



Status on CCS in Denmark

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POLITICAL AND REGULATORY HIGHLIGHTS



Key political elements

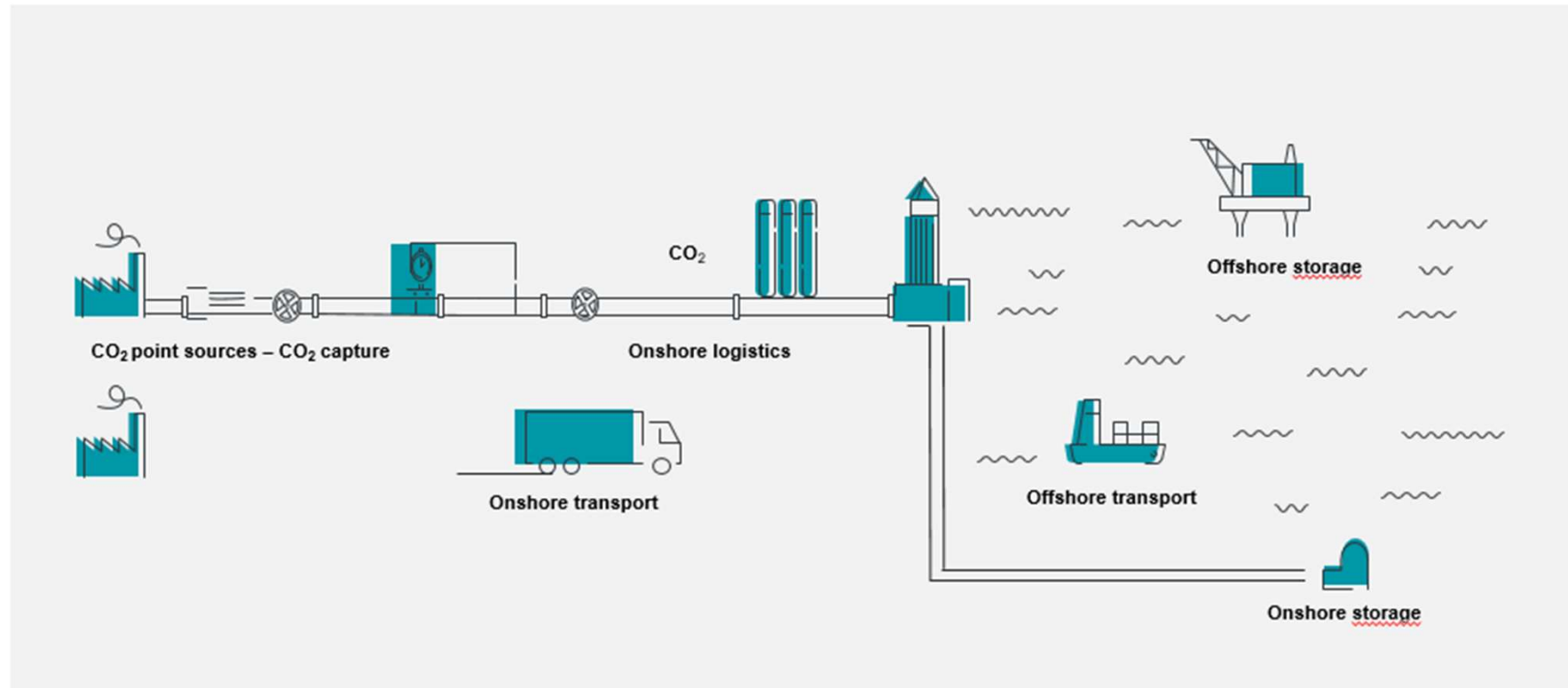
- The Danish Climate Act (2019): GHG emissions reduction of 70 % by 2030 and climate neutrality by 2050
- Climate Agreement for Energy and Industry (2020): CCS constitutes an essential element in achieving the climate policy objectives enshrined in Climate Act.
- Agreement on a Roadmap for Capture, Transport and Storage of CO₂ (2021): Plethora of initiatives, including enablement of CO₂ storage in Danish subsoil and CO₂ import/export.
- CC(U)S subsidy scheme-agreements (2020, 2021, 2022): total of 36,5 billion DKK (approx. 5 billion EUR) and reductions of 3.2 MTA CO₂ from 2030.

