Business model analysis: CCS & CDR in Swiss waste-to-energy (WtE) plants

CETP Carbon Rhine Route project (CO2RR)

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Within this framework, the Carbon Rhine Route project is developing pathways for inland European emitters to access carbon capture and storage, supporting the scale-up of carbon dioxide removal (CDR). Consortium partners include Airfix, Carbon Impact, Chemoil Logistics and Northern Lights.

CCS and CDR at waste-to-energy (WtE) plants in Switzerland

Waste-to-energy (WtE) is a **key sector for scaling BECCS** in Switzerland and Europe. According to the Swiss CCS roadmap, WtE is expected to deliver the **majority of the country's carbon dioxide removals (CDRs)**.

Scaling CCS at WtE plants requires viable business models. While current subsidies support early-mover projects – mainly in Northern Europe – **long-term solutions are essential** to enable widespread deployment.

Two proposed financing solutions for CCS at WtE Plants

1. Shared CCS funding through WtE fees

- All WtE operators contribute a **CCS fee** to customers to fund the **first demonstration facility**.
- Could serve as a **long-term mechanism**, allowing operators with CCS to **cover operational costs** without creating a competitive advantage.
- Proposed by the **CCS Taskforce of VBSA**.

2. Advanced disposal and recycling fee

- Applies to **all full or partial plastic products** imported or produced in Switzerland.
- Since up to **100% of fossil emissions** in WtE plants come from plastics, the fee directly addresses the main emission source.
- Simple to implement, has a **modest steering effect** and **ensures early movers are not penalised**.
- Proposed by **WWF Switzerland**.

Overview of deep dive into business models for CCS at waste-to-energy (WtE) plants

Content

- WtE is a key sector to scale BECCS in Switzerland and Europe
- High-level overview: current business models and future direction
- Workshop designs for initial business model discussions and in-depth financial modelling

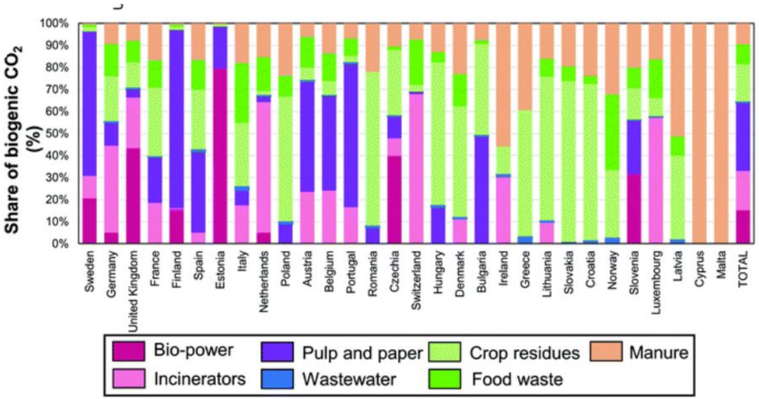
Data sources

- Airfix mandate with a Swedish waste-to-energy plant within Net Zero Cities programme and similar mandates (2025, anonymized)
- Airfix mandate with a Swiss waste-to-energy plant about business model
- "Finanzierungslösungen CCS by KVA" by Ramboll within mandate for Cargo Sous Terrain, in which Airfix had a significant role (2025)
- WWF proposal on advanced disposal and recycling fee (2023)
- Scienceindustries report by DENA and BAK (2025)

WtE as a key sector to scale BECCS

WtE is a key sector required to scale BECCS in CH and Europe

- Due to its significant role among potential BECCS (Bioenergy with Carbon Capture and Storage) carbon dioxide removal (CDR) pathways in both Switzerland and Europe, this sector was selected for an in-depth analysis to illustrate existing business models and explore potential future solutions.
- A frequently cited ETH Zurich study* estimates that approximately **7.5 billion tonnes of CO_2** must be sequestered through BECCS in Europe by 2050 to meet climate targets. This corresponds to about **5% of Europe's 2018 greenhouse gas (GHG) emissions, or roughly 200 million tons of CO_2 per year.**
- While the contribution of waste-related BECCS varies across countries (see graph), Switzerland's potential is particularly concentrated in **waste incineration**.
- In May 2022, the **Swiss Federal Office for the Environment (FOEN)** published a baseline study on CCS and CDR*, outlining a long-term plan to achieve **12 million tonnes (Mt) of CO_2 reductions or removals through CCS and NETs (Negative Emission Technologies)**. Of this total, 7 Mt are expected to occur within Switzerland, including **2 Mt of negative emissions**. These 2 Mt correspond to the biogenic share of emissions from waste-to-energy plants, which collectively emit about **4.5 Mt of CO_2 annually**, including both fossil and biogenic sources.



