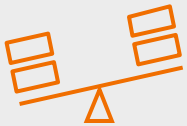
From independent projects to shared infrastructure – How to reach economies of scale? – Case Vantaa Energy

Lauri Kujanpää, VTT

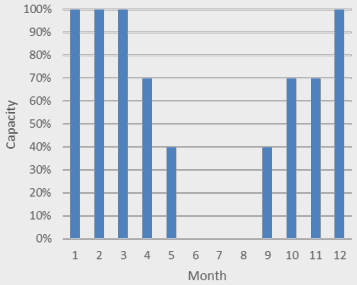
The potential benefits of transporting CO_2 in shared infrastructure

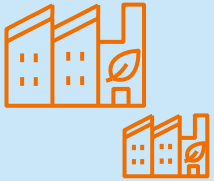
Economy of scale

CO_2 sources are decentralised, and long distance and multimodal transport chains are needed. Increasing the transport capacity reduces the costs of logistics.



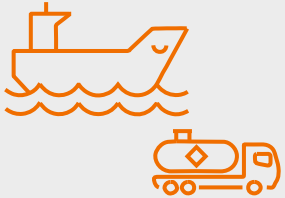
Balancing of seasonally variable capture





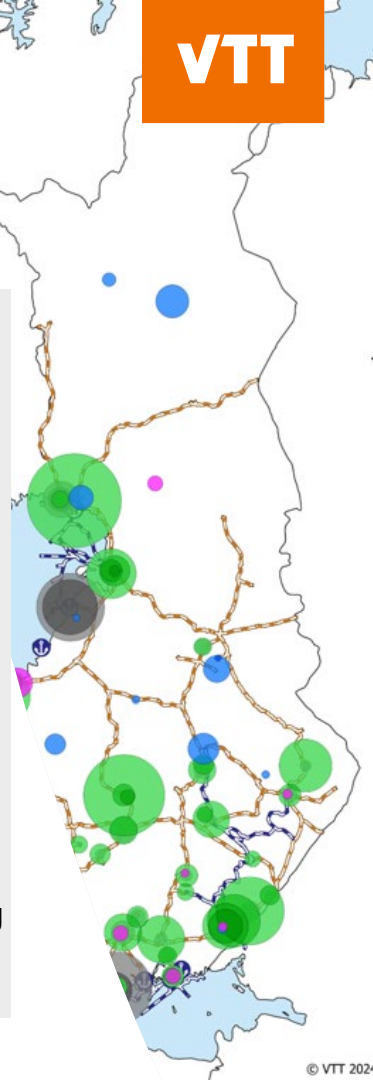
Entry of smaller capture facilities

Opportunity to reach sufficient economies of scale, while also encouraging CCUS participation due to sharing of costs and risks.



Efficient logistics for CO_2 markets

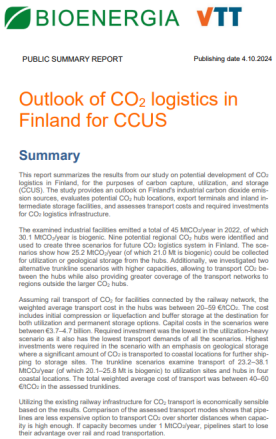
EU's Industrial carbon management strategy aims to develop needed regulatory frameworks, market design and infrastructure planning, establish standards, and assess the use of existing infrastructure for CO_2 transport.



VTT's recent and current studies on CO_2 logistics in Finland

- Technological carbon sinks in Finland (2023), Suomen Ilmastopaneeli

- Outlook of CO_2 logistics in Finland for CCUS (2024) Bioenergia Ry, public summary


BIOENERGIA VTT

PUBLIC SUMMARY REPORT Publishing date 4.10.2024

Outlook of CO_2 logistics in Finland for CCUS

Summary

This report summarizes the results from our study on potential development of CO_2 logistics in Finland, for the purposes of carbon capture, utilization, and storage (CCUS). The study provides an outlook on Finland's industrial carbon dioxide emission sources, evaluates potential CO_2 hub locations, export terminals and inland intermediate storage facilities, and assesses transport costs and required investments for CO_2 logistics infrastructure.

