

Full-Scale CCS at a Swiss Waste-to-Energy plant – opportunities and challenges



S4S CCUS Stakeholder Dialogue Sion

15.06.2026

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- Waste treatment for 180'000 residents from Glarus, Schwyz and St. Gallen
- plant renewal ongoing, planned 120'000 t_{waste}/year
- CHF 28 Mio. turnover



STIFTUNG ZENTRUM FÜR NACHHALTIGE
ABFALL- UND RESSOURCENNUTZUNG

CO₂ competence center

supporting the implementation of
CCS/CCU in the Swiss WtE sector

Carbon Capture at KVA Linth - activities

Feasibility Study Aker Carbon Capture + sus.lab ETH²

→ CCS @KVA Linth: 156-
190 CHF/tCO₂

CO₂-Emissionen: Vereinbarung zwischen Bund und Kehrichtverbrennungsanlagen

Bern, 16.03.2022 - Der Bund und die Schweizer Betreiber von Kehrichtverbrennungsanlagen haben die Vereinbarung zur Reduktion der CO₂-Emissionen der Branche erneuert. Die Vereinbarung wurde zwischen dem Eidgenössischen Departement für Umwelt, Verkehr, Energie und Kommunikation (UVEK) und dem Verband der Betreiber Schweizer Abfallverwertungsanlagen (VBSA) abgeschlossen. Die Betreiber verpflichten sich, bis 2030 Anlagen zur Abscheidung, Speicherung und Nutzung von CO₂ in Betrieb zu nehmen. Diese Vereinbarung löst jene aus dem Jahr 2014 ab, die Ende 2021 auslief.

Pre-Project (SIA31)

→ CCS @KVA Linth:
360 CHF/tCO₂

2013-2019

2021

2022

2024

2025

Studies on CCU: carbon
capture and methane
production¹



Agreement VBSA-DETEK³

1x100kt/a until 2030 – no ETS

Founding of ZAR CO₂ Competence Centre

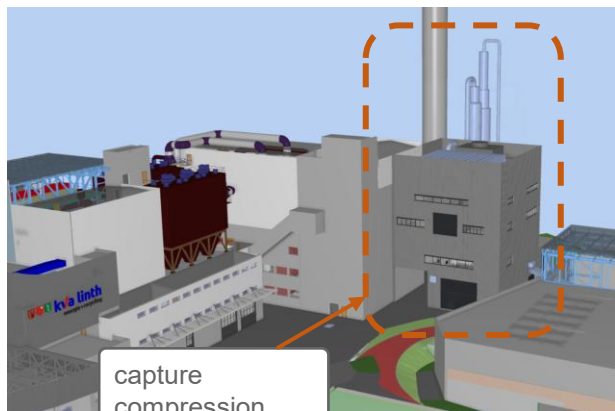


**Work packages CO₂
Competence Center
completed** (see report⁴)

¹ https://www.kva-linth.ch/fileadmin/user_upload/Vortrag_PtG_Energie_aus_Abfall_Band_16_259-274_Furgler.pdf
² <https://www.suslab.ch/projects-1/demonstrating-ccs-feasibility-with-waste-to-energy-plants-in-switzerland>
³ <https://www.bafu.admin.ch/de/vereinbarung-mit-kehrichverbrennungsanlagen>
⁴ https://www.kva-linth.ch/fileadmin/user_upload/Abschlussbericht_CO2-Kompetenzzentrum_2025.pdf

