



Roadmaps for fossil free competitiveness – follow-up 2021



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Foreword

Sweden's vision is to be the first fossil-free welfare nation in the world. The 22 roadmaps for fossil free competitiveness are the backbone of these efforts, and the purpose of this follow-up is to provide a more detailed picture of actual progress made towards putting them into practice. Are the industries implementing the planned measures and are politicians clearing away the obstacles highlighted by the owners of the roadmaps? Different actors working together is the success factor for a rapid climate transition and we therefore want to describe how both industry and politicians have delivered since the roadmaps were first laid down. This report is the first in a series of annual follow-ups.

The overarching impression is that both industry and politicians have upped the pace in the past two years, although in view of the severity of the situation, progress is still too slow. There are several surprising initiatives compared with the measures outlined in the roadmaps. The electrification of cars and lorries is progressing faster than planned, SSAB has already delivered the first fossil free steel to Volvo AB, LKAB has made the decision to invest SEK 400 billion in making all the iron they sell fossil free, Preem has made the decision not to invest in a fossil cracking plant and will instead be investing all its resources into converting the refinery to produce biofuels and becoming climate neutral before 2045. Sweden is thus abandoning the blast furnace technology, thousands of years old, and switching to hydrogen, the combustion engine, just over a hundred years old, is being replaced with electric motors and oil refineries are starting to make the switch to biorefineries. This is genuinely hopeful and only a fraction of the historic progress shown in the report.

The pace of actual emission cuts now also needs to increase but it is likely that progress will be jerky rather than linear based on when and how various major investments are implemented. Studying the extent to which different companies invest in different fossil free solutions gives us a picture of the degree to which the roadmaps can produce a more rapid transition. Considering how long the lead times are, investments and investment plans will be the most important indicator for

whether or not we will achieve our climate goals. Plans and investments are being made to such an extent that opportunities to attain the national goals before 2045 are now opening up.

What may nevertheless be most hopeful for the future, is that both the Government and industry have recognised that climate policy is a foundation for greater competitiveness and prosperity in general. The fact that this new logic is shared by industry, trade unions and politicians creates unique momentum for the Swedish climate transition. Several companies today are more afraid that the transition is going too slowly than that is going too quickly.

Since how the market for fossil free solutions develops is dependent on the policy pursued. The fact that the price of emissions has increased from 5 to just over 50 öre per kg CO₂ in the EU's Emissions Trading System based on "the Swedish proposal", since the first roadmaps were written cannot be overestimated.

The reduction obligation is a law that in principle guarantees that fossil carbon emissions from road transport will fall by 60 percent by 2030 and that greater industrial leaps will hasten the transformation of industry.

Sweden must not beat its chest but we have a unique vision and it is likely that there is no other country better placed to become the first fossil free welfare nation in the world. I meet so many business leaders, politicians, union leaders, local government leaders and representatives of the environmental movements, all of whom recognise the seriousness of the situation and the opportunity to up the pace. This insight that prosperity is more likely to increase than decrease in Sweden if we rapidly become fossil free is probably the most important export product in a world that is still taking too small steps towards becoming fossil free.

Fossil Free Sweden is a global project.

Svante Axelsson

National coordinator, Fossil Free Sweden

1. The first follow-up of the roadmaps

1.1 From roadmaps to action

The 22 roadmaps for fossil free competitiveness were drawn up by the industry sectors in partnership with Fossil Free Sweden in 2018-2020 (fig. 1). In the roadmaps, the industries themselves describe how they are able to be fossil free or climate neutral by 2045.

The two most important elements in the roadmaps are the measures that the industries highlight that they must carry out themselves and the political proposals that are to enable these measures. The ambition of Fossil Free Sweden's follow-up of the roadmaps is not to grade the different actors. It is too early as yet to judge whether the sectors are on the right track to attain their goals as in many cases the target of being fossil free is set for 2045 and only a few sectors have set interim targets for dates earlier than 2025. Instead our approach has been to point out the steps that have actually been taken towards achieving the goals.

The aim of this first follow-up report is to shed light in an even-handed and factual way, on the progress the sectors have made towards implementing measures and on which of the political proposals have been implemented or are in the process of being implemented. At the same time, we also highlight some of the major challenges faced by the respective industry.

