	52
Sweden	52
Finland	66
Norway	-
Russia	?

Large overall CO_2 emissions

=> CCS has to be considered seriously

Fossil and inorganic CO_2 emissons

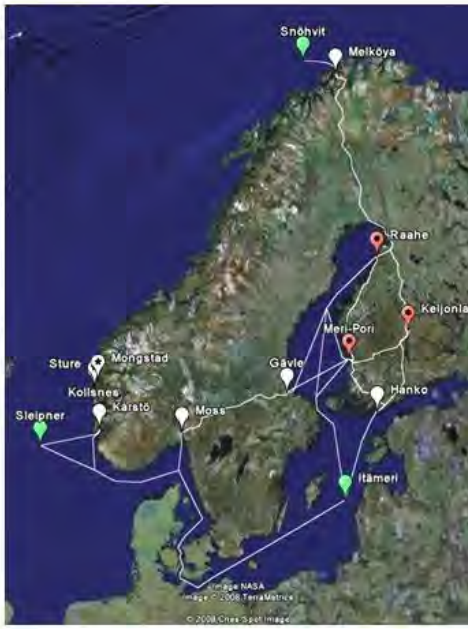
Biogenic CO_2 emissons



(VTT, 2010: Potential for CCS in the Nordic region, VTT Research Notes 2556)

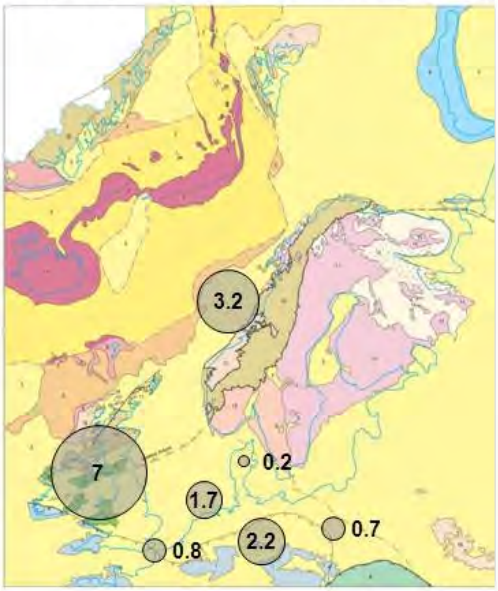
Key questions of CCS in Baltic Sea region

- **Capture**
  - Several technologies
  - Challengies related to energy penalty and cost
- **Transportation**
  - Long distance to known geological storage sites with large capacity
  - At least in the first phase, shipping i is the only alternative
- **Storage**
  - Nearest known storages located in North Sea/Barents Sea

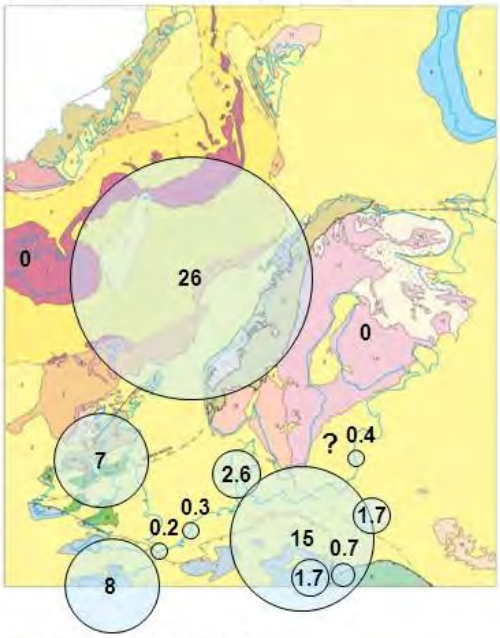


Current knowledge on geological storage capacity

Capacity in hydrocarbon fields (Gt CO_2)



Capacity in saline aquifers (Gt CO_2)