*__Sources:__ [Assessment of carbon dioxide removal potential via BECCS in a carbon-neutral Europe] by Lorenzo Rosa, Daniel L. Sanchez and Marco Mazotti, 2021;
[Carbon capture and storage (CCS) and negative emission technologies] by BAFU, 2022

Current business models and future direction

Reflections on current BECCS business models in Switzerland: Compliance market view

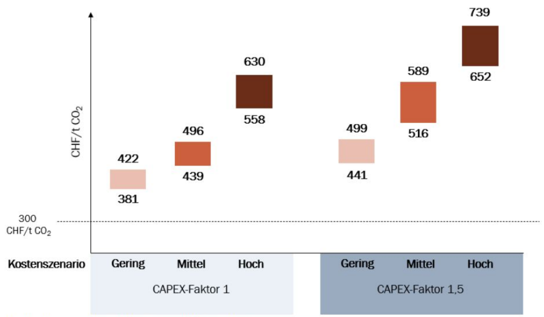
- Similar to other European countries, there are currently **no viable business models for large-scale BECCS deployment** in WtE plants. Existing projects – mainly in Denmark and Sweden – rely heavily on **public subsidies**, highlighting the absence of market-based solutions.
- Switzerland shows **growing openness** toward BECCS implementation, but key **regulatory and financial mechanisms** are still under development. In 2024, the **Federal Council** confirmed that a **nationwide increase in waste disposal fees** aligned with the **polluter-pays principle** would be possible under the **Environmental Protection Act (USG, SR 814.01)**.
- Additionally, the **Climate and Innovation Law foresees annual subsidies of CHF 200 million to support new technologies** and processes, including CCS. However, **WtE plants are excluded from this program**, as they are already covered by an agreement between the WtE association and the Federal Office for the Environment (FOEN). This agreement exempts them from the Emissions Trading Scheme (ETS) but **requires the construction of at least one CCS plant by 2030**.
- **CCS projects may also qualify as compensation projects** within the current offset obligations for fossil fuel importers, offering another potential – though limited – funding avenue.
- While discussions about **nationwide disposal fee increases** remain at a conceptual level, some cantons and regions are moving ahead with more concrete measures. Basel, Hinwil, and Innerschwyz (Linth) are actively exploring local solutions; the latter has already announced a **disposal fee increase from 2027**, referencing the **planned CCS pilot plant at KVA Linth as one justification**.
- Despite progress, **key challenges remain**. The existing subsidy scheme covering 50% of CAPEX and OPEX does not apply to WtE plants, and for large-scale projects, **the remaining financing gap is unresolved**. Moreover, **carbon credit prices from compensation projects are currently below the cost of CCS**, limiting economic feasibility and slowing progress toward scalable deployment.

*__Sources:__ Solidarische Finanzierung von Carbon Capture auf Kehrichtverbrennungsanlagen, Das Schweizer Parlament, 2024; Innerschwyzer Güselsäcke werden ab 2027 massiv teurer, bote.ch, June 2025; Förderungsprozess – innovative CO2-Reduktions-Technologien, Infrawatt, March 2025;

Reflections on current BECCS business models in Switzerland: Voluntary market view

- Beyond urgently needed compliance mechanisms, the v**oluntary carbon market (VCM) can also play a role in enabling viable business models for CCS**. Although some projects in Switzerland have received financing from corporate buyers or Stiftung Klimarappen, there are currently **no examples of voluntary CDR certificate sales from Swiss WtE operators**.
- **This contrasts with developments in other European countries**, where large-scale CDR certificate sales have already taken place. According to cdr.fyi*, major transactions include:
  - **Stockholm Exergi (Sweden)** – over 5 Mt CO_2 removals sold to Microsoft for delivery in 2024/25; project capacity: ~800 Kt CO_2/year.
  - **Gaia ProjectCo (Denmark)** – around 3 Mt CO_2 removals sold to Microsoft; project capacity: ~500 Kt CO_2/year.
- **Both projects receive substantial government subsidies** in addition to revenue from voluntary market buyers. While exact prices are undisclosed, estimates suggest ~EUR 200 per ton of CO_2 removed.
- By comparison, Swiss WtE plants have smaller CO_2 capture potential (~100–400 Kt CO_2/year), but **significantly higher cost estimates**. According to a recent DENA and BAK study, the cost of capturing and storing CO_2 from Swiss WtE plants ranges between CHF 381 and 739 per ton. These figures do not include subsidies, as **WtE plants are excluded from current federal support programmes under the existing FOEN–WtE association agreement**.

Abbildung 4: Kostenszenarien für Vermeidungskosten 2030



Quelle: Eigene Darstellung von BAK und dena

***Sources:** cdr.fyi/leaderboards; Stockholm Exergi wins auction for government support for BECCS, beccs.se, Jan 2025; 10 companies selected to compete for Denmark's CCS Fund with DKK 28.7 billion for Carbon Capture and Storage, Energysterelsen, May 2025.

Towards a collective solution for CCS in Swiss WtE plants

Several companies and organizations have explored **potential pathways for implementing CCS in Swiss waste-to-energy (WtE) plants**, and **all favor a collective approach**. Such a model would prevent **early movers** from bearing **disproportionate costs**, which would otherwise need to be passed on to customers in their respective regions.