Regulatory highlights

- January 27 2022: Denmark acceded to the necessary articles in the London Protocol
- July 1 2022: Legislation introducing a speedier and less extensive approval process for CO₂-storage pilot projects in the North Sea entered into force.
- August 1 2022: Legislation exempting geological storage and transport of CO₂ from prohibitions against dumping in the Marine Environment Act entered into force.
- August 15 2022: Opening of Denmark's first tender for CO₂ investigation and storage licenses (application window closing October 1).



BUILDING A CCS VALUE CHAIN



OVERVIEW OF DANISH CC(U)S SUBSIDY SCHEMES



	CCUS Fund (phase 1)	CCUS Fund (phase 2)	NECSS Fund	GTR Fund
Purpose	Emissions from technological flue gas processes, including negative emissions	Emissions from technological flue gas processes, including negative emissions and CCU	Negative emission from technological processes, including PyCCS (biochar)	Emissions from technological flue gas processes, including negative emissions
Eligible for subsidies	Fossil and biogenic CO2	Fossil and biogenic CO2 (including potentially DACCS)	Biogenic CO2 (including DACCS)	Fossil and biogenic CO2 (including DACCS)
First year of CO2 reductions	2025/26	2030	2024/25	2026/27
Yearly reductions from 2030	0,4 mil. tons	0,5 mil. tons	0,5 mil. tons	1,8 mil. tons
Contract period	20 years	20 years	8 years	15 years
Subsidy period	2025-2044	2029-2044	2024-2032	2026-2043
Total budget	DKK 8,9 bn (EUR 1,2 bn)	DKK 8,3 bn (EUR 1,1 bn)	DKK 8,9 bn (EUR 0,4 bn)	DKK 18,5 bn (EUR 2,5 bn)



STATUS OF SUBSIDY SCHEMES

CCUS Fund (phase 1)

- Three applicants have been pre-qualified to submit a bid for the tender
- Initial offers expected on 7th October 2022. Best and Final Offers (BAFO) expected 16th December
- Winner of first phase of the CCUS fund expected to be announced early 2023
- Design of second phase of CCUS will be subject to political deliberations during Q1 and Q2 2023

NECCS Fund:

- Final design on NECCS Fund is still in progress. Work expected to be finalized by end of 2022
- NECCS Fund tender expected to open in Q2 2023
- Based on market dialogue, NECCS Fund supported projects are unlikely to commence operations before 2025





BUILDING THE VALUE CHAIN: CO₂ CAPTURE

Ensuring the legal basis for CO₂ capture

- on waste-to-energy plants in general
- Provide municipally owned waste-to-energy plants the legal right to participate in the CCS value chain when they receive state aid for CCS.
- Handling of EU ETS quota in relation to CCS
- Establishing overview of permits etc. for CO₂-capture. Cooperation with other state agencies and municipalities
 - Environmental Protection Agency, Working Environment Authority, Safety Technology Authority etc.



BUILDING THE VALUE CHAIN: CO₂ TRANSPORTATION

- First bilateral agreement on cross-border CO₂ transportation expected to be announced soon
- Recommendations from 6 regional-clusters on CCUS infrastructure expected on 2nd of January 2023
- New CO₂ transportation legislation expected in 2023 regarding e.g. allocation of pipeline responsibilities





BUILDING THE VALUE CHAIN: CO₂ STORAGE

Storage activities

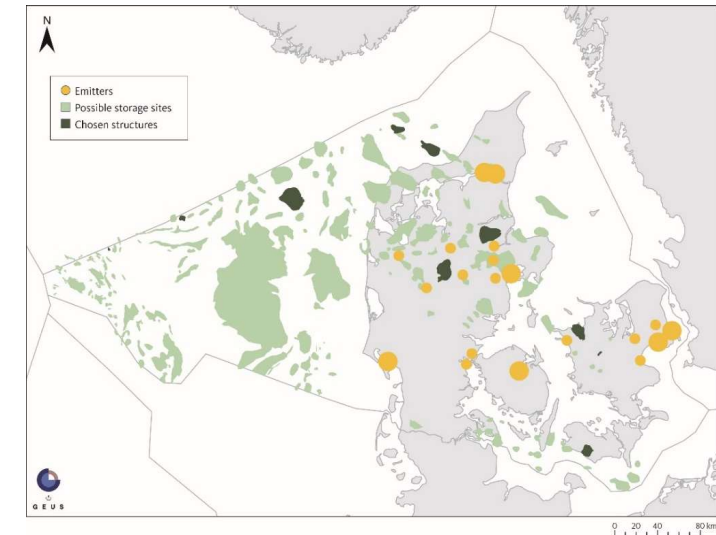
- Project Greensand (offshore) → submitted CO₂-storage pilot project application
- Project Bifrost (offshore)
- The Geological Survey of Denmark and Greenland (GEUS) has begun seismic preliminary studies of possible storage structures on land and near the coast

