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**Timing the climate transition in Sweden: A company's
green innovation journey towards negative emissions**

Teaching case study

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Abstract

This paper is a teaching case study written for educational purposes. The case brings forward a real-life situation of an organization that is engaged in the exciting but also risky journey of implementing a green innovation at a large scale. The case is written in a way that allows students to reflect and think about the organizational and leadership challenges and opportunities involved. The teacher can activate these reflections in the context of various possible theoretical and analytical frameworks, in a number of possible different courses. The case is about Exergi, the main utility company producing district heating in Stockholm. After successfully transitioning from coal to bio-energy sources, since 2020 Exergi has embarked on a new and far more ambitious venture: Bioenergy Carbon Capture and Storage (BECCS). This technology captures CO₂ emissions from biomass combustion and stores them, potentially resulting in negative emissions. BECCS plays a central role in IPCC mitigation pathways and Exergi has recognized an opportunity, but venturing into this uncharted territory presents numerous challenges. BECCS is a new and untested technology at an industrial scale, requiring substantial investments, and a market for selling carbon removal certificates (CRC) that does not exist yet. Though promising for reaching net zero targets in time, the viability of BECCS for Exergi depends on a supportive regulatory framework, cross-border cooperation, and the creation of a CRC market. To navigate these challenges, Exergi relies on creating an innovative organizational culture as well as mobilizing external stakeholders. Hence, CEO Anders Egelrud has hired individuals with entrepreneurial mindsets, and sought external expertise as well as creating strong networks and communication approach. Yet, some internal tensions have also come to the fore, due to the rapid internal dynamics. Overall, Exergi's transition from coal to BECCS reflects the commitment to sustainable practices by an incumbent, and its willingness to seize new opportunities. The company's success driving this transformation forward hinges on many events coming together, both external and internal to the firm.

“We were accused of abusing our dominant position in the pricing of district heating towards the market. We received a penalty from the competition authority and were forced to pay a large fee. So, all of this went to my desk, in my second year as CEO in the company. To us, this was the cue for turning over every stone in the company and to jump start our innovation journey”. “We concluded that we not only need to phase out coal, but actually we can also go beyond zero, we can be net negative¹ in our total production of energy in Stockholm with the help of carbon capture and storage.”

(Anders Egelrud, CEO, Exergi Stockholm).

1. Introduction: Time is ticking

In 2020, Anders Egelrud, the CEO of Exergi, the main utility company producing district heating in Stockholm (Sweden), took the decision to shut down the last facilities of KVV6 – a coal-fired plant – that had been gradually decommissioning the previous years. The final closure of KVV6 signified a major milestone for Stockholm’s climate ambitions. In gross numbers, it enabled a 50 % reduction of the city’s total CO₂ emissions annually and a final closure of a 150 year’s fossil fuel dependence.

CEO Anders Egelrud was satisfied to see that Exergi efforts to phase out coal by substituting it with bioenergy sources (using residues from forestry, sawmills, and pulp and paper production) had been a major accomplishment. The move had required some important investments, and the firm managed to do it without increasing heating prices for end-users. This was important because the crisis that ignited Exergi’s green transition from fossil to bio-energy sources came in 2010, when the company was accused of abusing their dominant

¹ Becoming carbon negative requires a company, sector or country to remove more CO₂ from the atmosphere than it emits. Meeting ambitious international climate goals requires global CO₂ emissions to fall below zero in the second half of this century, achieving what is known as net negative emissions. (International Energy Agency (IEA) 2023)

position in the pricing of district heating towards the market. In this process, Exergi was fined 1 million SEK (Swedish Kroner) the equivalent to 90 000 USD or 84 000 €, and forced to decrease the price of district heating by 1 million SEK annually. The root cause of the high price was connected to a string of green taxes on CO₂ that Sweden introduced since early 1990s. These taxes had led to tremendous costs for coal-fired utilities, which were then trespassed down to higher end prices for customers. Exergi was eventually acquitted, but the litigation process made the company turn over every stone of their business operations not only looking for cost reductions, but most importantly, looking for a new approach.

Overall, the transition from coal to biomass completed in 2020 was climate, financially, technologically, and socio-politically an undisputed success. Namely, it had reduced a substantial amount of CO₂ emissions, it had kept the costs under control, it had avoided to pass extra costs to end-users, it successfully used the available technologies, and it had contributed to the socio-political goal of Stockholm city to become a fossil-fuel-free city by 2040.