Given that WtE plants in Switzerland are **well-coordinated through a strong national association**, this organization – or a dedicated entity acting on its behalf—could effectively **coordinate collective planning, financing and implementation** of CCS and permanent storage.

This **coordinated approach** could also serve as a **blueprint for other countries**, where similar organisational structures exist.

The following slides present **two conceptual models** developed by **Ramboll** and **WWF**, both of which have been publicly discussed in Swiss CCS forums, including **Airfix**.

Solution 1: Solidarity-based financing model

As part of the **CCS Taskforce of VBSA**, Ramboll proposed a **solidarity-based financing mechanism** for implementing CCS across Swiss waste-to-energy (WtE) plants. The key objective is to **remove CCS deployment from competitive market pressures** within the waste sector.

Core concept:

- All Swiss WtE plants (**KVA**) contribute to a **Carbon Capture Fund**.
- The fund finances both:
    1. The **first demonstration project**, and
    2. The **gradual retrofitting** of all WtE plants with CCS.

Key design principles:

- **Market neutrality:** Installation and operation of CCS facilities must not distort competition in the waste management sector.
- **Cost-covering fee:** The CCS operator receives a **per-tonne CO_2 fee** that fully covers costs
    - High enough to ensure investment and operation,
    - Low enough to avoid competitive advantage.
- **Central governance:**
    - **All rights and obligations** related to the captured CO_2 are transferred to a **designated foundation**, including ownership of **NET certificates** and any avoided emissions.

Summary:
A **simple and collective financing model** enabling sector-wide CCS deployment—balancing fairness, cost-efficiency and environmental integrity.

Source: https://www.datocms-assets.com/134367/1734531130-11_klimafonds_24_ramboll_finanzierung-ccs_kva.pdf, Ramboll, Dec 2024

Solution 2: Advanced disposal and recycling fee

WWF proposed an **advanced disposal and recycling fee** to support CCS implementation at Swiss waste-to-energy (WtE) plants, addressing the **financial disadvantage of early movers** who would otherwise face higher disposal fees compared to non-CCS operators.

Core idea:
A **nationwide fee**, similar to the existing **vRG (advance recycling fee)** applied to electronic devices, would finance CCS at WtE plants.

- The fee would apply to **all plastic products** (full or partial) **imported to or produced in Switzerland**.
- The rationale: **up to 100% of fossil emissions** from WtE plants originate from **plastic waste**.

Two variants proposed:

1. **Full CCS coverage:**
    - The fee covers CCS costs for both **fossil and biogenic emissions**,
    - Revenue from selling **emission certificates** is deducted.
2. **Fossil-only coverage:**
    - The fee covers CCS for **fossil emissions only**,
    - CCS costs for **biogenic emissions** are financed through **emission certificate sales**.

Advantages:

- **Simple and quick** mechanism to finance CCS deployment.
- **Minimal price impact** on plastic products, with a potential **steering effect** toward lower-emission materials.
- **Prevents competitive distortion** — early movers and their customers **are not penalized** for leading on climate action.

Source: "Die hohen CO2 Emissionen der KVA klimafreundlich entsorgen: Eine vorgezogene Entsorgungs- und Recyclinggebühr für Kunststoffe macht es möglich", WWF, Feb 2023

Key enabler: A robust regulatory framework for CDR financing

A **clear and stable regulatory framework** is essential for scaling and financing carbon dioxide removal (CDR) solutions, including BECCS.

According to a **BCG study for the German Association for Negative Emissions**, leading CDR countries share several defining features:

- ✅ **Measurable CDR targets** anchored in national climate strategies.
- ✅ **Accounting standards** and **regulatory infrastructure** for monitoring and certification.
- ✅ **Subsidy programs** supporting both **land-based** and **technical CDR methods**.
- ✅ **Integration into carbon pricing systems** or **emissions trading schemes (ETS)**.
- ✅ **Additional policy levers**, such as **clean fuel standards** or innovation credits.

International examples:

- 🇩🇰 **Denmark:** €3.8 billion CDR subsidy fund + clear BECCS/DACCS roadmap.
- 🇬🇧 **United Kingdom:** Layered approach with **Carbon Contracts for Difference (CCfD)**.
- 🇦🇺 **Australia: Carbon Credit Units** and **Emissions Reduction Fund**.
- 🇺🇸 **United States: Tax credits (e.g. 45Q)** supporting CCS/CDR investments.
- 🇨🇦 **Canada:** Combined **natural and technical removal focus**, with **tax incentives** and evolving certification systems.

Emerging Development:
➡️ Integration of **carbon removals into the EU Emissions Trading Scheme (ETS)** — currently under active evaluation for the coming years.

Source: "Investitionsbedarf und Unterstützungsmechanismen für die Skalierung von CDR", BCG x DVNE, Jun 2025