Denmark's first tender for CO₂ investigation and storage licenses

- Tender opened 15th of august closing date 1st of october
- First investigation licenses expected to be issued by early 2023, first projects from 2025
- June 21 2022: Agreement on framework for CO₂ storage in Denmark, primarily on state co-ownership of storage permits
- Bill enabling state participation (North Sea Fund) in CO₂ storage licenses is expected to enter into force on 1 January 2023.

Strategic environmental impact assessment & tender for onshore CO₂ investigation and storage licenses

- Strategic environmental impact assessment expected to be completed by end of 2023
- First tender for onshore CO₂ investigation and storage licenses are expected to open Q4 2023/Q1 2024





Thank you

Possibilities of CCS and CCU in the Nordic Countries

Ongoing work/Finland

Hanne Siikavirta
Ministry of the Environment
Climate Unit

Framework at national level

- Climate Change Act (423/2022) has entered into force 1 July 2022
 - Key objective is to ensure that Finland will achieve carbon neutrality by 2035 at the latest.
 - New emission reduction targets by 2030 and 2040 are included in the Act and the previous emission reduction target by 2050 is updated.
 - 60 % by 2030
 - 80 % by 2040
 - 90 % by 2050 with a view to reach 95 % reduction
- Plans and Strategies
 - The Medium-term Climate Change Policy Plan
 - Climate and Energy Strategy
 - Climate plan for the land use sector
- Parliamentary group appointed by Government for stronger implementation of Finland's climate targets with long-term perspective to support the national implementation and preparation processes (until 30 June 2023).



CCUS/Specific features

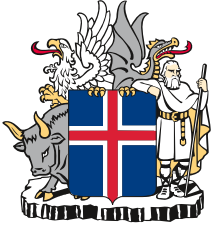
- No possibility for geological storage of CO₂ in Finland
- Around 70 large facilities emitting CO₂ (both fossil and biogenic)
 - In 2020 41.4 Mt CO₂ (60 % biogenic)
- Located both at coast and inland
- CO₂ needs to be transported by ship for possible storage outside Finland.



CCUS/Ongoing activities

- The Sustainable Growth Programme for Finland allocated EUR 150 million to hydrogen and carbon capture and utilisation projects.
- E-fuels will be included in the transport fuel distribution obligation from the beginning of 2023.
- CCS/CCU techniques to reduce CO₂ emissions caused by waste incineration will be piloted.
- There is diverse set of on-going commercialization and piloting activities related to carbon removal and utilisation by Finnish technology providers and also CCUS projects with major actors in the Finnish energy and process industry.
- Government has initiated a strategic research project for carbon use and removals <https://tietokaytoon.fi/-/hiilidioksidin-kaytto-ja-poisto-carbon-dioxide-usage-and-removal->
- Also studies related to voluntary carbon markets have been commissioned by ministries (collected information in <https://ym.fi/sv/frivillig-utslappskompensation>)
- Work to address legislative framework (EU-level, national level) and preparatory work related to bilateral agreements (CCS).





Iceland CO₂ capture and storage

Helga Barðadóttir, Deputy Director

Government of Iceland

Ministry of the Environment, Energy and Climate





Iceland - Climate Target

- At least 55% net greenhouse gas emissions reduction by 2030 compared to 1990.
 - to be achieved by acting jointly with the European Union and its Member States and Norway.
 - Iceland's ESR share not yet defined.
- **NEW target Government Agreement November 2021** - 55% reduction target ESR (non-ETS).
- Goal on **Climate neutrality** no later than **2040**
- Goal on fossil fuel free Iceland 2040



CO₂ capture and storage in Iceland

- CCS Directive entered into force in Iceland in 2015.
- Amendment made in 2021 where storage on industrial scale was permitted.
- At first only Research and Development projects were allowed.
- Work is ongoing on a regulation based on the CCS Directive.
- One application for a storage permit is in process.