(Data: GeoCapacity 2009; VTT 2010 – Russia and not included)

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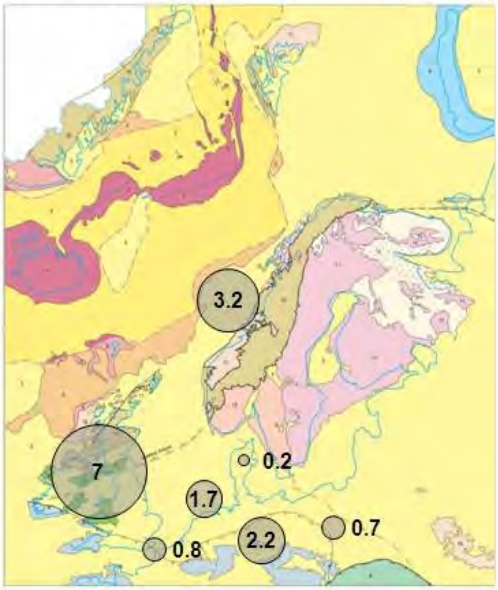

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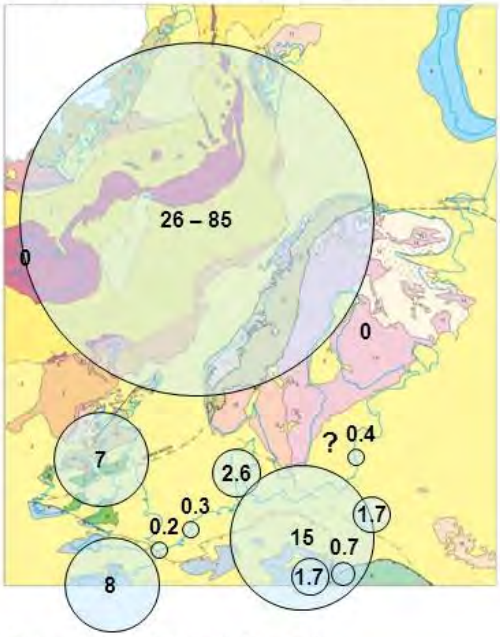
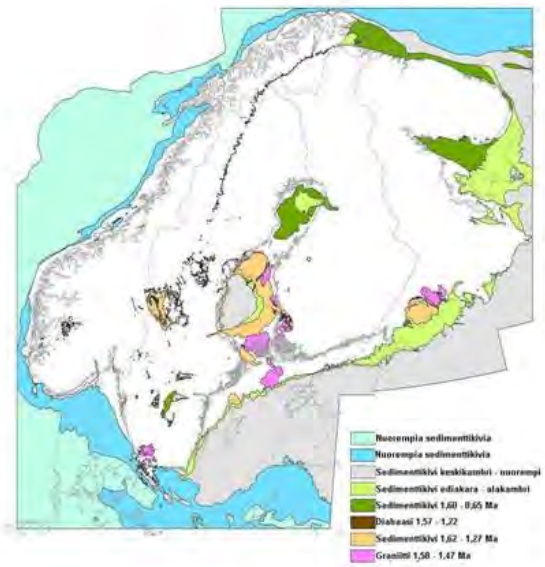


(Data: GeoCapacity 2009; VTT 2010 – Russia and not included in study)

