

CLEEN

Cluster for Energy and Environment



ccsp

Carbon Capture and Storage Program

Introduction to Carbon Capture and Storage Program

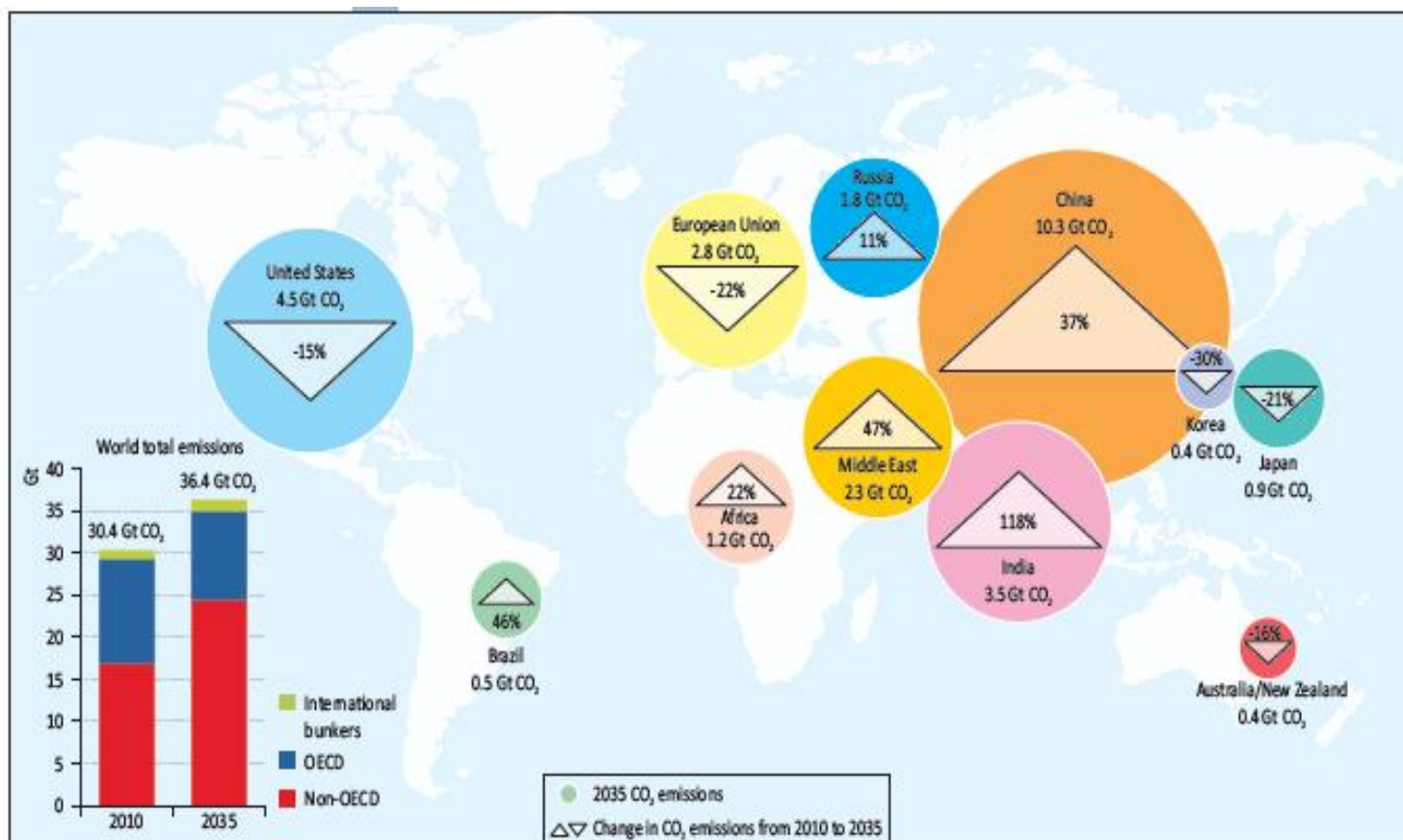
14.3.2012, Hiilitieto ry:n talviseminaari 2012

