

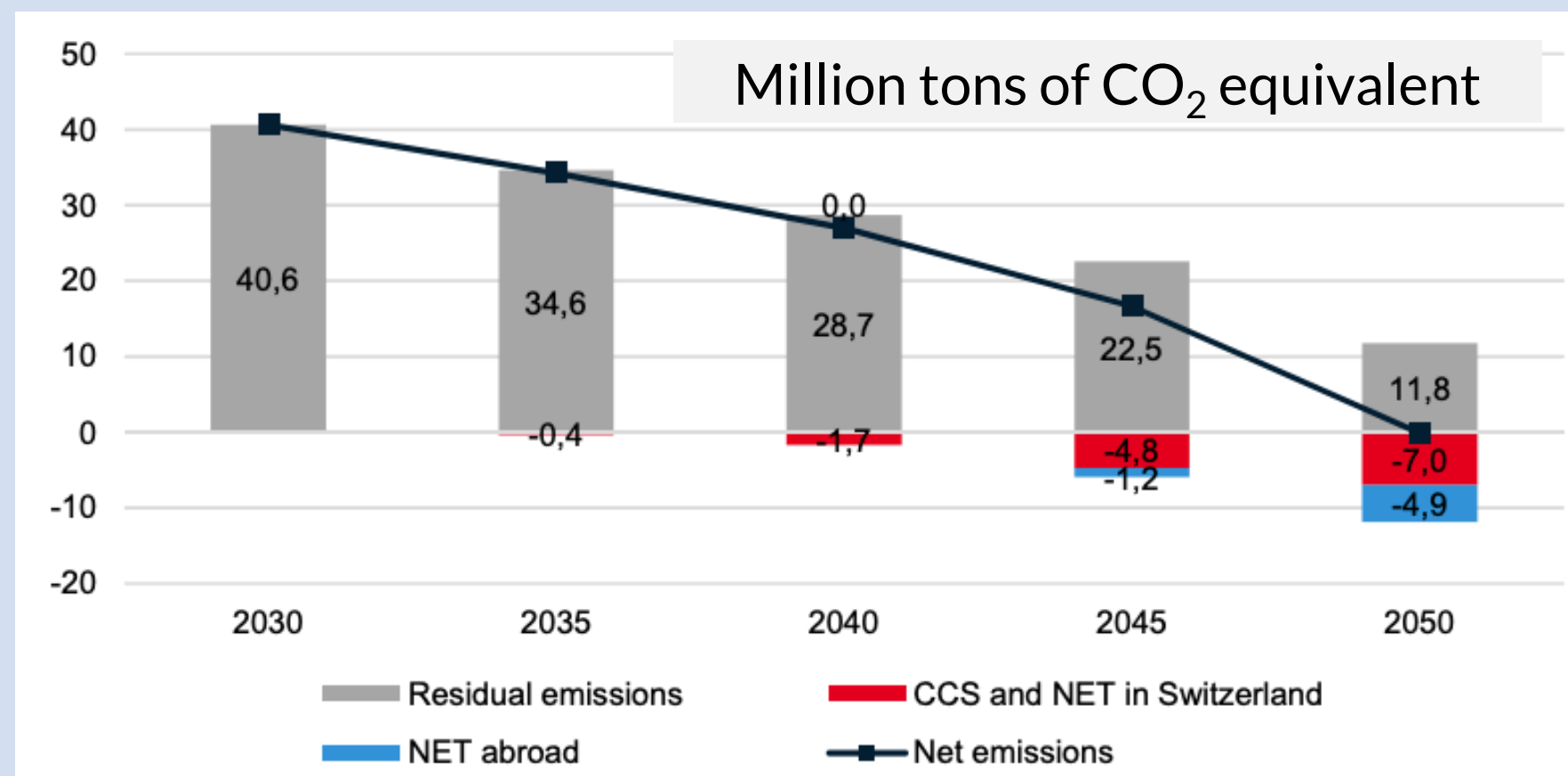
Demonstration and Upscaling of CARbon dioxide Management solutions for a net-zero Switzerland

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1 Background

According to *Long-Term Climate Strategy for Switzerland* published by The Federal Council (2021) CO₂ capture and storage shall play a key role to achieve the Swiss goal of carbon neutrality by 2050.