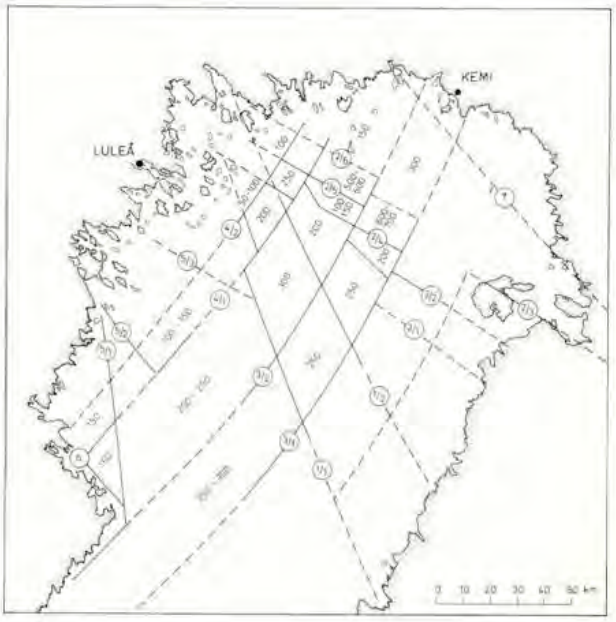
Project *Application of CCS in Finland*

- Storage potential of Finland was studied
- Only few theoretically potential sites
- None of them valid for CO_2 storage



Northern part of Gulf of Bothnia (Bottniska viken)

- Sedimentary deposit in the northen parts of Gulf of Bothnia
- Depth of the deposits is low
- Deposits do not fulfill any criterion of CO_2 storage



B A S T O R – Baltic Sea Storage of CO_2

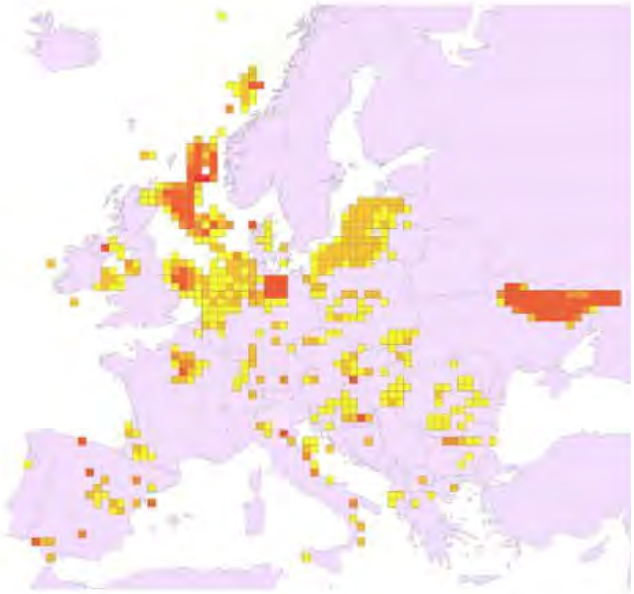
- Study on CO_2 storage potential in Baltic Sea region
- Collaboration with the Swedish CCS project consortium
- The first phase started by the Finnish CCSP research programme

- The study is based on analysis of previously measured available data
- Focus is in the southern part of the Baltic Sea region

- In connection to CCSP programme and Bastor: establishment of "the Baltic Sea Cluster"
  - Forum to discuss and exchange information on CCS and especially on geological storage potential in Baltic Sea region
  - To increase awareness on CCS in the Baltic Sea countries

Geological basis

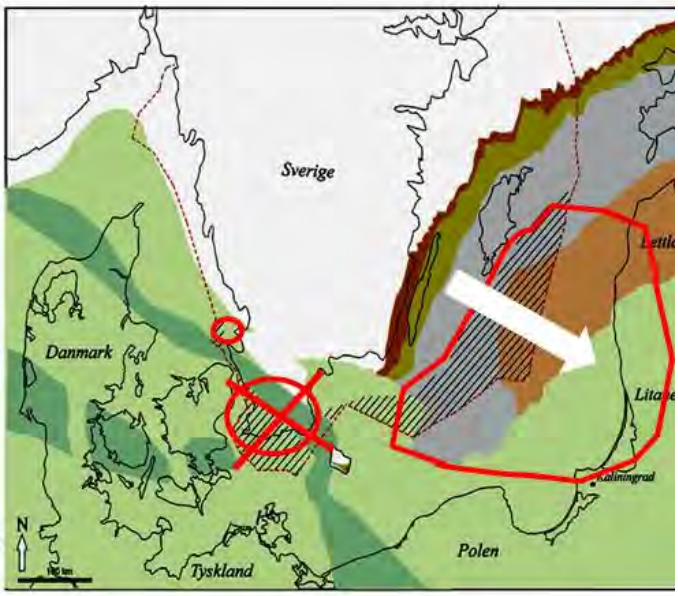
- Southern parts of the Baltic Sea region significantly more potential than northern parts
- However, North Sea much more potential