1.2 Follow-up structure

This first follow-up report highlights a couple of important examples of progress made in each industry since the roadmaps were launched, together with some of the challenges that need to be resolved (Chapter 3). A more exhaustive description of the work of the sectors on the measures highlighted in the roadmaps is provided in Appendix 2: Follow-up of sectors' measures in the roadmaps (only in Swedish). Here the sectors have described the efforts they have made since the roadmaps were launched to achieve the respective commitment or measure by listing examples of steps taken by companies, and initiatives or approaches within the industry.

Since 2019, Fossil Free Sweden has issued three lists priorities containing a total of 54 proposals to help politici-

ans to prioritise between the huge number of policy proposals in the roadmaps. These proposals are followed up here by describing the initiatives and decisions that have been taken by the Government, and also by government agencies, to implement the respective policy proposals. At the time of writing, the Budget Bill for 2022 has not yet passed through the Riksdag (the Swedish Parliament) but the follow-up nevertheless includes aspects of the initiatives presented in it.

With the backing of the industries, Fossil Free Sweden has drawn conclusions on what the five most important political decisions are that have been made since the first roadmaps were launched in 2018 and what the five most important challenges are where political decisions need to be taken imminently if the roadmaps are to be achieved (Chapter 2). The initial list following up all 54 policy proposals is in Appendix 1: Follow-up of Fossil Free Sweden's policy proposals (only in Swedish).

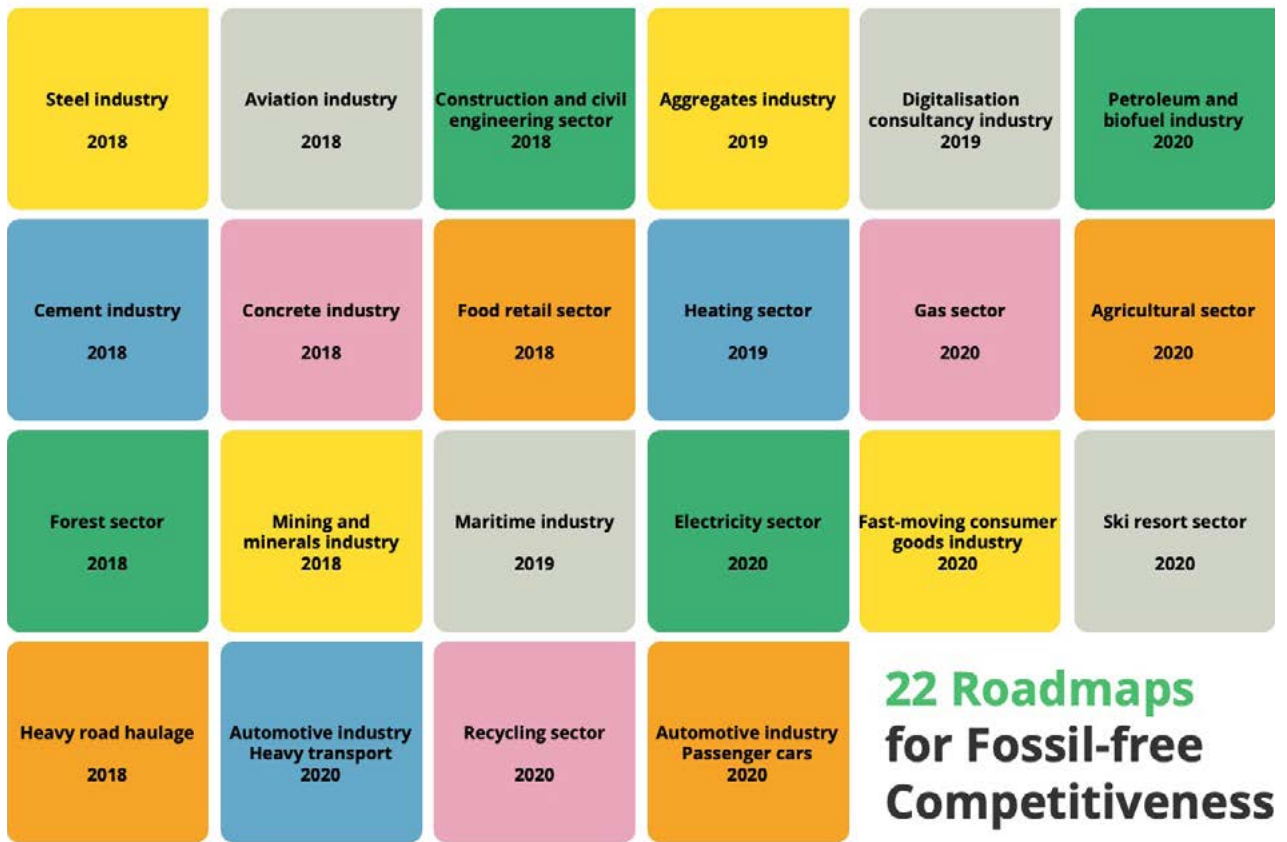


Figure 1. The 22 roadmaps were produced in 2018–2020. The figure shows the year in which each roadmap was launched.