With such a success in its pocket, the positive legacy of any energy utility was already secured. However, that was not enough: Exergi was about to embark in yet a second and much riskier move: the move towards Bioenergy Carbon Capture and Storage (BECCS), a new technology never scaled up beyond pilot demonstration sites, with high market uncertainty.

Reducing CO₂ emissions by changing the type of energy source, and using existing technologies is one thing; but using a new climate technology (BECCS) that has not been scaled up at industrial level before, that requires massive investments, and that is based on a business case that requires a market which does not yet exist, is quite another thing. BECCS is probably good for the climate, but is it also good for Exergi? And will it all work out on time?

“Last Friday we decided to close our last coal boiler after this winter [closing in Spring 2020] and today we inaugurate the BECCS test facility. These are two events that clearly show that

we as a company are serious about our transition and that we contribute solutions to counteract climate change, remarked Stockholm Exergi's CEO Anders Egelrud."²

Exergi's path towards BECCS took shape in 2020. But it all started earlier in 2015, when Exergi head hunted Fabian Levihn, a researcher at KTH, the Royal Institute of Technology in Stockholm, who had been conducting research on climate technologies in energy utilities. At this time, the IPCC (the Intergovernmental Panel on Climate Change) released its 5th assessment report³. By reading it, Fabian had experienced an "Aha!" moment. In the latest IPCC's report, BECCS technology, assumed a much more prominent role than earlier for reaching the agreed climate targets. In fact, across the 116 scenarios consistent with limiting global warming to 2°C, 101 involved some form of negative emissions, either through BECCS or afforestation and reforestation. However, the IPCC did not evaluate the on-the-ground feasibility of such removals, they merely demonstrated the inevitability of Carbon Dioxide Removal. For Fabian, reading the IPCC's assessment report, it was clear that BECCS was part of the future, only a compelling business case was missing. Shortly after, in 2019, Exergi made the necessary preparations for advancing a small research and development (R&D) facility for testing carbon capture and storage technologies. They could also validate its economic and environmental efficiency with the financial support from the Swedish Energy Agency.

In 2020-21 Exergi requested EU R&D funding for creating a full-scale bio-energy carbon capture and storage facility at Exergi's combined heat and power (CHP) bio-mass plant KVV8, near Stockholm. In April 2022 the European Union Innovation Fund allocated 180 billion € (the equivalent to 190 billion USD or 2,100 billion SEK) to the BECCS project, a true milestone for securing its financial viability. In addition to these R&D funding sources, "the Swedish

² December 2019, in Sweden's first bioenergy carbon capture and storage pilot inaugurated | Bioenergy International <https://bioenergyinternational.com/swedens-first-bioenergy-carbon-capture-and-storage-pilot-inaugurated/> Accessed: 2023-09-06

³ These reports come assess all the science related to climate change (knowledge, impact and risks). It also assesses options for reducing the pace at which climate change is taking place.

Parliament has decided that Sweden will allocate state aid to promote the production of negative emissions.”⁴

BECCS stands for ‘bio-energy carbon capture and storage’, a new technology that removes CO₂ emissions by capturing the gas, liquifying it, and storing it bedrock where it can solidify (see box 1). The BECCS technology has so far only been tested at demonstration sites, never at a full production scale, and the rentability of the Exergi’s BECCS project relies heavily on selling carbon removal certificates, for which there is not yet a market. There are also high stakes for Exergi reputation, because BECCS potentially signifies a major shift from being the ugly duckling in the pond of Stockholm’s climate ambitions to becoming the beautiful swan in exhibiting green innovation, opening a new export market for Sweden.

Time is ticking, and Exergi’s challenge is to timely manage many different aspects and dimensions, daring to bet on the outcome of known unknowns to successfully lead the BECCS project that might not only transform the approach towards carbon removal, but also Exergi as a firm.

”Actually, I managed to get “Rock and Roll” and “Have the guts” written into our success factor, which was approved by the CEO. And I think, having the guts, is really what is needed.”

(Fabian Levihn, Head of R&D).