CO₂ capture and storage in Iceland

- Special geological circumstances in Iceland
- The Icelandic government has not set forth a formal strategy on CCS.
- Declaration of Intent 2019:
 - The Government, Carbfix and 5 PII companies

“The above parties hereby declare their intent to investigate fully whether the CarbFix method developed by Reykjavik Energy in collaboration with the University of Iceland and foreign partners could become a realistic option, technologically and financially, to reduce the emission of CO₂ from heavy industry in Iceland. “



Carbfix

- The Carbfix project has been in operation since 2012.
- Captured CO₂ dissolved in water and stored in the basaltic layers, where it turns to stone
- Carbfix is operated as a research project in accordance with the CCS-directive,
- The upper limit for research project is 100 kt. CO₂ eq. - are fast approaching that limit.



Direct air capture

- Climeworks operates the ORCA plant in Hellisheiði
- Cooperation with Carbfix



Import – transport of CO₂

- Coda terminal
 - Carbfix is planning to build a storage hub in Iceland.
 - Import of CO₂ with ships from Europe.
 - Import of CO₂ from all kinds of industry.
 - Newly awarded a big grant from the EU Innovation fund.
- **DNV verification of Methodology & Implementation**

CCS in Sweden: Policy, government actions, funding, and priorities going forward

Possibilities of CCS and CCU in the Nordic
Countries, September 28th, 2022

Svante Söderholm

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CCS in Sweden foundation

- In June 2017, Sweden's parliament introduced a climate policy framework with a climate act for Sweden.
 - 85 % reduction target by 2045, baseline 1990
 - By 2045, Sweden is to have zero net emissions of greenhouse gases into the atmosphere, and thereafter negative emissions
 - About 11 millions CO₂-eqv. 2045

CCS strategy

No formal strategy

Inquiry on
supplementary
measures

- Main part on bio-CCS (and CCS)
- Pointed out the way to reach climate goals with CCS as one tool

Government
assignments to the
Swedish Energy Agency,
all finalized 2021

- Propose a support scheme for bio-CCS – reverse auctions
- Prepare a proposal for a treaty with Norway – London protocol
- Create a national centre for CCS as a part of the agency

Support scheme for bio-CCS

- Benefits of reverse auctions
 - Cost efficient / Minimize risk of over compensation
 - Comply with state aid rules
 - (Most) Stakeholders in favour of reverse auctions
- Reverse auctions:
 - In the first stage about 2 millions of tons per year from 2030 (i.e. roughly 3-5 plants)
 - First auction 2023, storage from 2026, support period 15 years. Volume 600 000 ton CO₂/year
 - Two more auctions
- Long term commitment, involve stakeholders

Priorities – issue to be treated



Reporting and accounting – UNFCCC



**Two revenue streams –
trade negative
emission
rights/certificates**

Important issues:

Supplementary measure

State aid rules

Cost efficiency, not for ever

Facilitate the emergence of a market

Is it possible to avoid double claim -
Two different systems: countries and
companies.



**EU COM: certification of CDR, revision of ETS and facilitate the
emergence of a market**

Future and ongoing projects

Stockholm Exergi, EU supported, full scale bio-CCS facility
800 000 tonnes p.a.