2. Policy for fossil free competitiveness

The two most important aspects of the roadmaps for fossil free competitiveness are the industry's own measures and the policy proposals. In their roadmaps, the industries submit proposed policy decisions that need to be made if the roadmaps are to be able to be implemented. There are more than 350 proposals in total and to help politicians to prioritise between this large number, Fossil Free Sweden has released three different lists of policies with 27 prioritised proposals in 2019, 17 proposals in 2020 and 10 proposals in 2021. These 54 proposals in total are followed up in Appendix 1, which reports on the steps that have been taken to implement them.

In this chapter we highlight the five most important policy decisions that up until 27 October 2021 (including the proposed budget for 2022) have been made and the five most important challenges that remain and need to be resolved for the roadmaps to be able to be implemented.

2.1 Political processes

Policy expresses a desire. But delivering on that policy also depends on the type of decision required. When major reforms are to be implemented, the decision often takes a year or more because inquiries have to be set up, consultations carried out and potential legislation scrutinised by the Council on Legislation before the Government can finally submit a Government Bill which can be voted through by the elected representatives in the Riksdag. Other kinds of decisions such as ordinances or appropriate letters can be taken by the Government themselves, within a shorter timeframe. The majority of decisions have budgetary impacts and when Sweden has a minority government, several political processes take more time because the parties that are willing to support the budget often make policy demands over and above purely budgetary criteria. Additionally, the proposals need to be drafted (and sometimes negotiated) between the Ministries and in several cases also negotiated with the European Commission before they can finally be presented for Riksdag approval. This is not a defence for the fact that some proposals are not implemented but does provide a certain amount of understanding as to why

political decisions cannot always be made at the pace that might be desirable. It also demonstrates that large parts of the actor landscape are agreed that the most important steps forward are facilitated by negotiations between the parties.

Additionally, resources at the Government Offices of Sweden play a role in the speed at which changes can be made. The budget of the Government Offices has shrunk in recent years, which affects staffing levels in Ministries and thus the ability to pursue and prepare matters.

2.2 Five key decisions

The five most important political decisions up to 27 October 2021 (including the proposed budget for 2022) to speed up the implementation of several roadmaps are:

- **The long-term reduction obligation from 2022 to 2030:** This will reduce the fossil carbon dioxide emissions from fuel in the transport sector by approximately 60 percent by 2030, and also give refineries and fuel distributors a more predictable market enabling them to make investment decisions more easily. Additionally, the Government has obtained a ten-year tax exemption from the EU for biogas and bio-propane and proposes a production premium for biogas in the 2022 budget. The negotiated tax exception for high-blend biofuels such as HVO100 and E58 is for one year.
- **Expanded and broadened industrial funding:** Since 2019, the Industriklivet programme of grants to help industry reduce its carbon footprint has been increased by SEK 600 million to a proposed SEK 909 million for 2022 and been broadened in several stages, now also includes facilities that capture carbon dioxide and store emissions. The investment has been important in hastening the development of the Hybrit fossil free steel project and other innovative pilot and demonstration projects in the roadmaps of different sectors such as plastics recycling, battery production and hydrogen production.
- **Increased climate funding:** Since 2019, the Klimatklivet programme of grants to reduce emissions has



been expanded and widened and it is proposed that it be increased by a further SEK 800 million in 2022, to a total proposed SEK 2.8 billion. This is largely industry focused too, as 75 percent of payments go to industry. Unlike the Industrilivet programme, Klimatklivet supports companies that are not engaged in the EU's emissions trading system and who use relatively tried and tested technology such as producing biogas and switching from oil to biofuels in industry. Klimatklivet also provides extensive support for the expansion of charging infrastructure and other relatively cost-effective investments such as switching to fossil-free solutions in agriculture.

