Techno-economic modelling of the Baltic CCUS onshore scenario

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Abstract. Techno-economic modelling of the Baltic onshore CO_2 transport, storage, and utilization scenario included HeidelberCement-owned Kunda Nordic Cement (KNC) plant, the main Estonian cement producer, four Estonian and one Latvian power plant and CO_2 mineral carbonation of the oil shale ash, as possible CO_2 use option.

In 2019 nearly 6.5 Mt of oil shale ash (OSA) was produced in Estonia from energy production. Estonian OSA could be used as an effective sorbent in the proposed CO_2-mineralization process, using CO_2 from flue gas and producing precipitated $CaCO_3$ (PCC) of high quality.
Mineral carbonation of 0.42 Mt CO_2 using 3.8 Mt of fresh OSA and about 6.33 Mt CO_2 produced annually by five Estonian and one Latvian plant transported by pipeline for storage into the North-Blidene structure in western Latvia are combined in the CCUS scenario. Cambrian Deimena Formation reservoir sandstone is located at the depth of 1035-1150 m in the selected saline aquifer. The average optimistic storage capacity of about 270 Mt allows planning CCUS project for 30 years. The share of the Estonian emissions avoided and stored in Latvia is 86.5 %, including 8.2 % by KNC, while Latvian stored emissions will compose 13.5 %.

Annually 6.8 Mt CO_2 could be captured, transported and injected, including 6 Mt CO_2 avoided using transport and storage and 0.42 Mt CO_2 avoided using MC of Estonian OSA. During 30 years nearly 204 Mt CO_2 will be captured, used and stored, while 193 Mt CO_2 could be avoided.

The total average transport and storage (T&S) cost of the scenario is 18.4 €/t CO_2 injected. This cost depends on the transport distance, according to the applied methodology, and it is the most expensive for the Eesti Energia PPs. The lowest T&S cost of 5.54 €/t CO_2 injected will have Latvenergo TEC-2 PP located at a smaller distance from the storage site. At the price of EEAP (CO_2 Emission Allowance Price in EU ETS) of 40 €/t CO_2 and 50 €/t PCC, the CCUS scenario could be beneficial for three Eesti Energia and Latvenergo TEC-2 power plants. For the KNC and VKG Energia plants without CO_2 use options, the higher EEAP of about 48-50 €/t CO_2 is needed to cover all CCUS costs including capture, compression, transport, storage and monitoring. The transport and storage costs are distance-dependent, as pipelines are the most expensive part of the transport, storage and monitoring costs.

At the present EEAP of about 90 €/t CO2, all the participating plants will get benefits from the proposed scenario.

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