Box 1: The BECCS project

“The BECCS Stockholm project will create a world-class, full scale Bio-Energy Carbon Capture and Storage (BECCS) facility at its [Exergi] existing heat and power biomass plant in Stockholm, Sweden. The project will combine CO₂ capture with heat recovery, making the process much more energy-efficient than the process in a conventional Carbon Capture Storage (CCS) plant. It will capture and permanently store large quantities of biogenic CO₂, leading to carbon removals from the atmosphere, also called negative emissions. The BECCS Stockholm project has a potential to remove

⁴ The Industrial Leap, <https://www.energimyndigheten.se/en/innovations-r--d/energyintensive-industry/the-industrial-leap/> Accessed: 2023-09-06

around 7.0 Mt CO₂eq over the first ten years of operation. Net carbon removals are seen as an increasingly important technology-based solution to climate mitigation, indispensable to reach climate neutrality in 2050. The project will also be a catalyst for paving the way for a new market of net carbon removals. Besides the actual negative emissions achieved, BECCS Stockholm will also have a positive impact on the balance for renewable heat and electricity, resulting in additional reduction of around 0,8 Mt CO₂eq over the same period.” The project runs from 2021 and expects to start operation by the end of 2026.

Source: https://climate.ec.europa.eu/system/files/2022-07/if_pf_2022_beccs_en.pdf

2. Market- what market!?

Exergi financial viability is based on making important revenue streams selling BECCS-related negative emissions to other companies, in the form of Carbon Removal Certificates (CRC). Customers are firms who wish to reach their climate objectives, mainly by neutralizing their residual emissions and/or compensate other emissions, as a way to contribute actively to reach the Paris agreement goal to limit global warming to 1.5 °C. “In practice, a company would buy carbon removal certificates (CRC) corresponding to 1 tonne of negative emissions per CRC, with no other company being able to claim the same tonne in its climate accounting. In terms of accounting, the negative emissions would be accounted outside the sum of Scope 1 and Scope 3⁵ as neutralization of residual emissions or as compensation of other emissions in the company’s value chain.”⁶

It is worth noting that there is currently no market where firms which want to buy negative emissions can buy them. There are important market-related aspects to take into

⁵ The [GHG Protocol Corporate Standard](#) categorises GHG emissions associated with a company’s CCF as scope 1, scope 2, and scope 3 emissions. [Scope 1 emissions](#) include direct emissions from a company’s owned or controlled sources. This includes on-site energy and emissions from combustion as well as emissions from fleet vehicles (e.g. cars, vans, trucks,). Scope 2 emissions include indirect emissions from purchased or acquired energy, like electricity, steam, heat, or cooling. [Scope 3](#) includes all indirect emissions that occur in the value chain of a reporting company.

⁶ The proposition - Beccs Stockholm, <https://beccs.se/the-proposition/> Accessed: 2023-09-06

consideration, as there is still a lack of a fully-fledged regulatory framework creating a market for BECCS, not only in Sweden, but also in the Nordics, in Europe, and world-wide (see section below for more details).

Even if the market is not there yet, there seems to be promising signals both from potential customers and from politicians, that the way forward for reaching the goals of the Paris Agreement has to do with CCS technologies, removing carbon from the atmosphere. But one thing is the talking the talk, and another is walking the walk and realise BECCS commercial viability.

From the perspective of Exergi, the BECCS project is a considerable change of its traditional market: from Exergi's locally based traditional customers (the end-consumers of district heating and electricity in Stockholm's households), to new type of customers which are large firms operating globally (firms interested in neutralizing their CO₂ emissions). For this reason, BECCS represents a business opportunity for Exergi to move into a new potentially global market. It is also a good opportunity for Sweden, as a study has shown that only Estonia, Sweden, and Finland will probably be able to, not only to cover their own need for negative emissions, but also to export the remaining credits to customers in other countries⁷.