- **The permit processes:** Although 90 percent of all permit application processes for environmentally harmful activities under the Environmental Code receive a decision within two years, many important permit processes take far too long in a situation where the speed of the transition now needs to increase. Some processes have already begun and since the roadmaps were presented, the Government has taken positive decisions on the electricity grid side. This involves the opportunity to run parallel processes for new electric power lines and enabling the government agencies concerned to examine permits for new regional or national grid within the remit of new trial operations. Furthermore, the Government has tasked the County Administrative Boards with developing new methods for promoting an effective consultation process and launched the Environmental Assessment Inquiry to produce solutions to speed up the permit processes.
- **Green credit guarantees to reduce risk:** To reduce the risk to banks from embarking on financing major industrial shifts, the Government has introduced green credit guarantees which the banks can apply for. The amounts involved will increase over time to a maximum SEK 80 billion in 2024. On top of this, EKN, the Swedish Export Credit Agency has been given new rules enabling them to issue export credits to companies in Sweden with major export potential for solutions that can reduce emissions.

2.3 Five key challenges

The delivery of political decisions to clear away obstacles to the implementation of the roadmaps has been exten-

sive but several important decisions remain in key areas that need to be made if the roadmaps are to reach fruition. Below we outline five priority challenges for future governments to resolve and incorporate in the upcoming climate action plan to be presented in autumn 2023.

- **Circular solutions:** Sweden is not a leader in developing policies for circular resource-efficient solutions for all materials although we are aware that this is one of the keys to reducing greenhouse gas emissions while boosting competitiveness. For materials that do not already have a high degree of circulation, developing different incentives such as quota obligations and different forms of recycling certificates for certain materials plus product design within the framework of the EU's Ecodesign Directive are important questions for further investigation such that circular resources become more competitive. The Swedish Environmental Protection Agency is tasked with making proposals in this area. Furthermore, the Swedish implementation of the EU's definition of waste must be changed so as to enable circular and resource-efficient management e.g. of concrete, construction aggregates and asphalt at building sites. Today, too broad a Swedish interpretation of the EU's waste definition makes it difficult to develop different circular business models.
- **Faster and more efficient permit processes:** Permit issues have long posed a major challenge to many sectors, and for many people is the single greatest potential obstacle to the implementation of the industries' roadmaps. In the past decade, a number of inquiries have been appointed, without resulting in any decisive changes. Today, permit processes can be unpredictable in the defining what is to be included in the permit examination, the documentation required for this and how long the permit process is expected to take. Today there is a focus on details rather than on the whole picture. This may play jeopardise major industrial investments which could create global climate benefit and value for Sweden, for example in the mining, iron, steel and cement sectors. Both legislation and its application need to be reviewed. It is therefore good to see the legislation reviewed by the Environmental Permit Inquiry and the Climate Law Inquiry. This needs to lead to the introduction of an opportunity for a holistic as-

assessment in which climate benefit can also be taken into account, plus legislative changes to improve the efficiency of processing by the permit authorities and clarify the roles of different agencies and their participation in the permit processes to create greater consensus between the business operator and the agencies on what a permit application and an environmental impact assessment is to contain. Both business operators and agencies need to take greater responsibility and conduct an improved dialogue, for example as part of the consultation process. The Committee for Technological Innovation and Ethics (Komet) has submitted exciting proposals to set up a special committee for trial activities tasked with tackling regulatory obstacles when municipalities, regions and government agencies are looking to test new working methods, technical solutions or services. The Komet inquiry has also highlighted the importance of new governance for the heads of government agencies, giving them greater incentives to become more service oriented towards industry and citizens and even more innovative, e.g. in terms of finding solutions to the climate question. It is important that these proposals are now put into practice.

- **Investment in education and recruitment:** The industries and sectors now making large-scale transformative investments in fossil free industry need to be able to recruit large numbers of people with the right skills. The Government's coordinator for industrial projects in the north shows that 100,000 people are needed to meet the competence requirements of the whole of society over a fifteen-year period. The success of the entire transition nationwide demands both national and international expertise, plus reform and scaling up of education opportunities. The education concerned would partly be in-service training and partly university, upper secondary school and vocational education in the new areas such as hydrogen, battery chemistry, electrification and modern production technologies. In the 2022 budget, the Government has proposed a skills boost for education initiatives and skills boosting measures to meet labour market demand for skills to tackle the climate transition and achieve a circular economy, but more is needed. The Government needs to make a large-scale investment, earmarking

approximately SEK 10 billion kronor a year for education initiatives over the next decade.