Antti Arasto, Program Manager

VTT - Technical Research Centre of Finland

Energy-related CO₂ emissions

by region in 2035 in the New Policies Scenario and the change from 2010

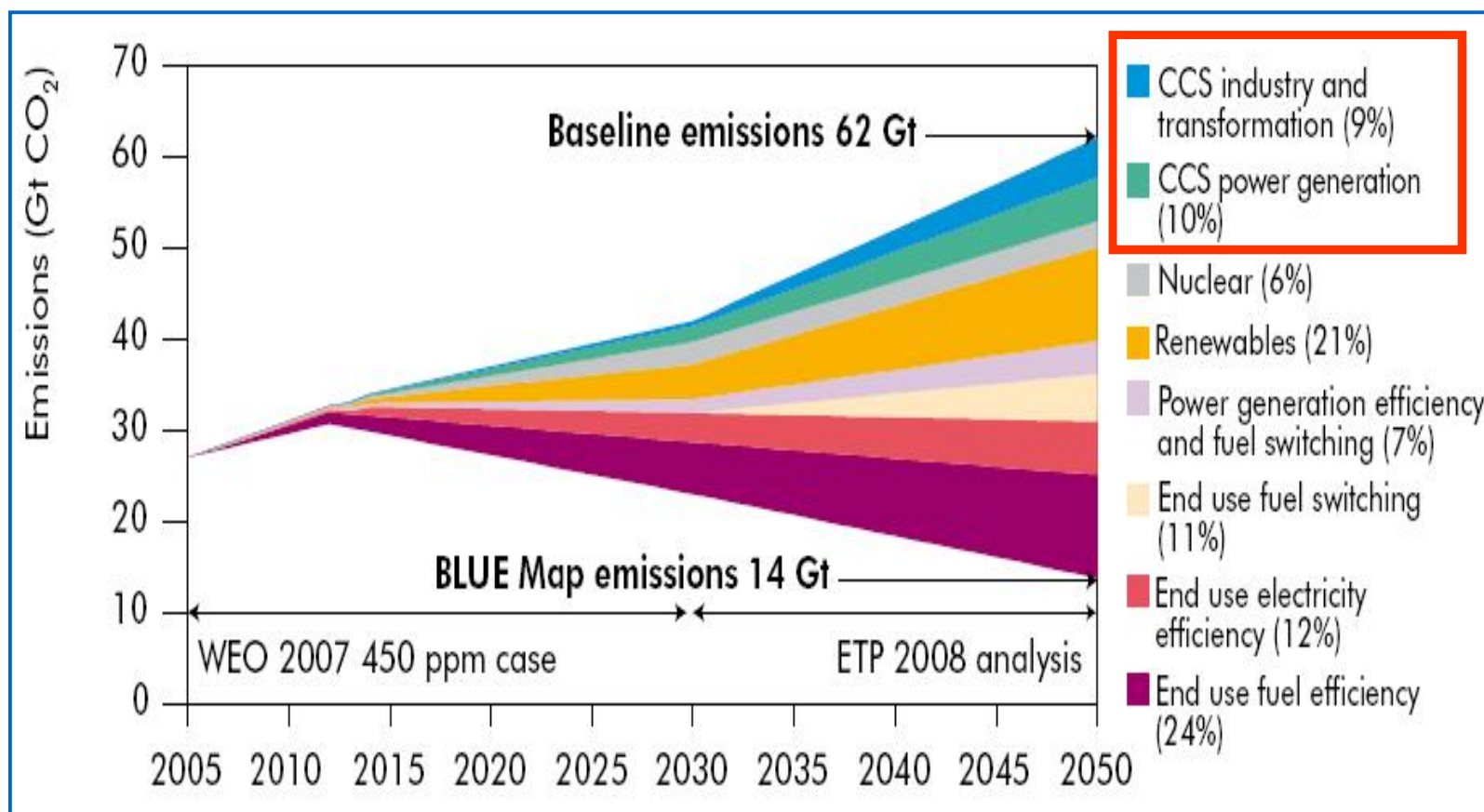


This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

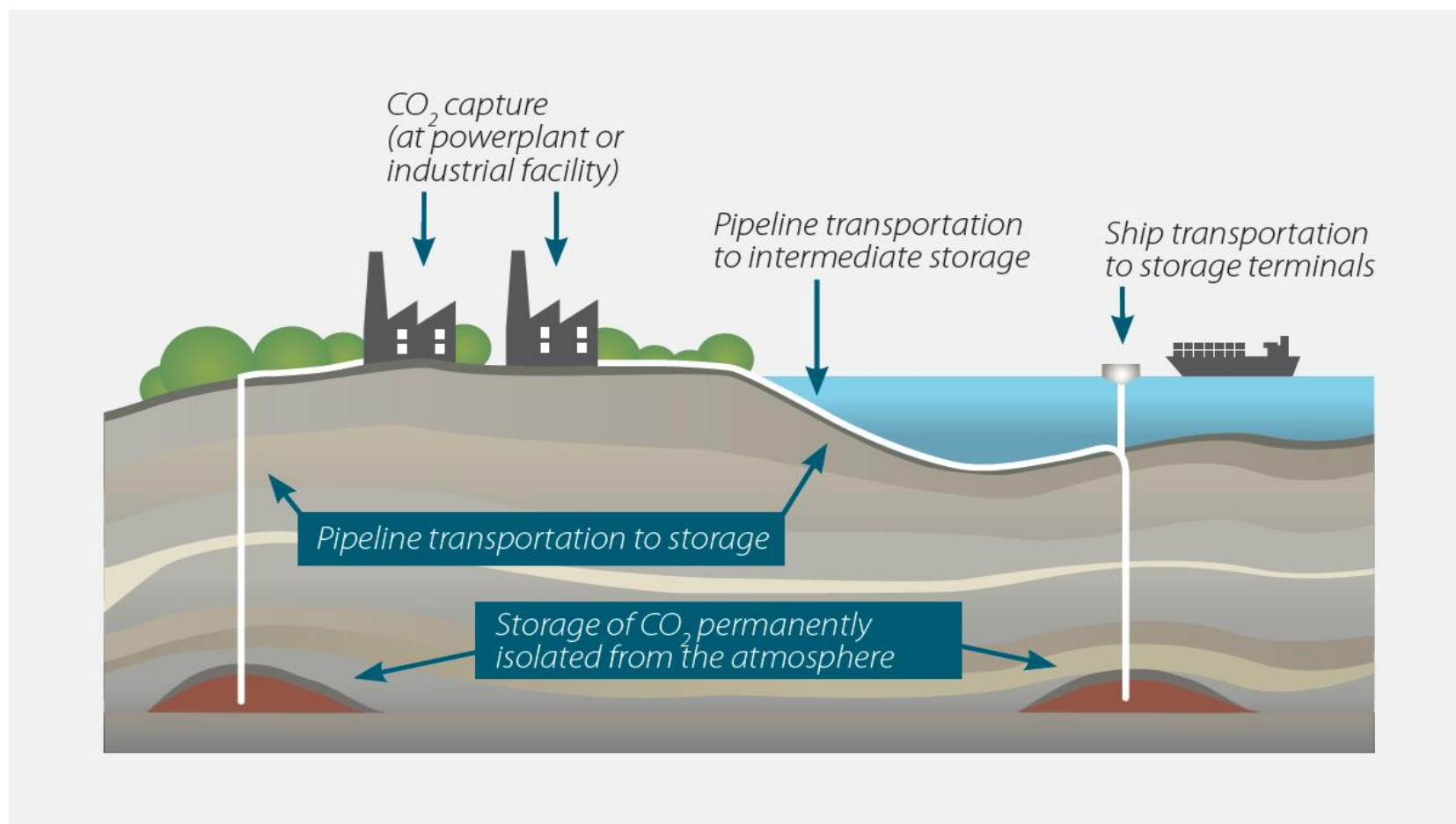
Notes: The circles reflect the relative volume of energy-related CO₂ emissions from selected countries and regions in 2035. The arrows indicate the change in these emissions from 2010 to 2035. The bar chart shows world energy-related CO₂ emissions and the split between the OECD, non-OECD countries and international bunkers.