The estimated costs of BECCS vary widely across the expert literature, according to geographic scope, and the specific BECCS technology. "Projects with access to abundant cheap biomass, feedstock production co-located with energy conversion, and proximity to geologic storage, can achieve lower cost and may be economic today"⁸. This is the case of BECCS Exergi, because Sweden has access to cheap and abundant biomass, Exergi has a co-location of BECCS and energy consumption in Stockholm, and will store the captured carbon in near-by North Sea bed geolocations (some of them old Norwegian oil fields). In gross terms, the costs related to BECCS facilities in Stockholm that aims to capture 1 million ton CO₂ per year, are related to a heavy investment for building the capture facility, and then the cross-border transport and storage. The investment for capture is estimated to cost between 420-840 million € (the

⁷. Rosa, L et al. 'Assessment of carbon dioxide removal potential via BECCS in a carbon-neutral Europe' Energy & Environmental Science, 14, 5, 5 2021

⁸ page 4 in: Surveying the BECCS Landscape - EFI Foundation, <https://efifoundation.org/reports/surveying-the-beccs-landscape/> Accessed: 2023-09-06

equivalent to 450-900 million USD or 5-10 billion SEK), transport varies about 20-50 €/tCO₂ (the equivalent to 22-54 USD/tCO₂) and storage about 15-70 €/ tCO₂ (the equivalent to 17-75 USD/tCO₂)

Whereas a general analysis suggests three possible scenarios on the future socio-economic impact of BECCS in Sweden –all of them positive in different degrees⁹ – this might look somehow different for Exergi as a company. The actual implementation of BECCS on-the-ground is facing many uncertainties. A recent Master thesis evaluating BECCS potential in Sweden, concludes that “the most critical, and often deep uncertainties of BECCS deployment are political or regulatory, and external to Sweden”¹⁰.

At this point in time, there are few global competitors to this project, and Exergi is currently one of the few ones envisaging a full-scale commercial production in the near future. According to the USA-based Energy Futures Initiative’s report in 2022, “the handful of BECCS projects deployed globally are mostly pilot- or demonstration-scale, capturing less than 400 kilotons (kt) of carbon dioxide (CO₂) a year.”¹¹

In many ways, with its BECCS project, Exergi is entering a global race with an untested climate technology towards a new market, with all what it means in terms of uncertainties and risks, but also of opportunities. Exergi has moved very quickly, aiming to grasp the opportunities: If it goes to plan, in barely 10 years, they will reach a full commercial operation of the BECCS plant, the first of its kind in Europe. But many uncertainties remain, not least the uncertainty of the market, which is largely related to regulatory aspects.

⁹ The Economic Impact of Beccs in Sweden (pdf), Implement, (2022)
<https://www.stockholmexergi.se/content/uploads/2022/02/BECCS-Economics-Sweden-Accessed: 2023-09-06>

¹⁰ Oscar Stenström, Robust BECCS deployment strategies under deep uncertainty : A case study of Stockholm Exergi, 2023, <http://kth.diva-portal.org/smash/record.jsf?pid=diva2%3A1737175&dswid=-5441> Accessed: 2023-09-06

¹¹ p. 2 in Surveying the BECCS Landscape - EFI Foundation, <https://effoundation.org/reports/surveying-the-beccs-landscape/Accessed: 2023-09-06>

3. Connecting the dots

The support of a broader innovation ecosystem is essential for the implementation and commercialization of BECCS. There are at least three issues of paramount importance that are relying on policy-makers and regulatory bodies for the full deployment of BECCS: firstly, the regulations and processes related to operators' CCS permits; secondly, the European (and particularly Nordic) policy coordination to secure the deployment of infrastructure, which is key for BECCS cross-border value chain; and thirdly, the regulatory framework to develop a CRC market. Each of these three aspects are work in progress, and there are some time delays and uncertainty.

Firstly, there are some environmental permits needed for carbon capture, transport and storage. Currently, firms in the BECCS operation value chain¹² (like Exergi) need different, partly overlapping permits, i.e. permits for capturing CO₂, for transporting CO₂, for intermediate storage of CO₂, and for permanent storage of CO₂. Operators need to obtain all these permits in Sweden and elsewhere, and they have expressed critique that in this early stage those permits take a long time to obtain, and hope that the authorities will make the processes more predictable and standardised in the near future.¹³

“The Swedish environmental permits are such a nightmare, taking some 3-4-5 years or so. I think all working in the Energy sector would agree that Swedish process is somehow tedious and gruesome...” (Fabian Levihn, Head of R&D).

Secondly, a successful scaling-up of BECCS, requires an integrated assessment of the whole CCS value chain (capture, transport and storage) in order to select the most cost-effective CCS chain and decrease the overall financial risks in connection with the CCS chain. Exergi is considering options to store the CO₂ in Norway, which requires transportation from their capture plant to Norway¹⁴. However, regulatory aspects are still open for cross-border

¹² These operations need to comply with existing regulations on Carbon Capture and Storage, implemented in Sweden according to the EU's CCS directive (Directive 2009/31/EC).