Several feasibility studies on bio-CCS – first step to participate
in auction, mainly CHP and WtE

Intermediate storage in a harbour – both on the west coast
and the east coast

Test facilities on plants



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Capture and storage

- the chicken and the egg of CCS



Picture source: <https://nypost.com/2018/09/05/physicists-actually-solved-the-chicken-or-egg-conundrum/>



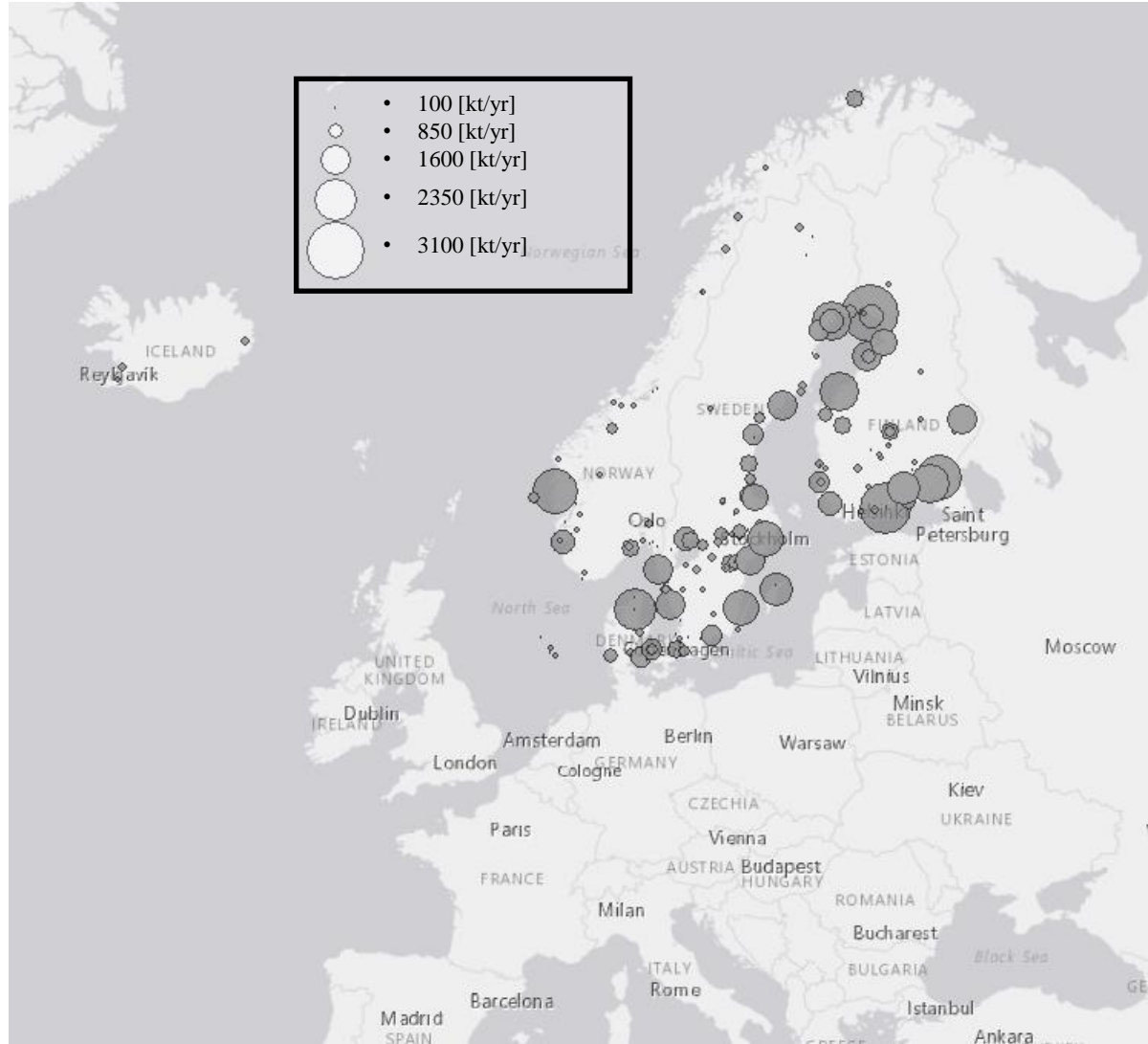
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Communicated emission targets

Carbon neutral by:

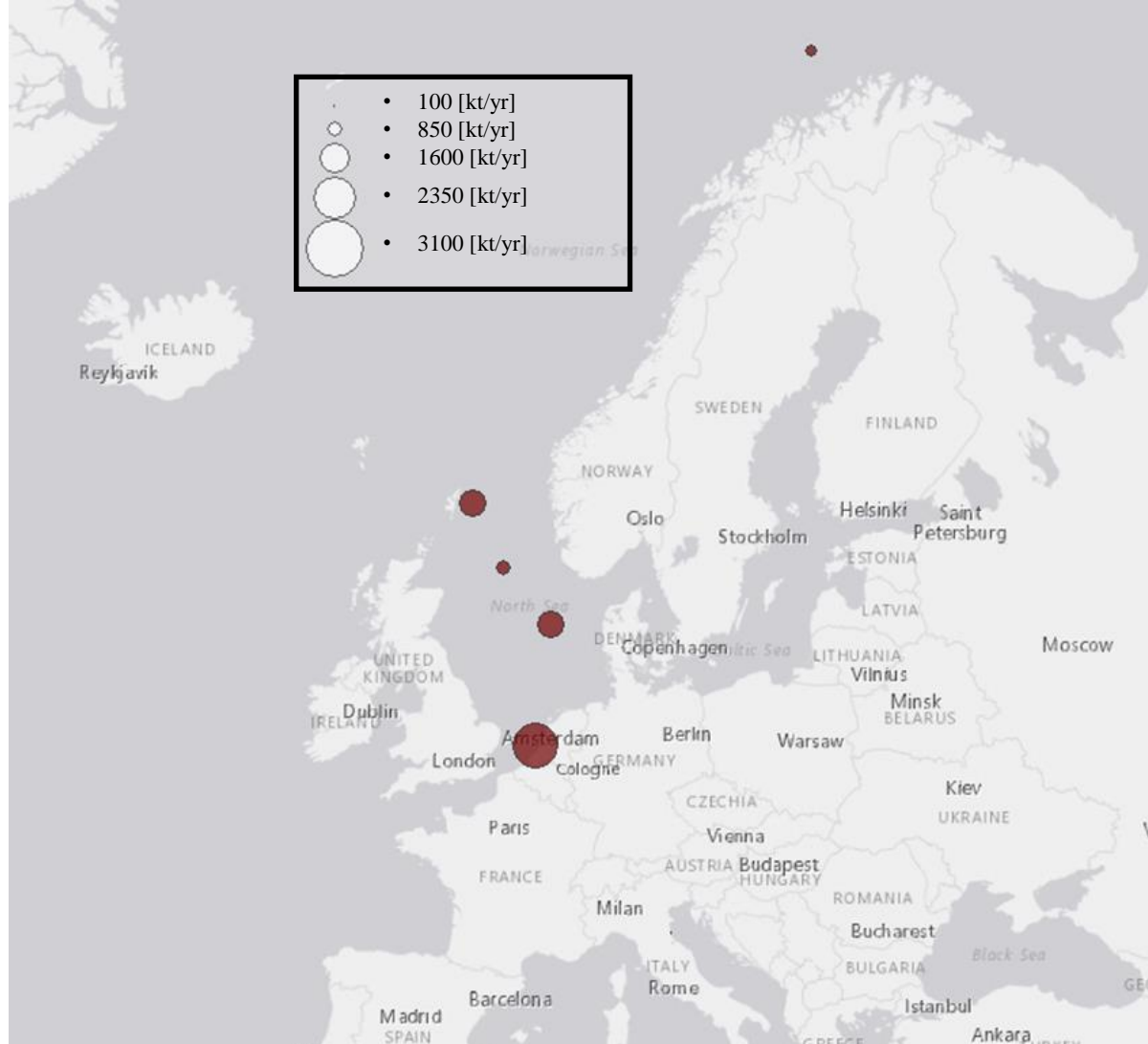
- Denmark: 2050
- Finland: 2035
- Iceland: 2040
- Norway: 2030 (or 2050?)
- Sweden: 2045

Capture potentials [kt/yr]