"Countries' net-zero emissions pledges must urgently be translated into strong near-term policies and action"

(United Nations Environmental Program - Emissions Gap Report 2020 - Dec. 2020)

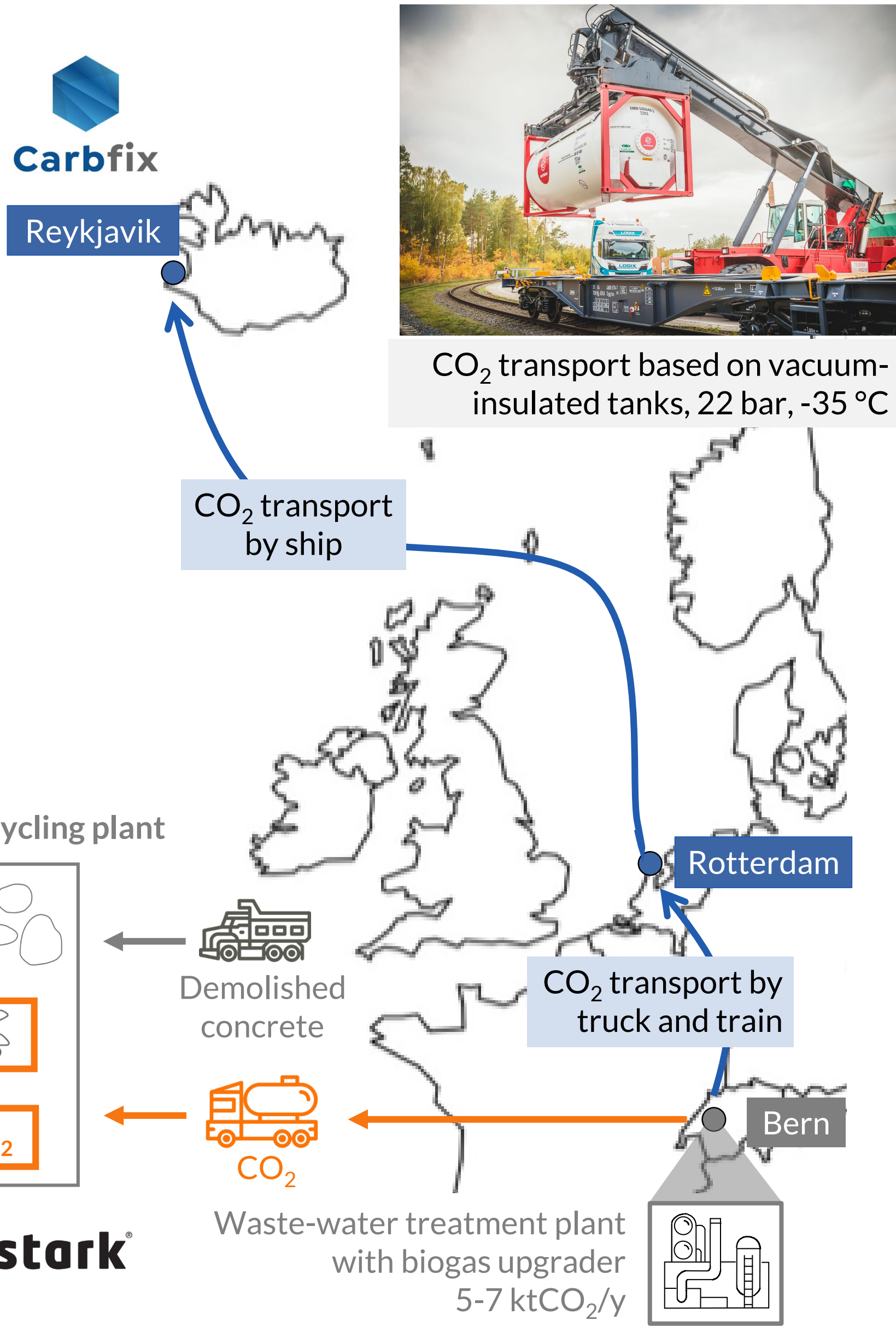
Total emissions (fossil and biogenic) from Swiss CO₂ point sources (2018/2019):
Waste-to-Energy (30 plants) 4.5 Mt CO₂/y
Mineral industry (7 plants) 2.6 Mt CO₂/y
Chemical industry (9 plants) 1.1 Mt CO₂/y