The examined industrial facilities emitted a total of 45 $MtCO_2$/year in 2022, of which 30.1 $MtCO_2$/year is biogenic. Nine potential regional CO_2 hubs were identified and used to create three scenarios for future CO_2 logistics system in Finland. The scenarios show how 25.2 $MtCO_2$/year (of which 21.0 Mt is biogenic) could be collected for utilization or geological storage from the hubs. Additionally, we investigated two alternative trunkline scenarios with higher capacities, allowing to transport CO_2 between the hubs while also providing greater coverage of the transport networks to regions outside the larger CO_2 hubs.

Assuming rail transport of CO_2 for facilities connected by the railway network, the weighted average transport cost in the hubs was between 20–59 €/tCO_2. The cost includes initial compression or liquefaction and buffer storage at the destination for both utilization and permanent storage options. Capital costs in the scenarios were between €3.7–4.7 billion. Required investment was the lowest in the utilization-heavy scenario as it also has the lowest transport demands of all the scenarios. Highest investments were required in the scenario with an emphasis on geological storage where a significant amount of CO_2 is transported to coastal locations for further shipping to storage sites. The trunkline scenarios examine transport of 23.2–38.1 $MtCO_2$/year (of which 20.1–25.8 Mt is biogenic) to utilization sites and hubs in four coastal locations. The total weighted average cost of transport was between 40–60 €/tCO_2 in the assessed trunklines.

Utilizing the existing railway infrastructure for CO_2 transport is economically sensible based on the results. Comparison of the assessed transport modes shows that pipelines are less expensive option to transport CO_2 over shorter distances when capacity is high enough. If capacity becomes under 1 $MtCO_2$/year, pipelines start to lose their advantage over rail and road transportation.

- CO_2 capture and supply for P2X processes (2024-2025, on-going), RePowerEU

Funded by the European Union
NextGenerationEU

Bio-CO2 Use and Removal

Vantaan Energia

06.05.2025

DRAFT

Vantaa Energy CCS project will capture ~650 ktpa of CO_2 emissions to future-proof its current Waste-to-Energy plant

vantaan energia

Decarbonizing is key for European Waste-to-Energy plants to be competitive long term

CCS is Vantaa Energy's best option to decarbonize – sufficiently mature technology with state/EU funding options

The CO_2 will be transported by a **6 km pipeline to Vuosaari port**, liquefied and shipped for storage in the North Sea

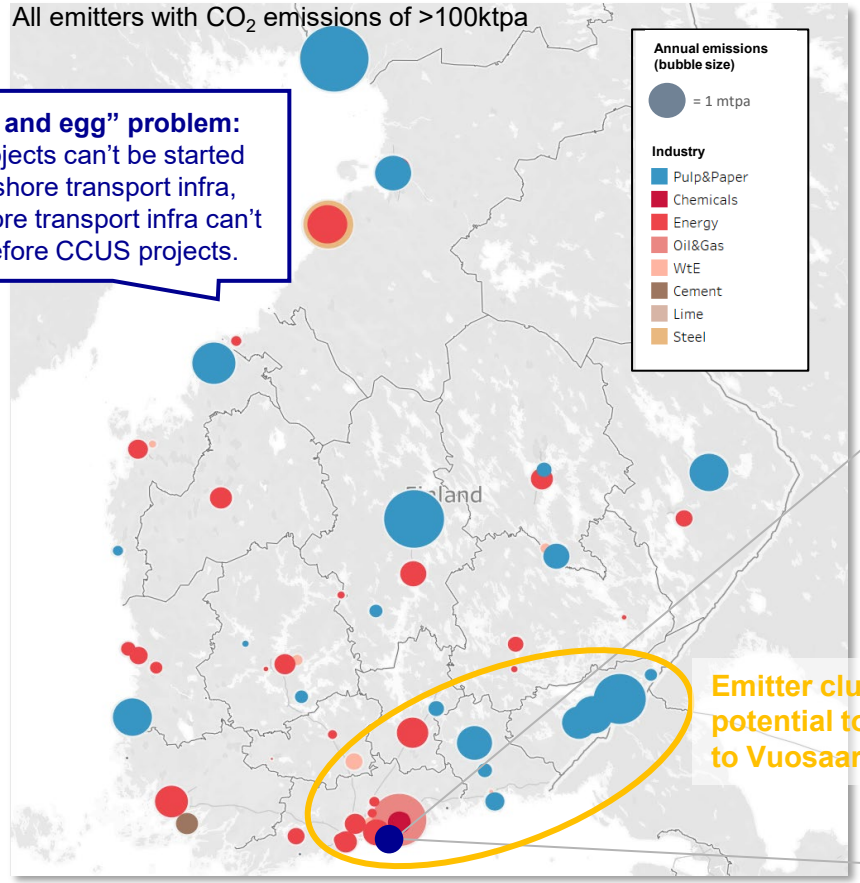
Planned construction start in 2027 and **commissioning in 2030**