IEA WEO 2011

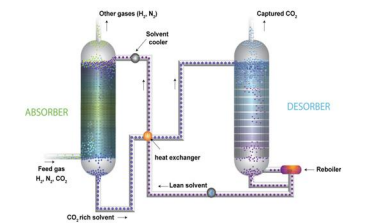
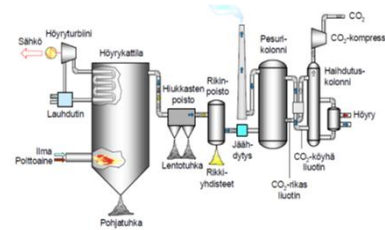
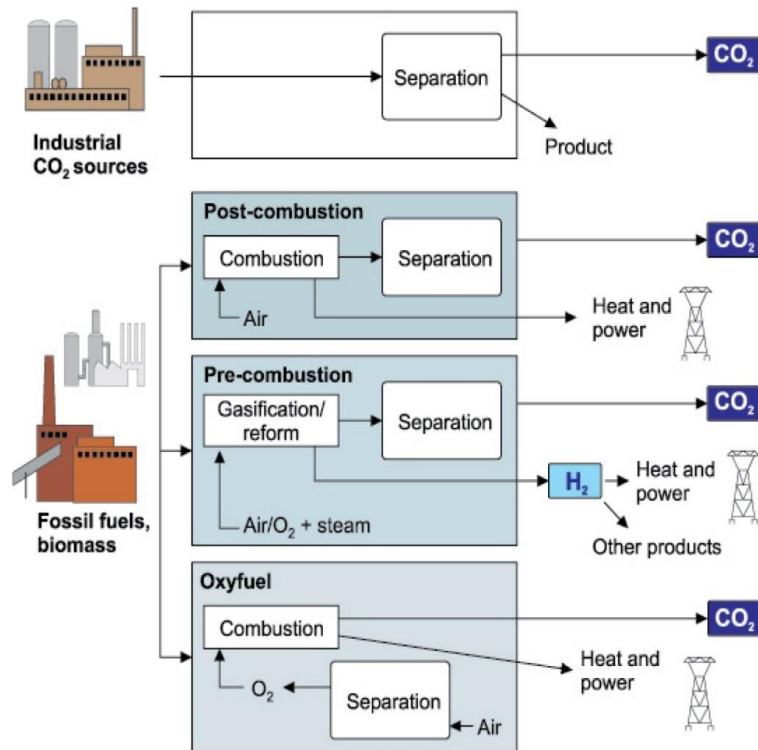
Backgrounds - A World-Wide Technological Change Needed



Carbon capture and storage (CCS)

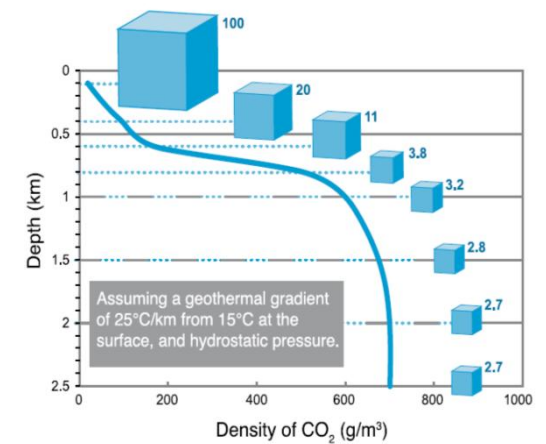
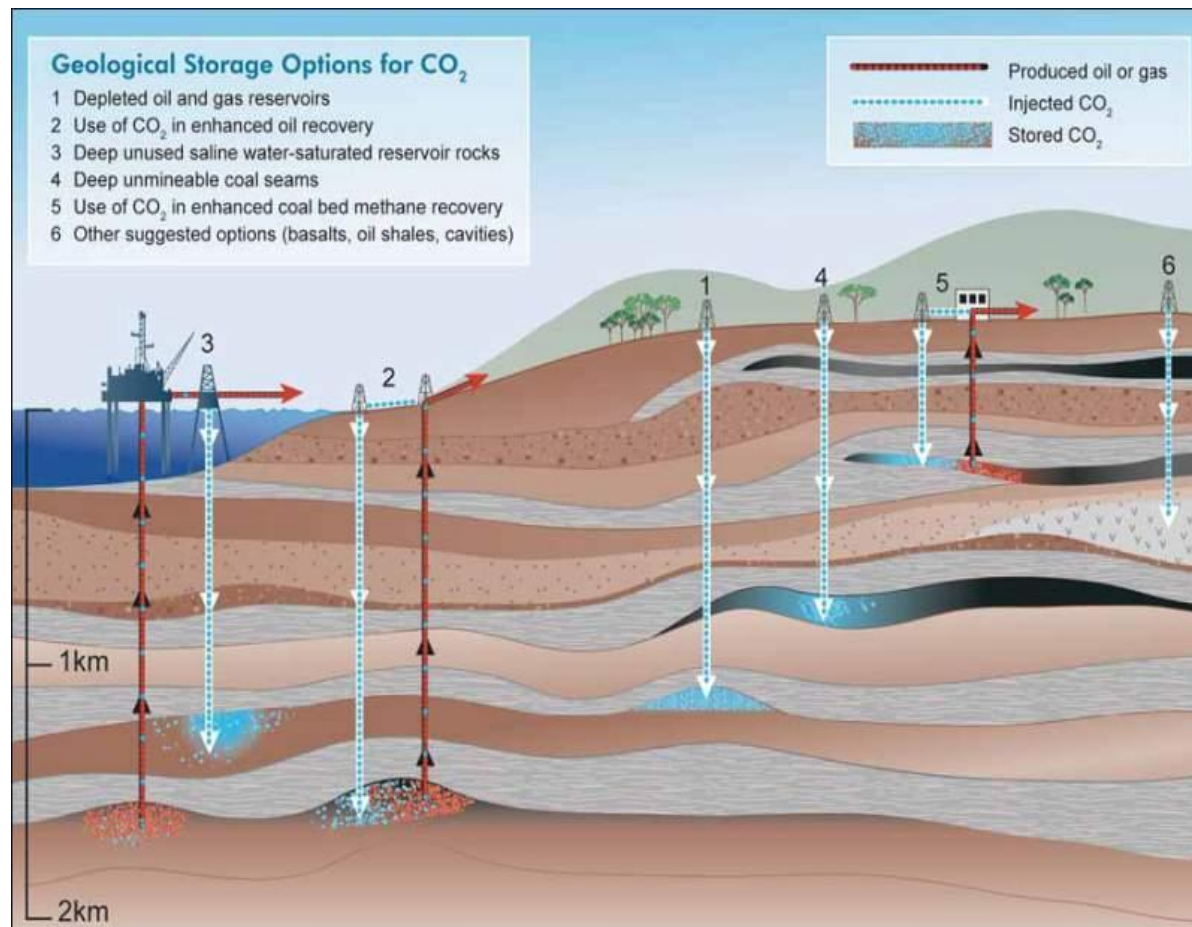