¹³ Romson, Å., Steen, L. (2021). "Miljö tillstånd i kedjan om bio-CCS". In: Löblad, E., et al. (2021). "Samverkan kring infrastruktur om transport och lagring av koldioxid". Energiforsk rapport 2022:838, Annex B.)

¹⁴ Northern lights project-a commercial CO₂ cross-border transport connection project between several European capture initiatives (PDF) https://ec.europa.eu/energy/maps/pci_fiches/PciFiche_12.4.pdf

transport of CO₂, as well as for permanent storage. This a relevant matter for BECCS value chain and for its pricing, and therefore financial investment decisions are linked to that¹⁵.

Exergi is currently hopeful that there will be cross-border policy coordination between the Nordic countries to secure a timely development of the components across the CCS (Carbon Capture and Storage) value chain. CCS plays an important role in the Nordic countries' political ambitions for full carbon-neutrality by 2050, and reaching such target will need joint action and cooperation among them on CCS. Certainly, Nordic countries have a unique and long-standing cooperation on energy and climate¹⁶, but the technological and market potential of bio-energy CSS is unevenly distributed between the Nordic countries. Incentives for cooperation depends on securing opportunities for the transfer of mitigation outcomes¹⁷ between the Nordics. In other words, the Nordic countries with less strong bio-energy CSS potential but with strong net-zero targets could support their firms with financial incentives to buy BECCS-produced CRCs from another country, transferring mitigation outcomes across borders. So far, there is no Nordic-level market-based cooperation to speed up the realization of the Nordics BECCS potential. However, the introduction of financial incentives for BECCS, has started to be introduced on a Swedish national level¹⁸. In 2022, the Swedish government announced state financial support for BECCS technology with an amount of 36 billion SEK, the equivalent to 3.3 billion USD or 3 billion €. The decision is a follow-up to the national goal of zero net greenhouse gas emissions by 2045. Alongside with efforts to reduce greenhouse gas emissions, the financial support for BECCS demonstrates that Sweden is recognising the necessity of BECCS at a large scale.

¹⁵ Regulatory framework for CCS in the Nordic countries, <https://pub.norden.org/temanord2023-521/> Accessed: 2023-09-06

¹⁶ Nordic Clean Energy Scenarios, Solutions for Carbon Neutrality (pdf) <https://www.nordicenergy.org/wordpress/wp-content/uploads/2021/09/nordicenergyresearch2021-01.pdf> Accessed: 2023-09-06

¹⁷ Policies for the promotion of BECCS in the Nordic countries, Möllersten, K et al. 2021(PDF) <https://www.norden.org/en/publication/policies-promotion-beccs-nordic-countries>, Accessed: 2023-09-06

¹⁸ On the First, second, third....Proposal for the design of a bio-CCS support system. <https://energimyndigheten.a-w2m.se/Home.mvc?ResourceId=203642>, Accessed: 2023-09-06

Lastly, there is not yet a private market for negative emissions. BECCS is not part of the European Emission Trade System (ETS). The ETS is a market mechanism within the European Economic Area, that allows countries, companies or manufacturing plants, which release greenhouse gases into the atmosphere, to buy and sell these emissions (as permits or allowances) amongst themselves. Hence, to create a BECCS CRC market, new national and EU regulations are needed to ensure a robust monitoring, reporting and verification (MRV) system of carbon credits, and to ensure the credible and transparent voluntary use of carbon credits that avoids double claiming.

As an early mover, Exergi needs not only to anticipate the move of others, but also to identify mutual benefits and negotiate these in order to mitigate its own risks. To stay ahead, Exergi is very engaged in expert-based meetings at national, Nordic, European Union, and global levels, willing to promote and keep everyone onboard about BECCS. This aims at reducing uncertainties for Exergi. Hence, Exergi's core approach is to communicate and show the legitimacy of their technology, and to align the objectives of various political and social players around BECCS. To get support for BECCS at various policy levels, Exergi's communication tactic is centred on consistently repeating the plausibility of BECCS for climate mitigation. A key for being successful in those policy forums, is to be able to provide credibility both on technological issues and on methodologies to quantify real and accurate GHG benefits of BECCS. Fabian Levihn¹⁹, who is a recognised scientific expert in the field of BECCS and its role for climate mitigation, is crucial for leveraging credible messages. Networking and building external stakeholder relations is equally, or even more, important as everything else in Exergi's BECCS project. In fact, the commercialisation of BECCS depends on political players understanding the potential value of BECCS for the whole of Sweden, and moving quickly to set up a well-functioning regulatory framework that balances business opportunities and safety.