Pre-project CCS Linth

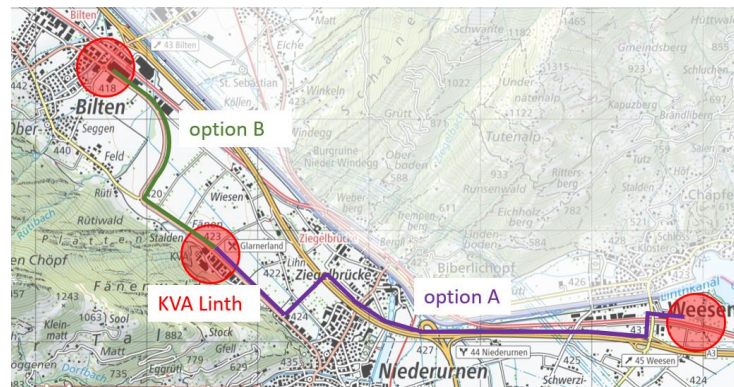
location KVA Linth



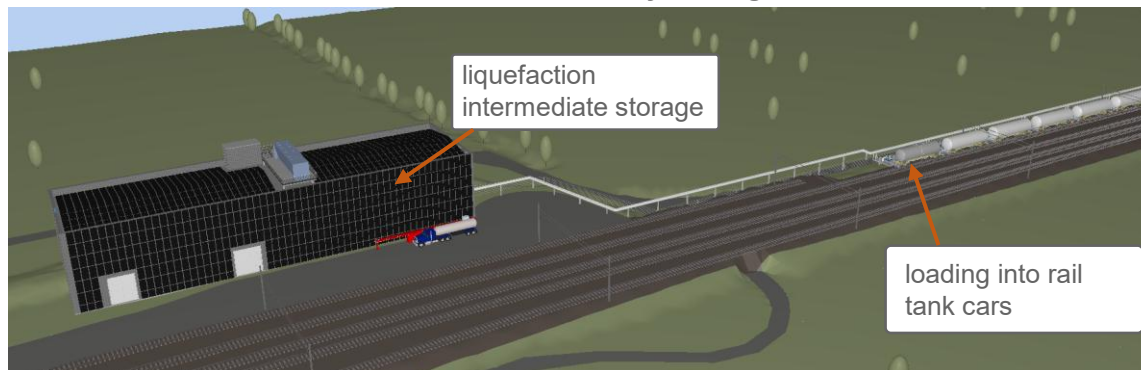
capture
compression
drying
heat integration
cooling

- Capacity: 130'000 t_{CO2}/year
- Planner: Ramboll u. tbf+Partner
- **HPC** w/o additives and **amines** with MEA, two suppliers each

CO₂ Pipeline to Railway loading station



location railway loading

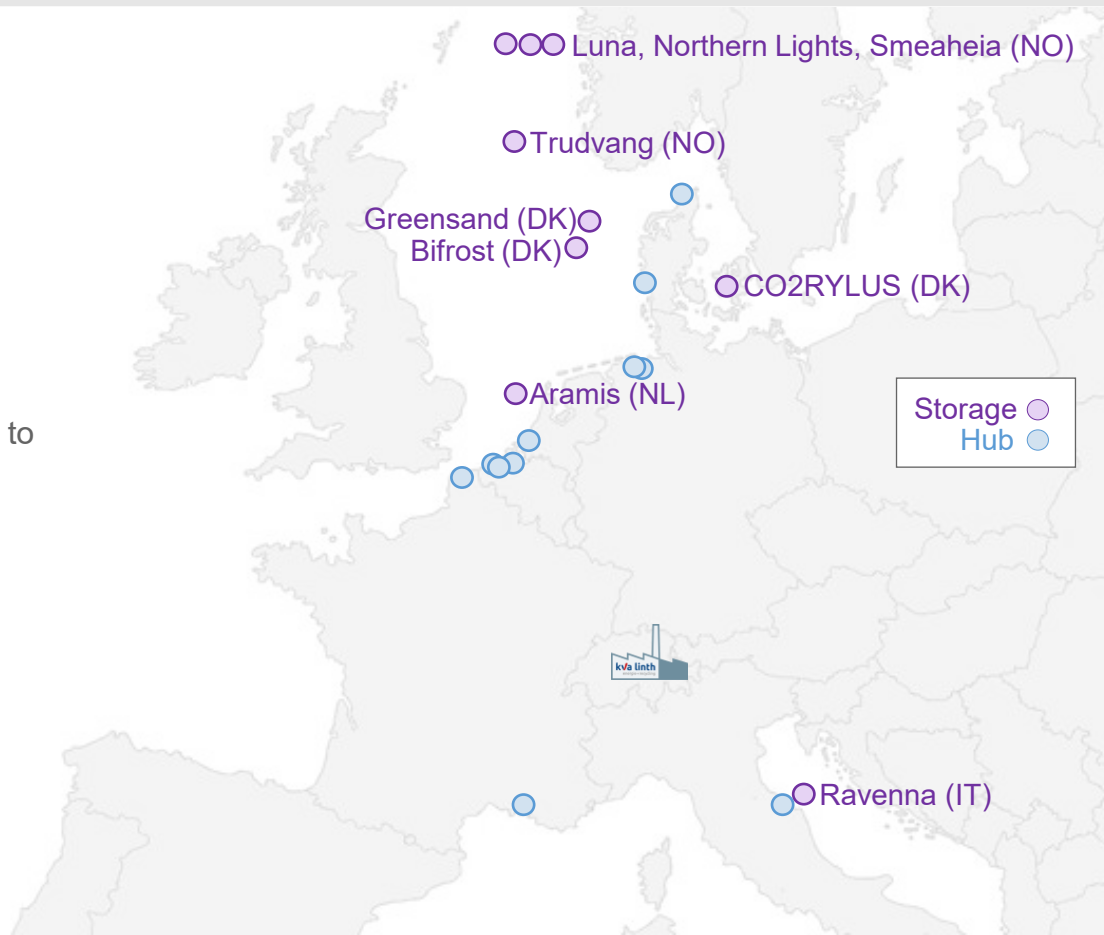


International transport and storage

Transport by train ~ 20 rail tank cars every 3 days



CO₂-Hub: unloading, intermediate storage, feed to ships / pipeline for transport to storage site