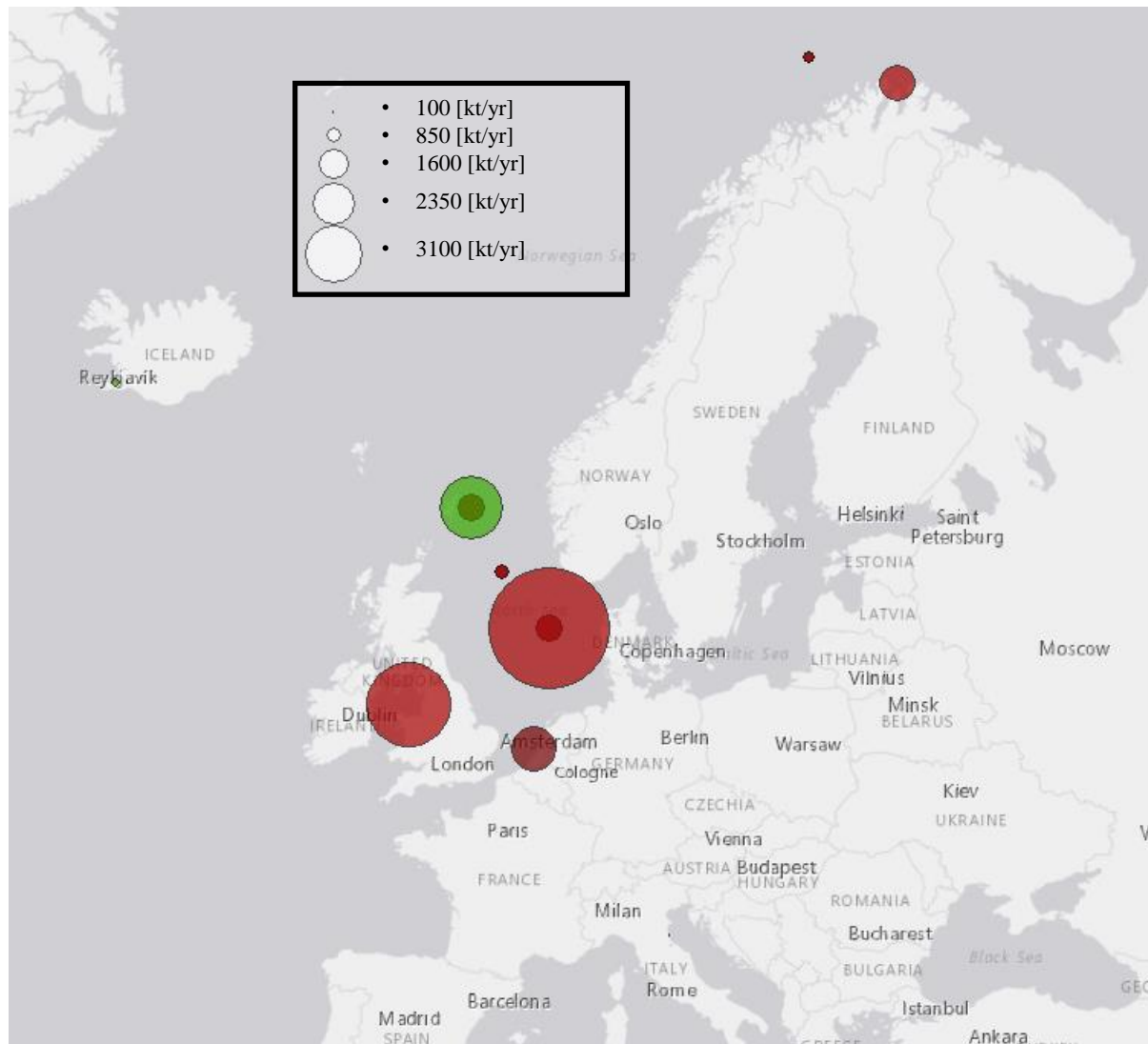
- Total emissions in 2017.
- Emissions per year as scale.
- Map made in ArcGIS with data from European Pollutant Release and Transfer Register (E-PRTR).

Existing/decided storage projects 2024 [kt/yr]