- **Clear guidelines and systems for sustainable public procurement:** Public procurement at municipal, regional and national level is a powerful muscle in our national economy on which approximately SEK 800 billion of the tax income we all pay is spent. Naturally, in the immediate future this procurement should be completely fossil free to support the companies that offer more fossil free solutions. Many of the roadmaps highlight the importance of increased demands that public procurement is fossil free, including in the construction, transport and cement sectors. In the 2022 budget, the Swedish National Agency for Public Procurement received SEK 20 million for fossil free and circular procurement but more is needed. There is a need for clear guidelines and systems from the Government and the National Agency for Public Procurement for all three levels in society. One actual proposal, for example, is for the Swedish Transport Administration to raise its ambitions in road and rail procurement such that all new infrastructure is climate neutral by 2030 at the latest, and that a climate bonus be introduced for projects that reduce emissions by up to 100 percent.
- **A joined-up approach to electrification:** In many cases, electrification is what enables the industries to become fossil free. Much is being done but more must be done both in electricity supply, the national grid and charging infrastructure to ensure that industries and individuals are willing to risk investing in new technology that requires electricity. As far as the electricity supply is concerned, Sweden will need to double its electricity production by 2045. The Swedish national grid must also, working with the Swedish Energy Agency and the Swedish Energy Markets Inspectorate, be given clear guidelines on adapting its existing grid development plans to enable different industrial investments in climate neutrality that demand high amounts of electricity. As for the charging infrastructure, the issue is one of creating clear communication about where and how fast charging stations for cars, buses and lorries will be in place in every municipality and region while the necessary resources for this infrastructure must be offered. This should be built on the handshake

for charging infrastructure between 18 regions in the Government's electrification promise. In addition to this, road traffic tax should be modernised to internalise different costs to society caused by road traffic. One proposal is for a charge per kilometre which can be differentiated based on emissions, the road used, the technology used and the time of day when the driver is driving, among other things.

Besides these challenges, in July the European Commission presented a proposed policy package "Fit for 55" affecting many industries which will impact on

opportunities to implement several of the roadmaps. The EU law involved includes a reformed and expanded emissions trading system (ETS), an updated renewability directive, LULUCF, and tighter carbon dioxide criteria for light vehicles. For a small export-focused country dependent on bio-based and circular solutions: and a trailblazer in fossil free industry, the new regulations will bring risks and opportunities. It is important that the Government, government agencies and industry coordinate even more to constructively work to ensure that the new regulations encourage trailblazers and fossil free solutions.





3. Progress and challenges of each sector

The 22 sectors that produced roadmaps for fossil free competitiveness are all very different. Some industries comprise a few major actors at the production stage while others consist of a number of actors of varying sizes in different parts of the value chain. There is also a great deal of variation in terms of where the greatest emissions of the industry actors lie; for some this is in the process while for others, for example, transport is the sector's greatest source of emissions. Implementing the roadmaps will demand joint activities that are often coordinated by one industry organisation or a conglomeration of companies formed for this purpose. It will also involve initiatives and investments by indivi-

dual companies or joint ventures between companies from different industries.

How the industries have worked further on their roadmaps since launch is described in Appendix 2: Follow-up of sectors' measures in the roadmaps (only in Swedish). This chapter highlights some examples of measures in the respective industry and some of the challenges that lie ahead. Some measures and projects implemented involve several sectors and in the same way, many of the challenges are shared. Together they provide a picture of where we are in the transition to a fossil free Sweden in autumn 2021.



Aggregates industry

Aggregates (sand, gravel and crushed rock) are an indispensable raw material for urban development and constructing infrastructure in the form of roads, railways, ports and airports. Every year, approximately 100 million tonnes of aggregates are delivered from about 1,200 quarries.

Today, the fossil emissions from the production of aggregates amount to approximately 0.25–0.45 million tonnes of CO₂ equivalents per year. On top of this, transporting aggregates accounts for almost 30 percent of heavy goods transport in society, amounting to approximately 1 million tonnes of CO₂ equivalents.

To implement the roadmap, the industry is mainly working on:

- **Electrifying the production process**
- **Using fossil free fuel in the production process**
- **Smarter transport and more efficient location of quarries**
- **Circular material flows**

99 Electrified production and logistics at the quarry can cut emissions by 98 % and energy costs by 70 %.

The Swedish Aggregates Producers Association (SBMI) is responsible for the process of implementing the roadmap. Progress is followed up regularly by SBMI's board and SBMI has launched and led a number of projects seeking to drive the climate transition of the aggregates industry.