Carbon capture and storage technologies



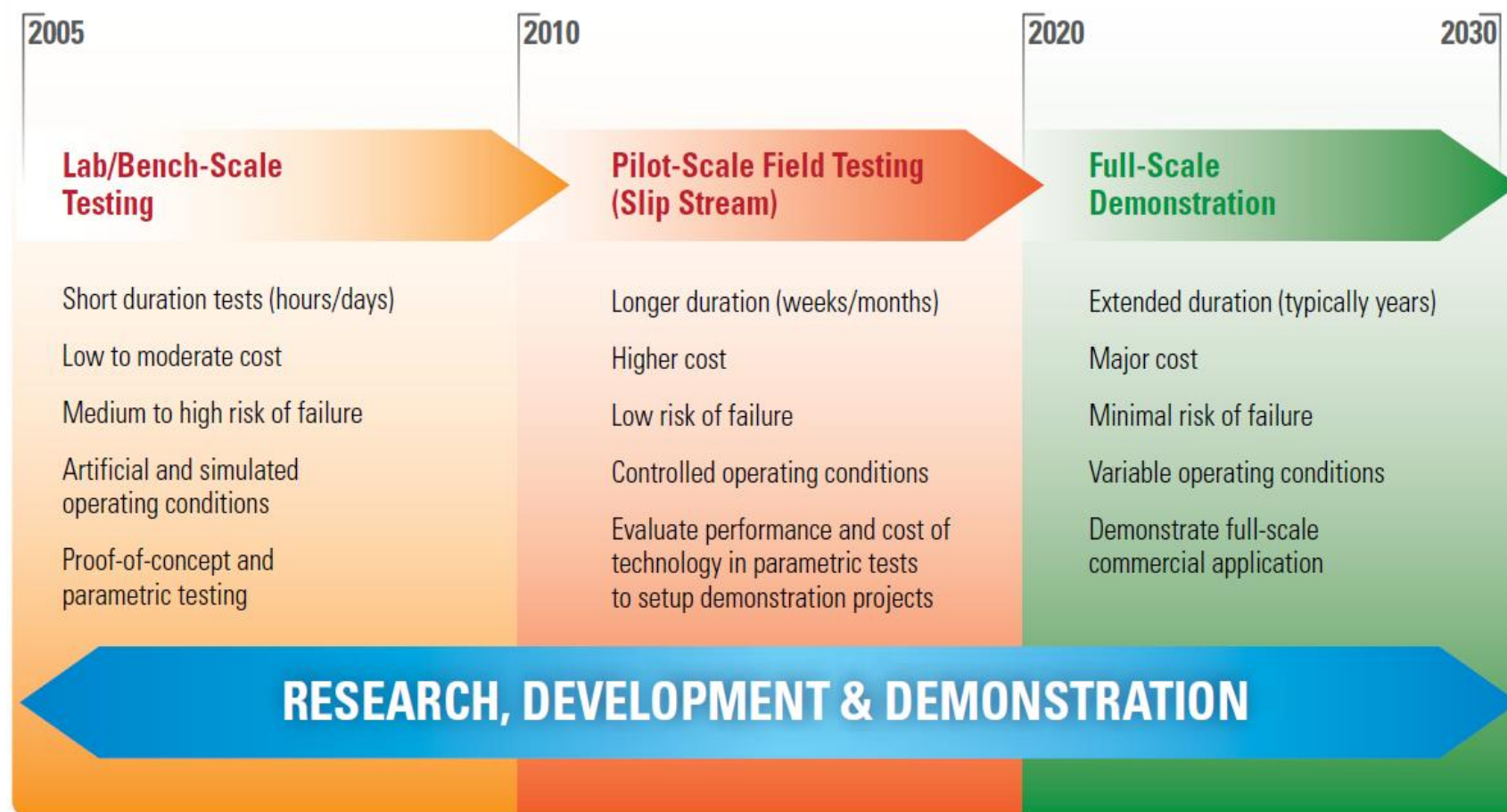
More information: <http://www.vtt.fi/proj/ccsfinland>

Geological storage of CO₂



- Depth of reservoir: 800-2500 m
- Porosity and cap rock

Advanced CO2 Capture Technology RD&D (NETL/DOE 2010)



Significant CCS sites (injecting $> 0.7 \text{ MtCO}_2/\text{y}$) around the globe



Key

- Sites which are currently injecting CO₂
- Planned CCS sites. Generally plan on injecting at least 700,000 tonnes CO₂ per year.
- Sites which have been cancelled or have completed injection.