Source: Arup SCCS study 2010, Forum on Sustainable Fossil Fuels Berlin 18-19 October 2010

The potential for geological storage in the southern part of Baltic Sea

- Areas with deep aquifers of Cambrian sandstone in the Swedish zone and further south east
- Porosity, volume potential and containment (sealing) require significant exploration efforts
- Swedish Government excludes Scania (SW) from CO_2 storage when implementing CCS Directive

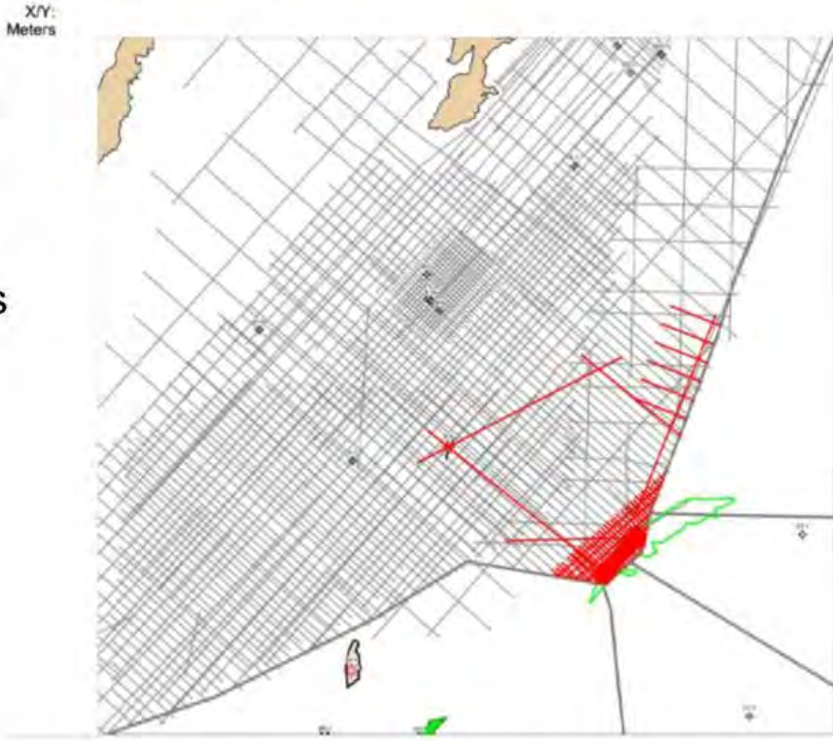


Source: Erlström, SGU, (OPAB)

OPAB - seismic surveys 1969-07

(32 000 km seismic lines)

Project has been started by The Finnish CCSP programme and Swedish CCS project consortium but all Baltic Sea countries are invited to join the project