Progress since the roadmap was launched

The industry's production processes are rapidly being electrified

Today the majority of quarries in continuous operation have moved to electrified crushing production where an electricity grid with sufficient capacity is available. Inspired by Skanska and Volvo's "Electric site" project, the next step is for quarry logistics to also go fossil free. The project demonstrated that this could reduce emissions by 98 percent and energy costs by 70 percent. Where sufficient capacity is not available in the electricity grid, many have switched to biodiesel (e.g. HVO or FAME) despite this involving higher operating costs.

Testing smart electrification in smaller quarries

SBMI has also carried out a project that seeks to enable electrification on a broad front even in smaller quarries with a higher flexibility requirement. Three different concepts have been produced and in 2021 the most advanced concepts have been tested with good results in Norrbotten. SBMI has also worked with partners including Chalmers University of Technology to start to develop a concept to also electrify the diggers that load the aggregates.

EPD for aggregates enables climate requirements in procurement

Following growing pressure from clients in the industry, some actors in the sector have produced their own tools for environmental product declarations (EPD), making it possible for procurement clients to set clear and relevant climate requirements. SBMI has been working in a project with Chalmers that seeks to produce an industry-wide method for EPD for ballast.

Targets and milestones

- 2019 ▶ Roadmap launched.
- 2030 ▶ Greenhouse gas emissions halved (compared with 2015).
- 2045 ▶ Fossil free aggregates industry.

Industry challenges

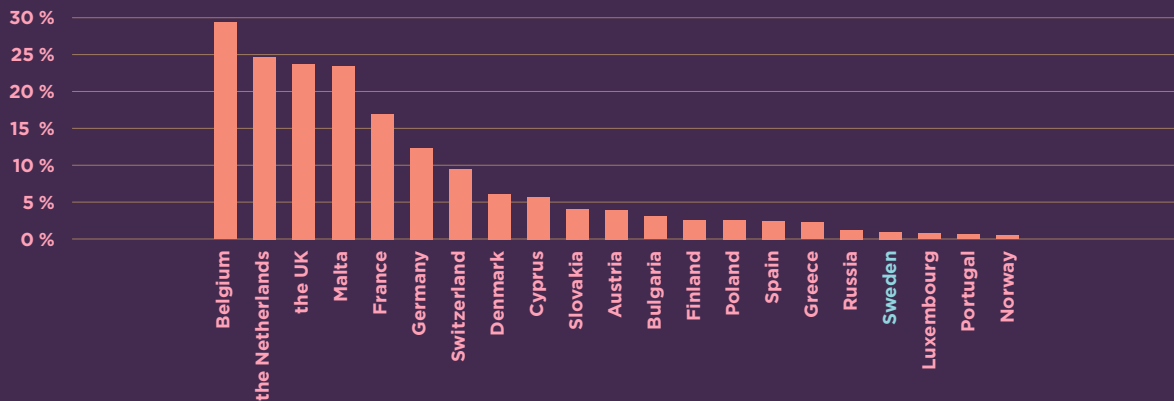
A circular economy is also needed in urban development

Under the current regulations, recycling of aggregates is complex, time-consuming and has dubious basis in law. Sweden’s implementation of the EU’s Waste Directive currently classes high-quality aggregates produced during construction projects as waste, which makes circular management difficult. There are no end-of-waste criteria for products that have themselves been labelled as waste. This leads to too high amounts of aggregates being processed in a linear rather than a circular fashion, being driven to landfill instead of being used in urban development.

Quarry permits needed near construction sites

Aggregates are a regional product. If they are transported further than about 20 km, the costs and the emissions become unreasonable in relation to the product. However, long and unpredictable permit processes with major regional differences in application make it difficult to obtain permits for producing aggregates near to the construction site.

SWEDEN TAKES A LINEAR APPROACH TO FAR TOO MUCH AGGREGATE MATERIAL. THERE ARE MANY EU COUNTRIES WE COULD LEARN FROM.



Proportion of recycled material as % of annual production, 2019. Source: UEPG, European Aggregates Association.

100 million tonnes of aggregates are delivered every year. Industry companies want to play their part in circular and resource-efficient management.



Agricultural sector

The green industries with their production of renewable raw materials and product processing, have an important role to play in the climate transition to a circular and bio-based economy in which Sweden attains its environmental quality objectives.