Commercial Application of CCS (to date)



Sleipner
1 Mt/y CO₂



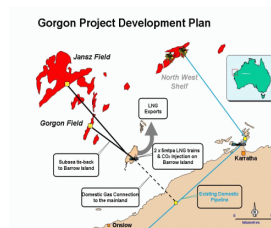
Weyburn
2.5 Mt/y CO₂



In-Salah
1.2 Mt/y CO₂



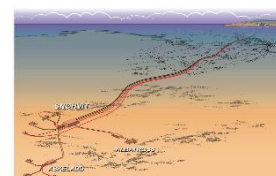
Snohvit
0.7 Mt/y CO₂



Gorgon
3 Mt/y CO₂



**350 km overland
pipeline**



**160 km sub
sea pipeline**



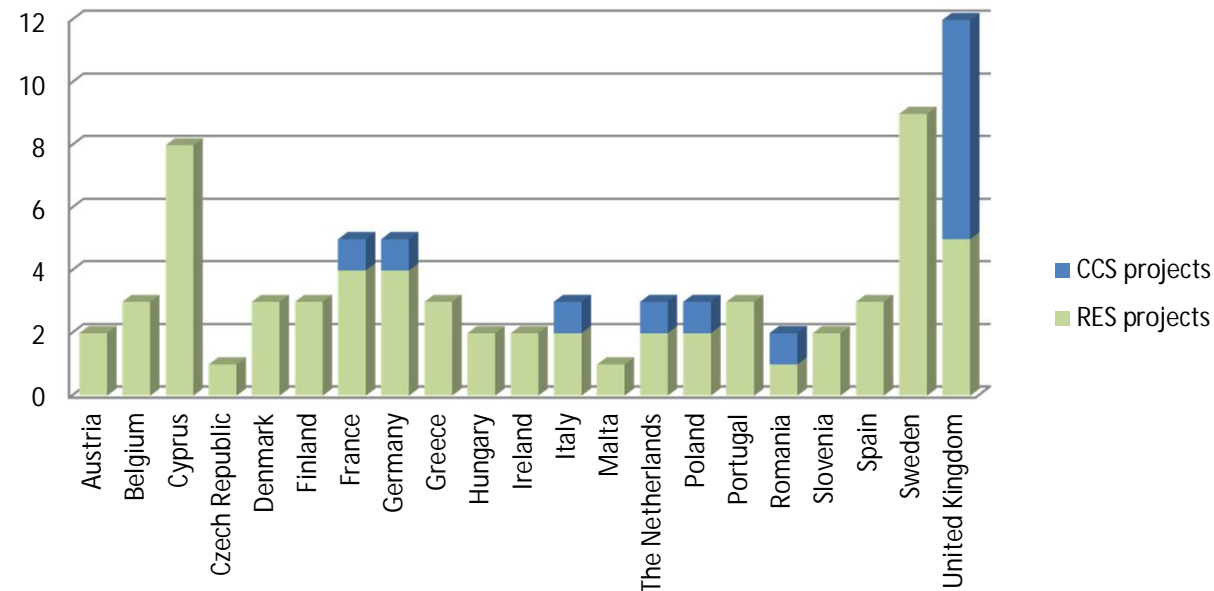


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Carbon Capture and Storage Program

NER300 projects proposed to EIB by 13.5.11

NER 300 project proposals



The NER300 is the world's largest CCS funding mechanism; the European Commission will grant 300 million EU emission unit allowances – today worth about €4,5 bn – to fund at least eight CCS projects and 34 renewable energy projects.