ETH Zürich, Prof. André Bardow / Julian Nöhl

- The project causes $\text{CO}_{2,\text{eq}}$ -emissions of **7.9-13.6 % of the stored CO_2** . The value depends mainly on the chosen storage location
- the **main part** is caused by **transportation** (4-9%)

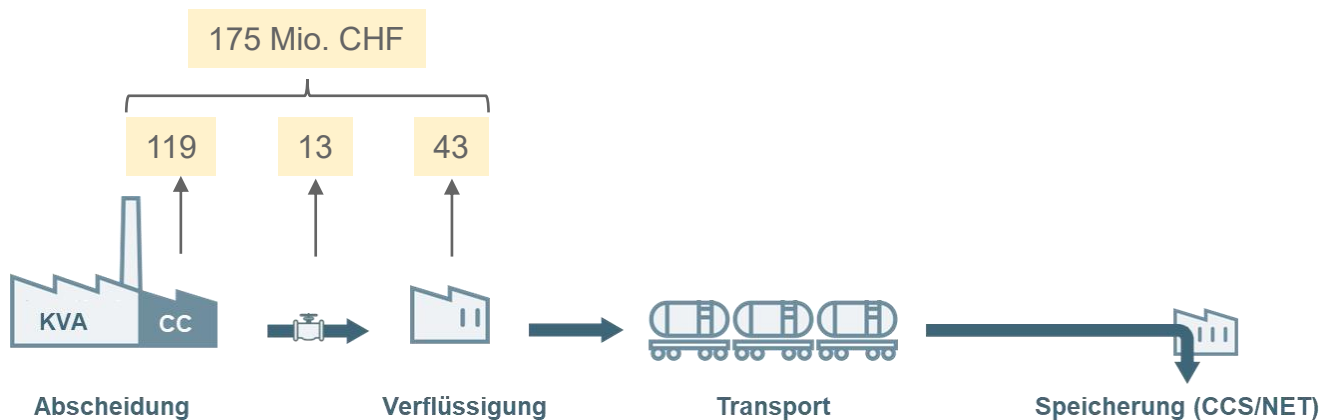
→ The energy- and material use lowers the climate benefit only by around 10%

- In future, the efficiency will increase further, mainly because of
 - **CO_2 -pipelines** for transport
 - decreasing CO_2 -intensity of **electricity in the involved countries** (IT, DE, DK ...)



CCS Linth Costs (capture technology HPC)

CAPEX



annuity: 11.9 Mio. CHF/year
(depreciation period 25 years, 4.6% interest)