Greenhouse gas emissions from agriculture amounted to 6.9 million tonnes in 2019, equivalent to approximately 13 percent of Sweden's total emissions. The roadmap focuses on carbon dioxide emissions, which amount to approximately 655,000 tonnes, about 80 percent of which is from use of machinery and the remainder from heating agricultural premises. The sector is working on other emissions via a number of initiatives, such as the sustainability targets produced by the Federation of Swedish Farmers (LRF). Farming is also contributing to the climate transition by producing and processing renewable raw materials.

To implement the roadmap, the industry is working on

- **switching inputs from fossil fuels to renewable energy in the boilers used for drying grain.**
- **switching inputs from fossil fuels to renewable energy to heat farm buildings and greenhouses.**
- **switching from fossil fuel to fossil-free fuel in tractors and other machinery.**
- **phasing out the use of mineral fertiliser manufactured using fossil energy, which is currently not manufactured in Sweden.**

LRF is responsible for the process of implementing the roadmap together with HKScan, Arla and Lantmännen.

“Farming businesses were early investors in solar panels and installation rates remain high.

“Measures taken by farming under the Klimatklivet programme are estimated to achieve a reduction in emissions of 88,000 tonnes of CO₂ a year.

Progress since the roadmap was launched

The Klimatklivet programme is speeding up energy conversion

Measures taken by the agricultural sector under the Klimatklivet programme are estimated to achieve a reduction in emissions of 88,000 tonnes of CO₂ a year. The most common investments are in energy conversion, replacing fossil fuel with renewable energy in the boilers used to dry grain or heat farm buildings and greenhouses.

Fossil-free tractors on the horizon

In the 2020 growing season, Lantmännen Maskin and Energifabriken test drove two new tractors from Valtra running on the biofuel RME, which offers clear climate benefits compared with fossil diesel. The results were positive. New Holland is now selling a 180 horsepower tractor that runs on biogas on the Swedish market. Tractors that run on electricity and hydrogen are being developed by several companies in the form of robot tractors, self-driving concept tractors and hydrogen tractors, for example. However, these will take some time to reach farmers.

Major investment in solar panels

Agricultural businesses were early investors in solar panels and the installation rate remains high. Investments in battery storage to improve the efficiency of the farm's own energy systems have gradually started to take off and here there is an opportunity for several actors to work together to create a joint organisation able to sell the surplus on the open market and supply power to the Swedish electricity grid.

Industry challenges

Biofuel is more expensive than fossil fuel

Many companies are battling with low profits and switching to fossil-free fuel leaves them worse off financially in the current climate compared with those who continue to use fossil fuel. There is a great need to create better conditions and long term rules for biofuels and ensure a broad raw materials base.

Risk that the taxonomy will make things more difficult

The taxonomy proposed by the European Commission

Targets and milestones

- 2020 ▶ Roadmap launched.
- 2020 ▶ Achieved 25 % fossil-free fuel, drying and heating.
- 2025 ▶ 40 % fossil-free fuel, drying and heating.
- 2030 ▶ 100 % fossil-free fuel, drying and heating.

risks having a negative impact on the transition due to regulations for agriculture and forestry and the types of bioenergy products they contribute making things more difficult and driving up costs.

Lack of machinery that runs on alternative fuels

The lack of machinery that runs on electricity, biogas, ethanol or other fuels for work in the fields means that the transition is taking its time. The development of fossil-free machinery is moving too slowly and incentives for electric machinery are still too ineffectual.

Photo: LRF



Automotive industry – heavy transport

Emissions from heavy transport (more than 3.5 tonnes) accounts for about a third of the climate emissions of road traffic. In total, this means that lorries and buses account for about 6.5 percent of Swedish climate emissions. The Riksdag has decided that CO₂ emissions from domestic transport will be reduced by at least 70 percent by 2030 compared with 2010.

To implement the roadmap, the industry is working on three strategies:

- **Greater transport efficiency, i.e. more efficient vehicles and more efficient use of vehicles.**
- **Higher proportion of biofuels, both low and high blends.**
- **Electrification of the vehicle fleet, mainly including batteries but also fuel cells run on hydrogen.**

The industry organisation BIL Sweden is responsible for the process of implementing the roadmap, which includes a low and a high scenario for the proportion of electric lorries. The scenarios are based on the plans and strategies of manufacturers plus the EU's criteria for vehicles. BIL Sweden is working to achieve the high scenario, under which 50 percent of newly registered lorries over 16 tonnes will be powered by electricity in 2030.

“**Electric buses are being introduced at a rapid pace. Just over 600 electric buses are currently on Sweden's roads.**”

Progress since the roadmap was launched

Electric buses and electric lorries are here!