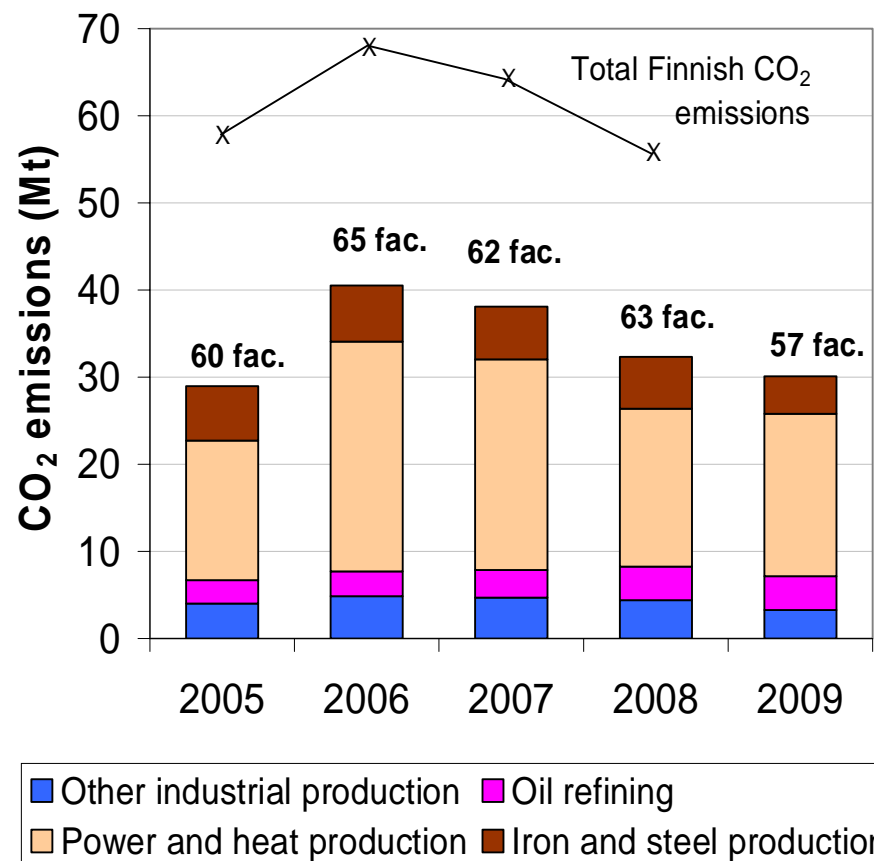


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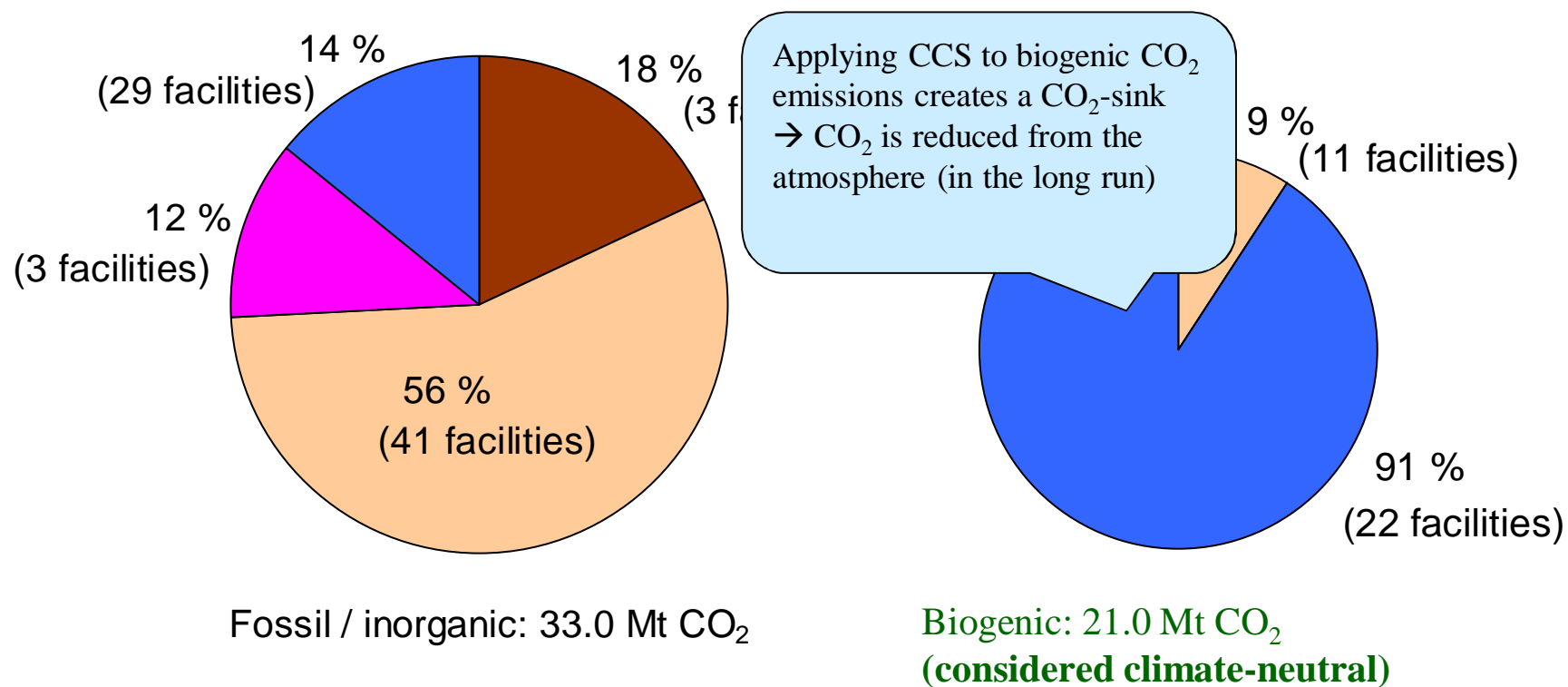
Carbon Capture and Storage Program

CO₂ emission sources in Finland

- Finnish greenhouse gas emissions 70 Mt CO₂eq in 2008
 - Of these, CO₂ emissions accounted for 58 Mt
 - Majority from power and heat production
 - Annual variations large
- Mapping of the largest (>0.1 Mt/a) emission sources performed →
 - 60 largest facilities account for 50-60 % of Finnish CO₂ emissions