¹⁹ PhD Fabian Levihn is also part time research fellow at the department of Industrial Economics and Management at KTH in Stockholm and his research is at the intersection of techno-economic systems focuses on how increased renewables affect energy markets and the conditions for bio energy carbon capture and storage (BECCS).

”From Day 1, to engage people in BECCS, not only the employees and investors, but to have the whole of Sweden engaged in this cause, has been a conscious decision”

(Fabian Levihn, Head of R&D)

Since 2020, there seems to be a bit of political momentum. Firstly, the Swedish government seems to be in the process of creating a support scheme for negative emissions in the form of reverse auctions. With this purpose, it has entrusted the national Energy Agency to design a market for carbon removals based on ‘reverse auctions of CRCs’²⁰. Secondly, the government has established a national centre for CCS inside the Swedish Energy Agency²¹. And third, it has also set up a R&D funding programme for CCS, i.e. the “Industrial leap programme”, which runs from 2018 to 2030 with a budget of 1 354 MSEK the equivalent to 123 million USD or 114 million €²². However, time is ticking and many uncertainties remain about whether these aspects will work out. This is key for Exergi because the full commercialisation of BECCS is entirely dependent on all the above working smoothly and soon.

To build up a momentum for BECCS, Exergi has been actively inviting prominent visitors – ranging from the President of the EU Commission to IPCC climate scientists²³– who are coming to see the BECCS plant live and are given a full demonstration of how it works. Getting the visitors to see the construction site, smell the residues from trees, and meeting the passionate engineers, Exergi hopes to create a push effect for BECCS. Moreover, to ramp up public

²⁰ The Swedish government has allocated 36 billion SEK (the equivalent to 3,2 billion USD and 3 billion €) for the reverse auction scheme during the years 2026–2046. The scheme has a target of up to 2 million tonnes biogenic CO₂ stored annually by 2030. This is to be achieved through 1 to 3 reverse auctions between 2023 and 2026. The support period per project should be up to 15 years.

²¹ This entails planning, coordination and promotion of CCS throughout the country. The Swedish Energy Agency will carry out its work in dialogue with industries, governmental authorities and the Government Offices of Sweden <https://www.energimyndigheten.se/en/sustainability/carbon-capture-and-storage/national-centre-for-ccs/> Accessed:2023-09-06

²² The Industrial Leap, <https://www.energimyndigheten.se/en/innovations-r--d/energyintensive-industry/the-industrial-leap/> Accessed: 2023-09-06

²³ E.g. Ursula von der Leyen (President of the EU Commission), Prime Ministers from the Nordics, EU and national minister delegations <https://bioenergyinternational.com/swedens-first-bioenergy-carbon-capture-and-storage-pilot-inaugurated/> Accessed: 2023-09-06

support and especially from the citizens of Stockholm, Exergi has been writing advertorials²⁴.

4. “Be curious, bold, test, and innovate!”

The CEO Anders Egelrud remembered the day when he first heard of BECCS and its potential for Exergi. It was a beautiful autumnal day in Stockholm 2018, the landscape was shifting colors from green to golden. The skyline over Värta Hamnen almost looked like a view from his hometown, in the North of Sweden. He could still miss the silence and grandeur of the nature up in the North. But also – and maybe more – the people and mindsets. Up in the north, people were able to hold the boat steady in times of crises. They were strong. Self-supporting. Not pretentious. In general, people from Stockholm were quite different from those from the North. They were the big city-types, more of salespeople- a lot of talk and for his taste – too correct and consensus oriented.

Anders realised that if he wanted Exergi to be able to do innovative things and move out of the box, he needed to attract new people. People with a more entrepreneurial mindset. This is why he headhunted Fabian Levihn, an engineer from KTH - the Royal Institute of Technology in Stockholm, to become the head of Exergi’s R&D unit. He was directly headhunted. He was smart, not only in a technical sense, but in a political sense too. He could talk and convey ideas to anyone. He was also deep into the international climate agenda.