OPEX

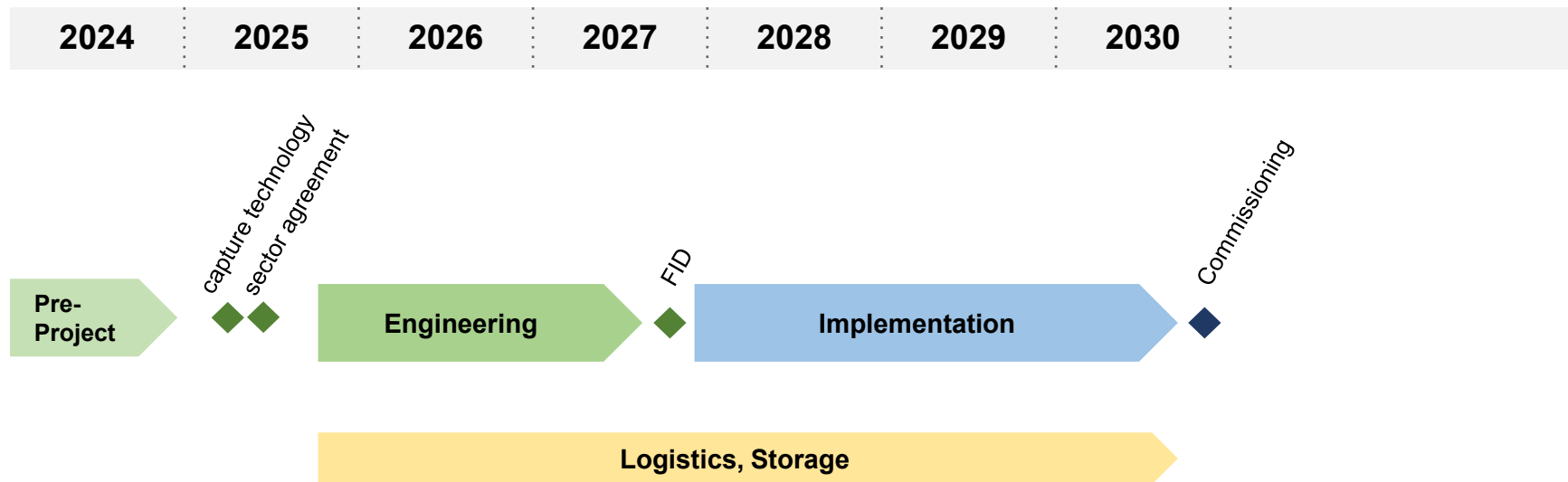
10.3 Mio. CHF/year

≈ 12.3 Mio. CHF/year

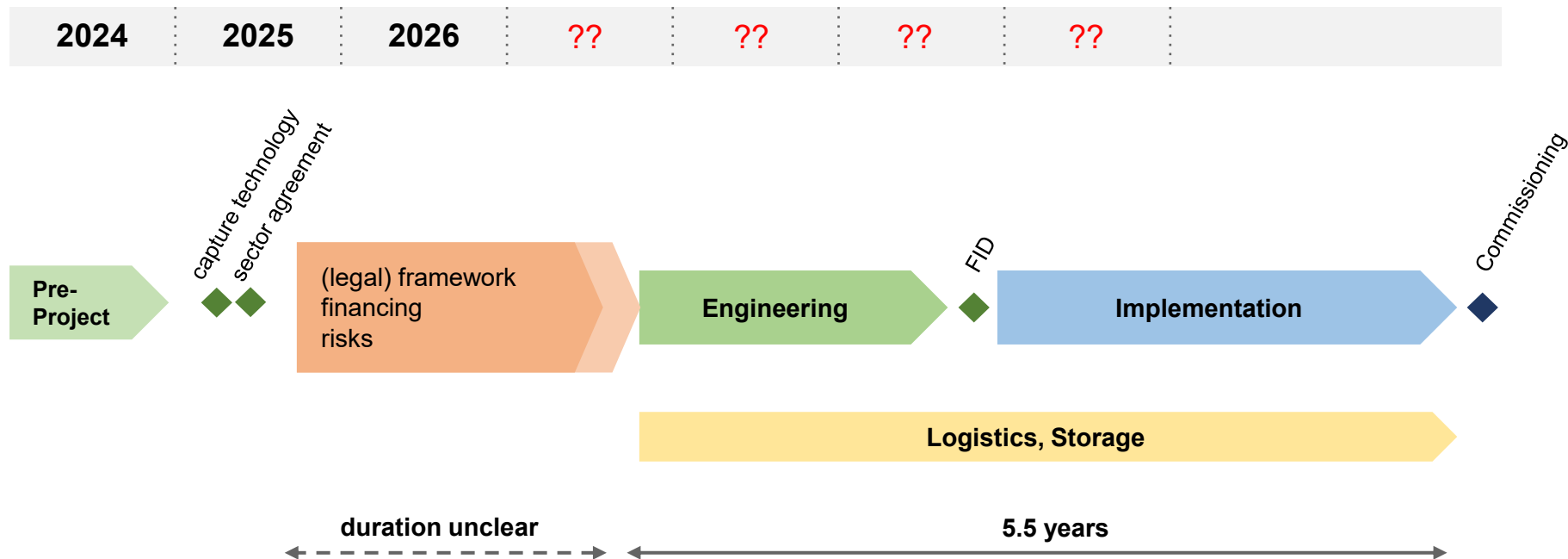
≈ 9.8 Mio. CHF/year

total cost: around **360 CHF/t** of physically stored CO₂
largest uncertainties in logistics + storage

Initial Timeline CCS Linth



Timeline CCS Linth



Challenges



- technology maturity / permitting
- geographic location of Switzerland
- space requirements (e.g. in cities – CO₂ transport)
- risks and uncertainties are still high
- financing + handling of risks / uncertainties
 - public ownership: limits, what we can decide
 - added complexity: split into biogenic and fossil CO₂, regional household waste and market waste
 - currently uncertain future framework (CO₂-act, ETS, agreement VBSA-DETEC)

Opportunities



- good flue gas quality of Swiss WtE plants
- energy availability + synergy with district heating
 - enough energy from waste incineration + no loss in district heating supply (KVA Linth)
- pioneering projects can have large benefit by lowering risks + uncertainties for future projects
- large potential in CH for avoiding hard-to-abate emissions + generating CDR's
 - CCS on all WtE plants could avoid / compensate around 30% of the remaining hard-to-abate emissions in Switzerland in 2050

Thank You!



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