Largest (>0.1 Mt/a) CO₂ emissions sources in 2008



■ Iron and steel industry

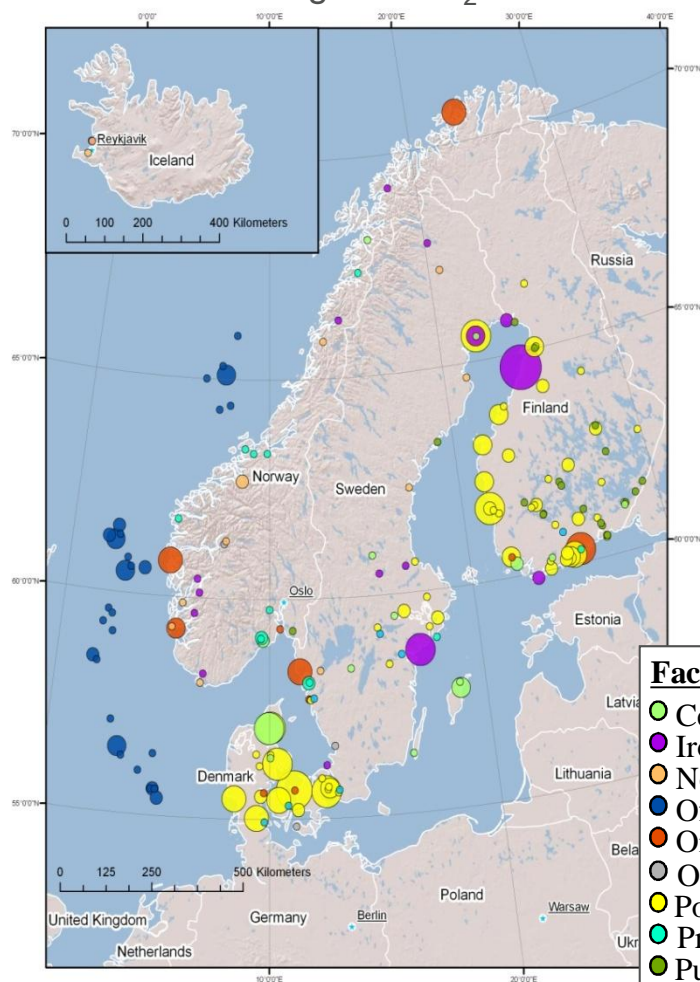
■ Power and heat generation

■ Oil refineries

■ Other industries

CO₂ Emissions in Nordic countries

Fossil and inorganic CO₂ emissions



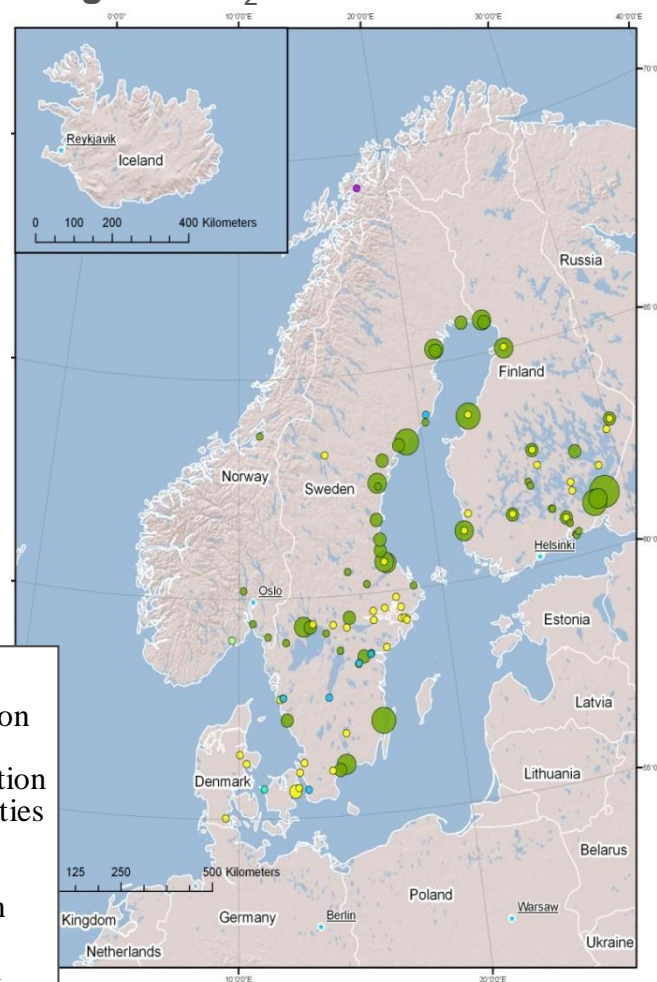
CO₂ em.(Mt/a)

- 0.1 – 0.5
- 0.5 – 1.0
- 1.0 – 1.5
- 1.5 – 2.0
- 2.0 – 3.0
- 3.0 – 4.0
- 4.0 – 5.0

Facility

- Cement and lime production
- Iron and steel production
- Non-ferrous metal production
- Offshore oil and gas activities
- Oil and gas refineries
- Other
- Power and heat production
- Production of chemicals
- Pulp and paper production
- Waste treatment or incineration

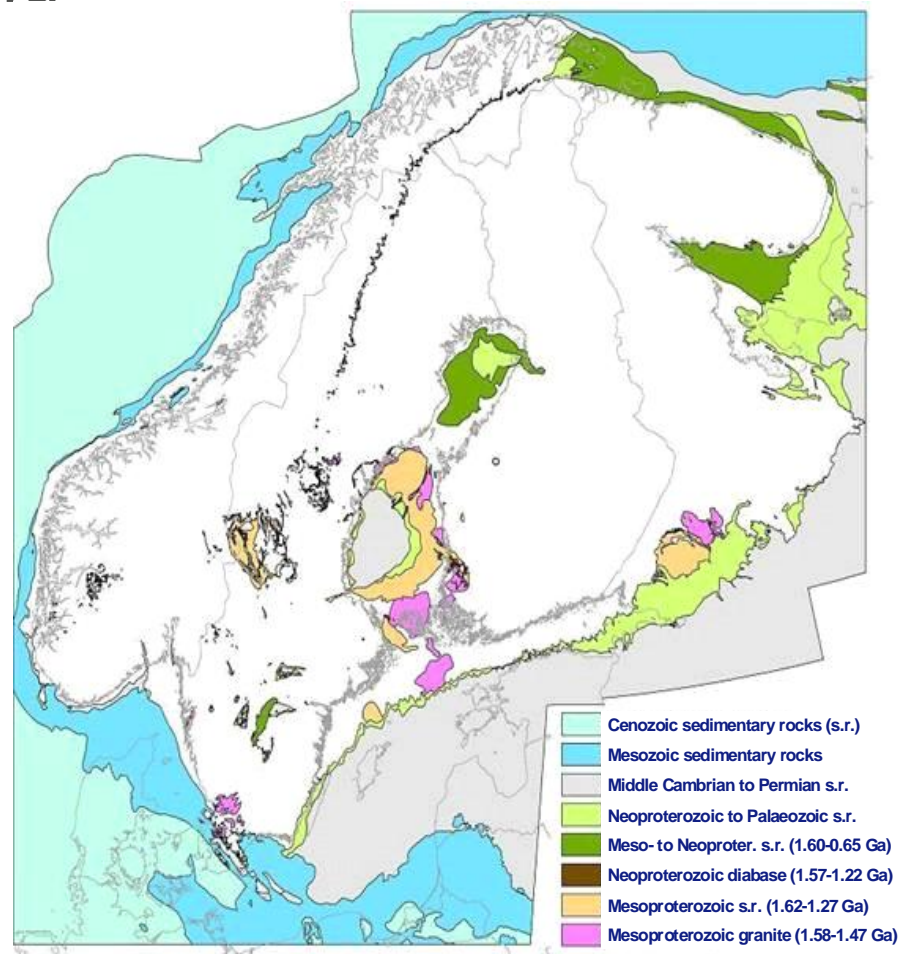
Biogenic CO₂ emissions



No formations for long-term underground storage of CO₂ in Finland

- Finnish bedrock belongs to the Fennoscandian shield area
 - No hydrocarbon reservoirs
 - Sedimentary rocks are very compact
 - Occurrence of saline aquifers unlikely
 - Bedrock may be suitable for intermediate storage of CO₂
- High availability of rocks suitable for mineral carbonation with CO₂
 - Carbonation technology not (yet) feasible for storage