Anders knew that for locally-based and publicly-owned energy utility companies like Exergi, the climate agenda was a strong cursor for business operations. For sure! But how? That day, when Fabian stormed in the cafeteria during “fika”²⁵ and talked about carbon capture and

²⁴ For example, in 2020, they published an article entitled “the Journey towards negative emissions has started” in Dagens Nyheter, the biggest daily newspaper in Sweden. Local government: “With this plan, Stockholm is on track to become the first carbon neutral city in the world.” <https://beccs.se/cdr/> Accessed: 2023-09-06

²⁵ The Swedish notion of Fika is a coffee break which has a particular social significance as an everyday ritual at the work place as well as in the home, and especially in the north of Sweden. As with other commensality practices, the most valuable parts are not the food or drinks that are consumed but what is created socially in those moments

storage and negative emissions, he was somehow taken on the bed. His reaction was short but clear. Ok. But show me the business case! Anders knew that his short and concise style of communication could be intimidating for some people, but it had not seemed to upset Fabian. In cases of poor performance, people needed to be prepared to get some harsh critique or even shouting. On the other side, he didn't believe in formal hierarchy and never said no to a "fika". These fika moments were an important part of the culture and in fact, it was often during these moments that good ideas were aired. He believed in people, in their skills - in them having the ability to do things. But, even if liked to nurture a sense of "*we can do this!*" familiarity with the employees, tough and financially heavy decisions rested on him, or him making a good business case to present to the board of owners. In his mind, his role as the CEO of Exergi, wasn't foremost to delegate but to make sure that that Exergi as a company was a head and innovative. So, when he hired Fabian, he knew that Fabian was a person that wasn't the type to follow an instruction guide - he was there to rock and roll.

Anders nurtured his perspective throughout the firm, and in 2018, when the company shifted its name from Fortum Värme to 'Exergi', the new tagline was set to: "*Be curious, bold, test and innovate!*". For Anders there were no turning back of the company, a turn that had started in 2010 with the litigation process (the lowest point ever for his company), through the subsequent move from fossil to bio-mass energy sources, and now with a totally new approach from positive to negative CO₂ emissions business approach. With BECCS, it was time to go through this innovation journey and others had to follow.

5. What type of organisation to get there? Can we make the innovation journey together?

The management team started to consider what resources and capabilities existed in Exergi to materialize the possibilities offered by BECCS. Soon it became clear that Exergi did not possess the internal analytical skills to do the required risk assessments and business/market studies, nor to leverage the tasks for business development to enter a completely new market. For that reason, Exergi started to draw on external sources for estimating BECCS potential, not only for itself, but also for Sweden in general and its possible contribution to economic

growth²⁶. Likewise, given the high uncertainties associated with BECCS, strategic foresight and intelligence analysis gradually became an important element for Exergi management. This is the reason behind why Exergi has organized its strategic foresight capabilities in a central team, with one main function, namely, to detect signals and explore possible future trends related to energy transitions. However, detecting weak signals in the external context is one thing, another thing is to make sense of these uncertainties and to act upon them. Therefore, in a similar effort to boost its organizational resources and capabilities, Exergi has been expanding substantially its business department, which has been growing steadily in size and competences, with managers and engineers focusing on developing a new business approach based on BECCS.

However, all these rapid changes brought forward some tensions within the firm. With the new approach, Anders had to balance efforts to attract new talent with entirely different profiles than the typical previous worker, and to reskill and convince the existing staff about BECCS. Exergi had no problem attracting new talent. Suddenly, there were more applicants than possibilities for employments. It had become popular to work for a company that aims at being part of an ambitious energy transition, working at the interface between innovation, energy, and sustainability. Yet, the majority of the staff at Exergi were long-term employees, who had been working many years on maintenance and on optimising existing systems and technologies. These workers had an affection to the “old version” of the company with its coal boilers, the informal “fika” moments, taking off their shoes in common areas – most importantly – their tasks focused on providing power and district heating to Stockholm households. Most of them were positive about the first transition of Exergi, when moving from coal to bioenergy sources; but they were more sceptical about the forthcoming transition towards BECCS - Why do we need to embark on BECCS? - It is very expensive and risky! To get the support for BECCS across the organization, the management set up several events and training on BECCS for the employees explaining the functioning of the technology and its opportunity for business. And these events seem to have had some effects, as some workers on the core business of Exergi- district heating- had started to view BECCS more positively.