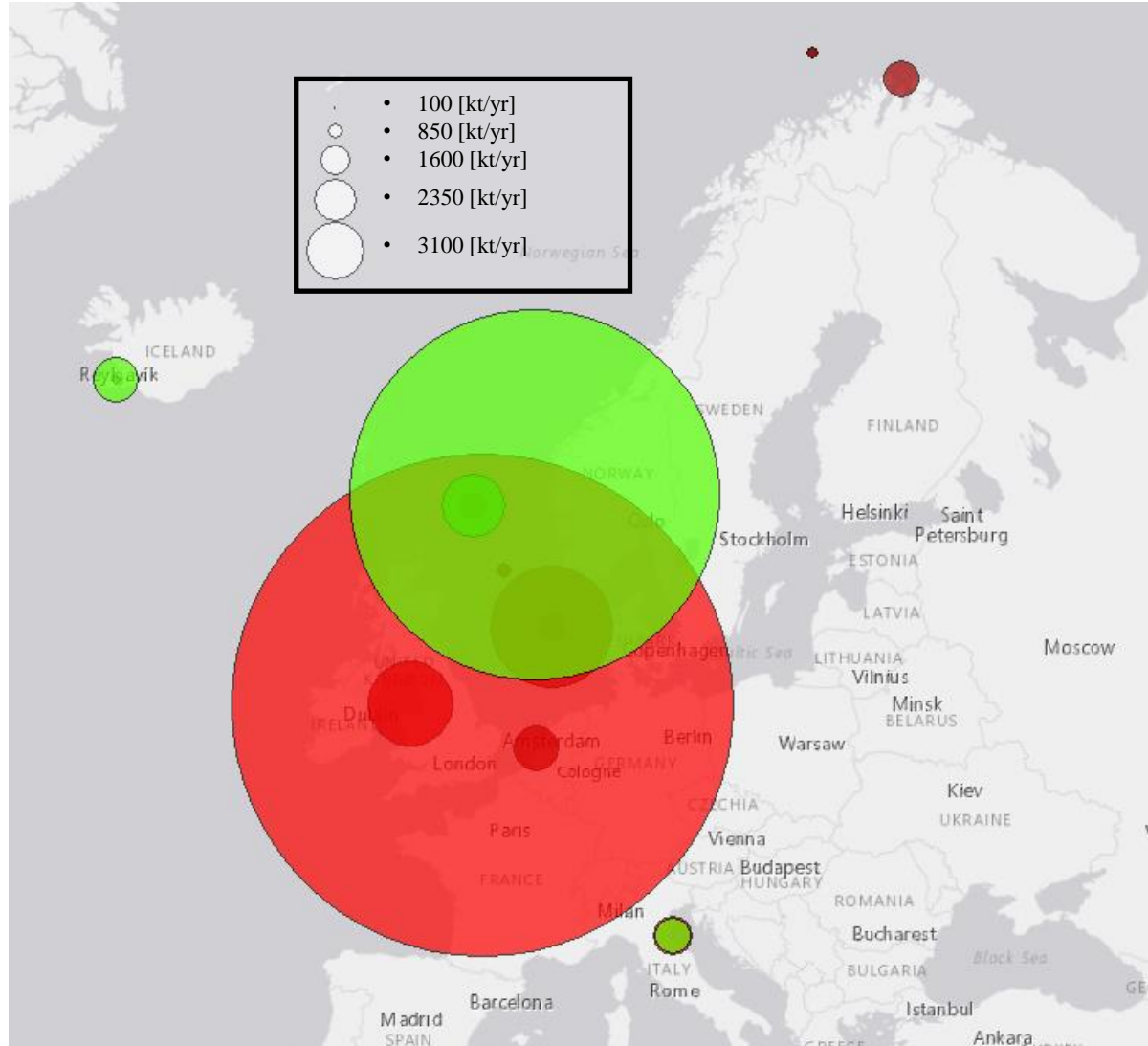
- Storage capacity of existing and decided storage projects.
- Capacity per year as scale.
- Map made in ArcGIS with data from European Pollutant Release and Transfer Register (E-PRTR).
- Red denotes already filled capacity while green denotes capacity that could be left to fill.

Decided/planned storage projects 2026 [kt/yr]



- Storage capacity of planned storage projects.
- Capacity per year as scale.
- Map made in ArcGIS with data from European Pollutant Release and Transfer Register (E-PRTR).
- Red denotes already filled capacity while green denotes capacity that could be left to fill.

Communicated storage projects 2031+ [kt/yr]



- Storage capacity estimations of communicated storage projects.
- Capacity per year as scale.
- Map made in ArcGIS with data from European Pollutant Release and Transfer Register (E-PRTR).
- Red denotes already filled capacity while green denotes capacity that could be left to fill.



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How to achieve full-chain CCS

- What can be done to improve the preconditions to realise investments?
- Who can coordinate between capture and storage stakeholders?