→ Captured CO₂ has to be transported abroad for storage

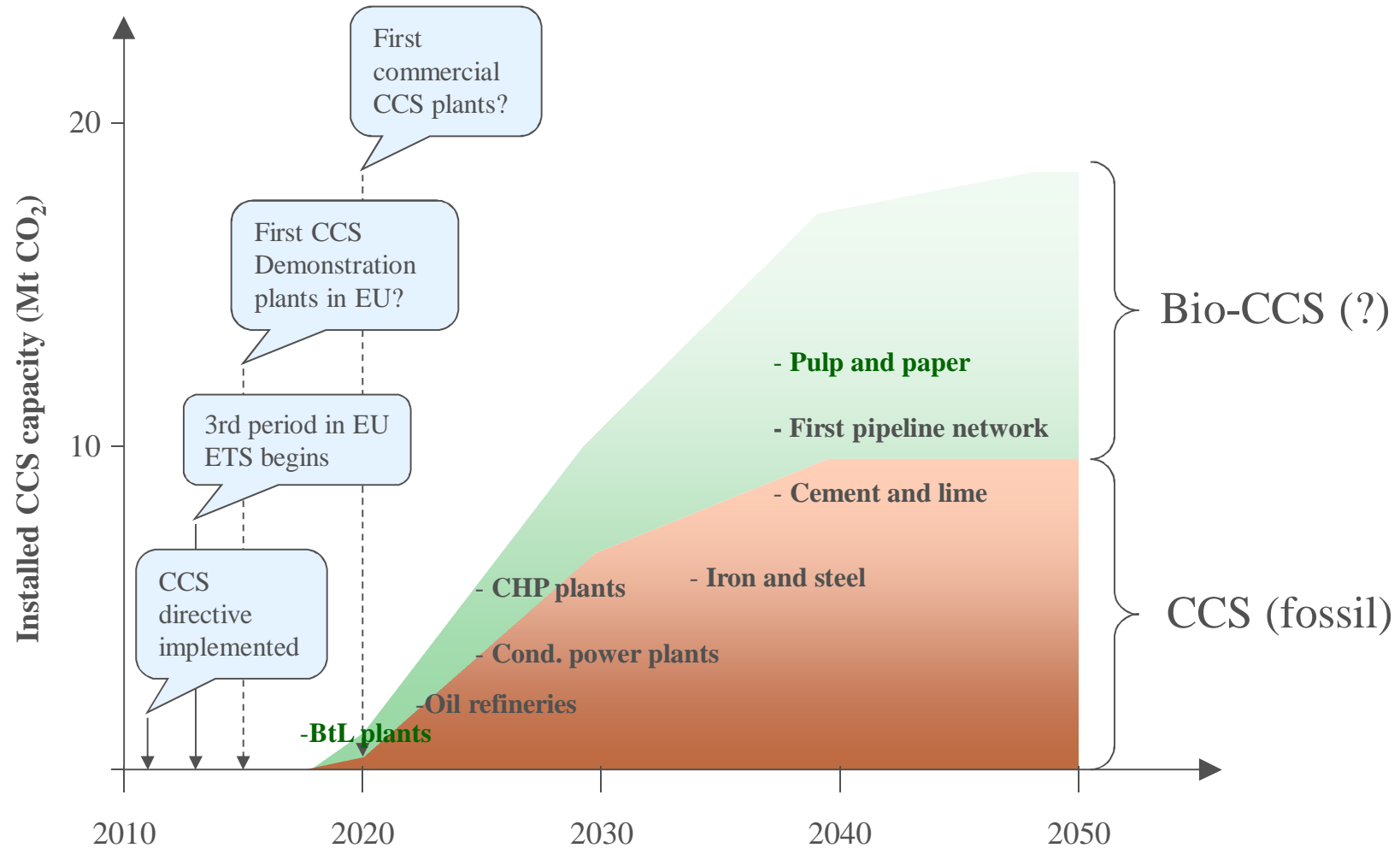




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Carbon Capture and Storage Program

Roadmap for application of CCS in Finland



Carbon Capture and Storage Program

17 industrial partners, 9 research partners, 5a ~20M€

Key technology areas:

- CCS in CHP systems
- CCS related to multi-fuel and Bio-CCS
- CCS solutions for oil and gas and for iron and steel industry
- Acceptability of CCS

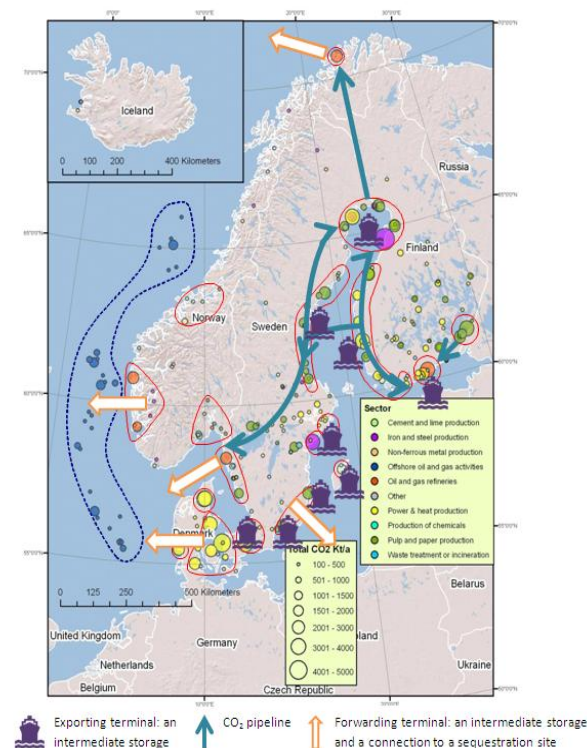
Long term breakthroughs:

- CLC (Chemical Looping Combustion)
- Mineral carbonation

Pilot SHOK program for international collaboration:

IEA GHG Programme, ZEP, EERA CCS Programme, IEA CCS Office, MEFOS, Sintef, IVL, EU FP7 projects, Baltic Sea Region collaboration, bilateral project collaborations, EASAC

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



Carbon Capture & Storage Program

WP1 Legislation, EHSS

CAPTURE

PROCESSING

TRANSPORT

STORAGE

**WP3 Capture
processes**

WP4 Processing and logistics

WP5 Storage

WP2 CCS concepts

WP 1 International collaboration



New and enhanced focus areas for FP 2

- Estimation of the costs and systemic interactions of CCS connected to CHP systems (with the known CCS technologies)
- Clear industrial CCS solutions under closer studies (oil and steel)
- Deepening the understanding of the acceptability of CCS with the strong viewpoint also on European level
- Baltic Sea aspect on CO₂ storage
- 2nd generation CCS solutions and concepts under development (BioCCS enabling carbon negative GHG balance, CLC aiming at superlative production efficiencies with CCS and mineral carbonation as an solution for CO₂ storage)
- New and deepened international collaboration at least with Swedish national CCS programme, EERA CCS Joint Program and ZEP on top of existing collaborative actions



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THANK YOU FOR YOUR ATTENTION

Antti Arasto

Program Manager

Antti.Arasto@cleen.fi