²⁶ Exergi commissioned a report on “The Economic Impact of BECCS in Sweden” from the consultant firm; Implement in 2018.

Still, some people in the company continue to think that the BECCS team has been given too much wind beneath their wings, and that BECCS is taking the first step of a green innovation journey towards unknown commercial success.

Bibliography

Journal articles

Rosa, L et al. 'Assessment of carbon dioxide removal potential via BECCS in a carbon-neutral Europe' Energy & Environmental Science, 14, 5, 5 2021

Yngve, A et al. 'Taking a closer look at the Swedish coffee break, "fika"', International Journal of Gastronomy and Food Science, 33, 9 2023

Web pages

Going carbon negative: What are the technology options? – Analysis – IEA, <https://www.iea.org/commentaries/going-carbon-negative-what-are-the-technology-options>, Accessed: 2023-09-06

Sweden's first bioenergy carbon capture and storage pilot inaugurated | Bioenergy International, <https://bioenergyinternational.com/swedens-first-bioenergy-carbon-capture-and-storage-pilot-inaugurated/> Accessed: 2023-09-06

The proposition - Beccs Stockholm, <https://beccs.se/the-proposition/> Accessed: 2023-09-06

EU INNOVATION FUND: Driving clean innovative technologies towards the market Beccs Stockholm: Bio Energy Carbon Capture and Storage by Stockholm Exergi Bio-electricity https://climate.ec.europa.eu/system/files/2022-07/if_pf_2022_beccs_en.pdf Accessed: 2023-09-06

Northern lights project-a commercial CO2 cross-border transport connection project between several European capture initiatives (PDF) https://ec.europa.eu/energy/maps/pci_fiches/PciFiche_12.4.pdf Accessed: 2023-09-06

Reports

Romson, Å., Steen, L. (2021). "Miljö tillstånd i kedjan om bio-CCS (Environmental permits in the bio-CCS chain)". In: Löblad, E., et al. (2021). "Samverkan kring infrastruktur om transport och lagring av koldioxid (Cooperation around infrastructure for the transport and storage of carbon dioxide)". Energiforsk rapport 2022:838, Annex B.)

IPCC — Intergovernmental Panel on Climate Change <https://www.ipcc.ch/> 5th Assessment Report, (pdf) Accessed: 2023-09-06

Energimyndigheten 'The Industrial Leap' <https://www.energimyndigheten.se/en/innovations-r--d/energyintensive-industry/the-industrial-leap/> Accessed: 2023-09-06

EFI Foundation 'Surveying the BECCS Landscape' <https://efifoundation.org/reports/surveying-the-beccs-landscape/> Accessed: 2023-09-06

Implement 'The Economic Impact of Beccs in Sweden' (pdf), <https://www.stockholmexergi.se/content/uploads/2022/02/BECCS-Economics-Sweden> Accessed: 2023-09-06

Wråke, M et al. 'Nordic Clean Energy Scenarios, Solutions for Carbon Neutrality' (pdf) <https://www.nordicenergy.org/wordpress/wp-content/uploads/2021/09/nordicenergyresearch2021-01.pdf> Accessed: 2023-09-06

IVL Swedish Environmental Research Institute, 'Regulatory framework for CCS in the Nordic countries', TemaNord 2023:521 (pdf) <https://pub.norden.org/temanord2023-521/> Accessed: 2023-09-06

Möllersten, K et al. 'Policies for the promotion of BECCS in the Nordic countries', 2021(PDF) <https://www.norden.org/en/publication/policies-promotion-beccs-nordic-countries>, Accessed: 2023-09-06

Energimyndigheten 'On the First, second, third....Proposal for the design of a bio-CCS support system'. <https://energimyndigheten.a-w2m.se/Home.mvc?ResourceId=203642>, Accessed: 2023-09-06

Master Thesis

Oscar Stenström, Robust BECCS deployment strategies under deep uncertainty: A case study of Stockholm Exergi, 2023, <http://kth.diva-portal.org/smash/record.jsf?pid=diva2%3A1737175&dswid=-5441> Accessed: 2023-09-06