3 Demonstration of CO₂ Management Solutions

International solution:
CO₂ transport and permanent geological storage - CCTS
CO₂ is dissolved in seawater, injected in basalt reservoirs and stored permanently via mineralization up to 1000 tCO₂ in 2022/2023

Domestic solution:
CO₂ utilization and storage in concrete - CCUS
CO₂ is stored permanently in concrete used for building or road construction up to 500 tCO₂ in 2022/2023



2 Project objectives

- To demonstrate the technical feasibility of using and storing CO₂ captured at a Swiss emitter and of generating **negative emissions** by:
 - Utilizing and storing CO₂ in concrete, thus realizing a domestic carbon capture, utilisation and storage (CCUS) value chain;
 - Implementing a carbon capture, transport and storage (CCTS) value chain based on CO₂ transport and permanent storage in a geological reservoir abroad.
- To investigate the potential of creating a CO₂ network linking clusters of Swiss CO₂ sources and storage sites, and its optimal design with respect to **techno-economic, environmental, and reliability** performance.
- To address **policy, legal, regulatory and acceptance challenges** to verify and ensure the financial and overall feasibility of CCTS and CCUS value chains.

4 Upscaling of CO₂ Management Solutions

Capture

Jura cement plant, Wildegg, 500 kt CO₂/y (70% process, 30% fuel)

ERZ waste-to-energy plant, Zürich 400 kt CO₂/y

No waste heat available
Limited content of biogenic CO₂ in flue gas
Limited space for CO₂ capture unit
Private sector/market competition
Covered by the Emissions Trading Scheme

Heat for CO₂ capture vs. energy sale
Biogenic CO₂ content in flue gas 50%
Limited space for CO₂ transport logistics
Public sector
City net-zero goal by 2035

Transport and storage

Key Performance Indicators

CO₂ capture, transport and storage amounts [log. scale]

2021: DemoUp CARMA truck-train-ship (1000 tCO₂)

2023: 1/2 large-scale biogas upgraders truck-train-ship (10 ktCO₂/y)

2025: 1/2 Waste-to-Energy plants truck-train-ship (100+ ktCO₂/y)

2026+: Clusters of Swiss emitters truck-train-ship + pipeline (1+ mtCO₂/y)

2030+: CO₂ network infrastructure and storage hubs (pan-European) (10+ mtCO₂/y)

Holistic approach

Climate policies

Emissions accounting, reporting tools and climate finance mechanisms for CCUS/CCTS solutions

Financing mechanisms

Investment and financing needs along the CCUS/CCTS supply chains and effective support policy designs

Legal and regulatory frameworks

Technical regulatory gaps for CO₂ trans-national transport and pipeline infrastructure

Social acceptance

Stakeholders mapping, knowledge and perception of the public towards CCUS/CCTS

5 Consortium

23 partners dedicated to solving the CO₂ emissions problem

Research institutions

ETH Zürich (5 depts. and centers)
 Swiss Federal Laboratory for Materials Science and Technology
 Paul Scherrer Institute
 Università della Svizzera Italiana

National organizations

Kästli
 Casale
 South Pole
 Jura Cement
 Entsorgung+Recycling Zürich
 SBB Cargo/Chemoil
 Stiftung Risiko-Dialog
 Lonza

Arxada
 scienceindustries
 Salzmann Transporte
 Sulzer Chemtech
 Ara Region Bern
 Perspectives
 Swiss Association of Waste Incinerators

International organizations

Carbfix
 Northern Lights

ETH spin-offs

Climeworks
 Neustark

CO2SeaStone, 2021-2024, www.carbfix.com/co2-seastone

Field injection, monitoring and validation of CO₂ dissolved in seawater
 Carbfix, ISOR, University of Iceland, University College London, ETH

DemoUpStorage, 2022-2024

Demonstrating the safe storage of CO₂ in Icelandic basalt via novel dense geophysical and geochemical monitoring techniques
 ETH, EPFL, University of Geneva, Eawag

ACCESS, 2021-2025, www.projectaccess.eu

Providing access to cost-efficient, replicable, safe, and flexible CCUS
 Coordinator: SINTEF Energy