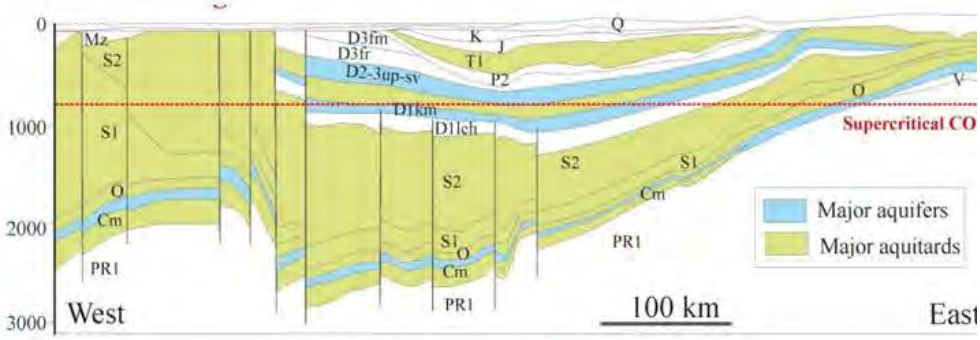


Geological Storage of CO2 in the Baltic Basin

- Cambrian reservoirs at 800m depth below seabed are the best storage sites
- Limited potential in depleted oil and gas fields – storage volume is small, difficult to access
- Saline aquifers in border monoclines have storage capacity

Source: after Sliaupa S., 2009

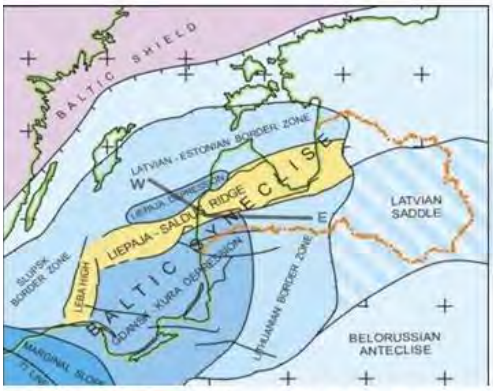
Depths of base of the Baltic Basin



Geological cross section west-east

Ranking of Baltic Sea Sub Basins for CO2 Storage

Rank	Basin	Characteristics	Score
1	Slupsk Border Zone	Proven reservoir/seal pair, moderate size structures, offshore, large saline aquifer, limited faulting, good accessibility, <500kms to strategic CO_2 sources	0.76
2	Gdansk-Kura Depression	Existing oil and gas production infrastructure, moderate sized structures, offshore, fair accessibility, >500kms to some strategic CO_2 sources	0.75
3	Liepaja Saldus Ridge	Proven reservoir/seal pair, moderate size structures, offshore, fair accessibility, <500kms to strategic CO_2 sources	0.75
4	Latvian Estonian Lithuanian Border Zone	Proven reservoir/seal pairs, small structures, potential saline aquifer, only small area sufficiently deep for CO_2 storage, accessible, 250kms to strategic CO_2 sources	0.71



Location basemap of the Baltic Depression showing its various sub-basins, based on Brangulis, A.P., Kanev, L.S., Margulis, L.S. and Pomerantseva, R. A., 1993 *Geology and hydrocarbon prospects of the Paleozoic in the Baltic region.* Geology of Northwest Europe: Proceedings of the 4th Conference edited by J.R. Parker, Geol. Soc. Lon.)

- Four main sub basins identified and ranked in order of suitability for CO2 storage
- The border zones have potential storage capacity in saline aquifers
- Existing oil and gas fields have limited storage capacity except as local sites for specific projects (e.g. Lotos refinery in Gdansk to B3 Field offshore Poland)

SLR

Conclusions and recommendations (1/2)

- Implementation of CCS in the Baltic Sea region has to be considered seriously (Poland, Denmark, Finland, Sweden, Estonia)
- Actual potential of CO_2 storage in Baltic Sea region should be studied in collaboration with Baltic Sea countries (BASTOR + continuation after BASTOR)

Conclusions and recommendations (2/2)

- CO_2 transportation/logistic issues in the Baltic Sea region should be studied and developed in collaboration with Baltic Sea countries (included on the agenda on the Finnish CCSP programme; negotiations with Swedish parties)
- Awareness of CCS in Baltic Sea countries should be increased
  - Establisment of "the Baltic Sea CCS Cluster" (on the agenda of the Finnish CCSP programme)
  - Discussion forum on CCS in the Baltic Sea region

Thank you for your attention

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