VECCS is an ideal project to unlock a scaled CCS value chain in Finland's South-East emitter cluster

ILLUSTRATIVE

Emitters are scattered, with no value chain infra.

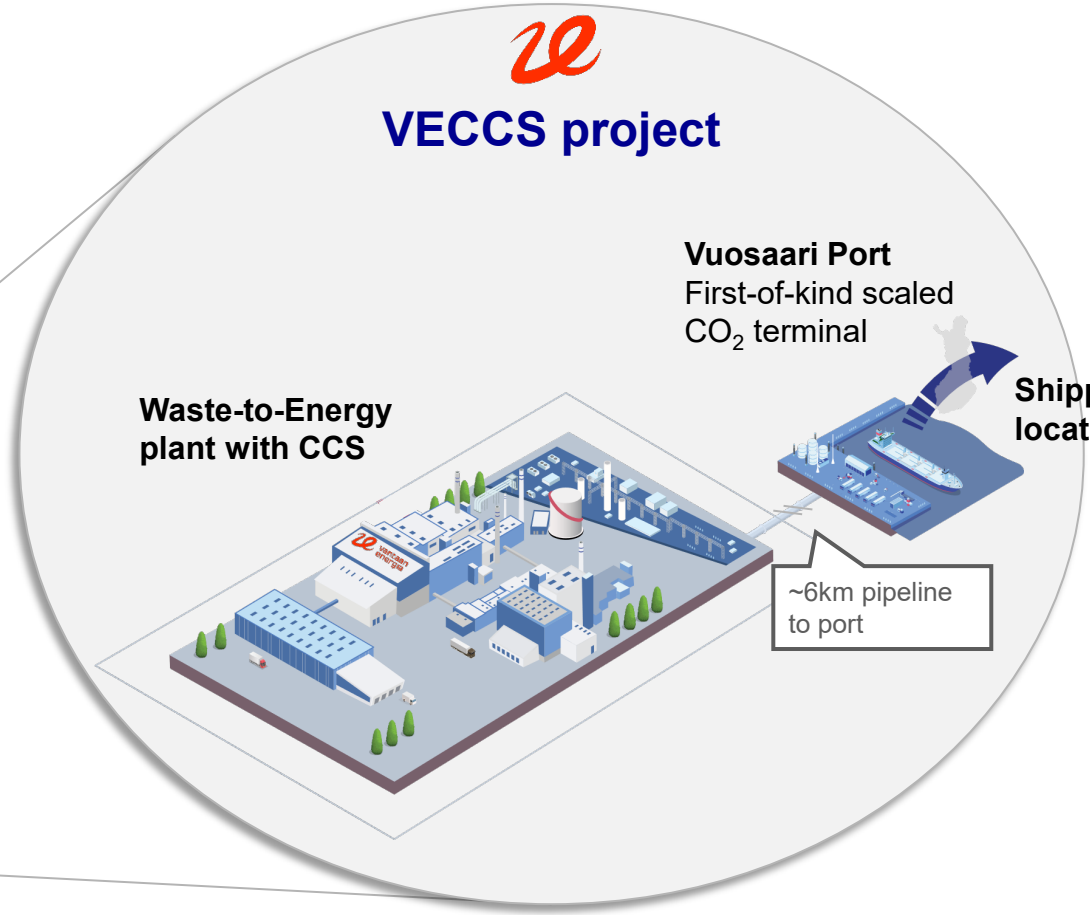
All emitters with CO_2 emissions of >100ktpa



"Chicken and egg" problem: CCUS projects can't be started before onshore transport infra, and onshore transport infra can't be built before CCUS projects.

Emitter cluster with potential to connect to Vuosaari Port

VECCS builds first-of-kind CO_2 port, enabling CCS value chain



Thank you!