The electrification of buses and lorries has soared in the past year. Electric buses were rapidly introduced in bus traffic. Just over 600 electric buses are currently on Sweden's roads. In autumn 2020, electric lorries were launched, which are now starting to be seen in the registration statistics. As at September 2021, 31 electric lorries, over 16 tonnes, have been registered.

Expansion of charging infrastructure

The Government and the supporting parties are budgeting just over SEK 1 billion in 2021 and 2022 to expand the charging infrastructure for heavy transport. The vehicle manufacturers highlight good access to charging infrastructure as the single most important success factor if electric vehicles are to break through on a broad front.

Increased research into electromobility

Within the remit of FFI, a partnership programme between the Government and the Swedish automotive industry, several major strategic projects have been launched to develop and demonstrate heavy transport solutions that lead to climate improvements. One example is the pilot project in which Volvo Lastvagnar and DHL are testing completely electric transport up to 60 tonnes in daily scheduled traffic between Jönköping and Gothenburg. Another project on electric transport in urban environments is being headed by Scania.

Industry challenges

Need for coordinated support for expansion of charging infrastructure

Support for electrification is currently divided across several government agencies. Support for the charging infrastructure, via the Klimatkivet initiative, is managed by the Swedish Environmental Protection Agency, while The Swedish Energy Agency is responsible for the climate premium for environmental lorries and the regional electrification pilot schemes. The conditions and criteria for receiving support are often difficult to understand and the processing times are long. Many haulage companies are encountering problems managing several parallel application processes, with the result that applications are not made, inhibiting the climate transition. The different roles and responsibilities of government agencies are unclear and the levels of support are not adapted to competitor countries such as Germany.

Targets and milestones

2020 ▶ Roadmap launched.

2030* ▶ 50 % of new registrations of heavy goods vehicles are electric vehicles.

2045 ▶ Vehicle fleet entirely fossil free.

* The target has been updated to 50% a few years before 2030 as progress is faster than anticipated.

Expansion of charging infrastructure too slow

There is still a lack of charging infrastructure for heavy transport. Due to EU rules on state aid, at-depot charging and destination charging are not included in the support now promised via the regional electrification pilot schemes. If exceptions are not gained for this provision, there is a risk that development will be jeopardised. Today the electricity network also lacks capacity in several places to meet increasing demand for electricity and power.

Photo: Lars Ardarve



Photo: Dan Boman



Automotive industry – passenger cars

Sweden's domestic transport accounts for almost a third of the country's total greenhouse gas emissions, with cars making up 61 percent of this. The Riksdag has decided that CO₂ emissions from domestic transport will be reduced by at least 70 percent by 2030 compared with 2010.

To implement the roadmap, the industry is working on three strategies:

- **Improving energy efficiency and more efficient use of vehicles.**
- **Higher proportion of biofuels, both low and high blends.**
- **Electrification, including hydrogen, of the vehicle fleet.**

Car manufacturers can contribute towards the transition by developing vehicles that meet the climate targets and in their roadmap the main strategy is electrification, but a higher proportion of biofuels will also be needed. The roadmap incorporates a low and a high scenario regarding the proportion of rechargeable car sales based on manufacturer's plans and strategies and the EU's criteria for vehicles.

The industry organisation BIL Sweden is responsible for the process of implementing the roadmap and is working towards the high scenario, which means that 80 percent of newly registered cars will be rechargeable in 2030.

99 In 2020, emissions from new cars fell from 120 g/km to 93 g/km.

Progress since the roadmap was launched

Record drop in CO₂ emissions for new cars

CO₂ emissions from new cars have fallen significantly in recent years. In 2020, emissions from new cars dropped from 120 g/km to 93 g/km. This is largely due to an increase in the proportion of rechargeable cars in newly registered vehicles but also to the fact that non-rechargeable vehicles have become more energy efficient. Sweden's reduction in emissions is among the fastest in the EU.

Expansion of charging infrastructure

The investment of the Government and other political parties in expanding the charging infrastructure is welcomed. Good, nationwide access to charging infrastructure is asserted by manufacturers as the single most important success factor in ensuring the breakthrough of chargeable vehicles on a broad front. Work to step up the transition has begun thanks to the Government's Electrification Strategy and the advisory body the Commission for Electrification.

More car models are rechargeable or approved for biofuel

The range of rechargeable models of car and light goods vehicles has expanded considerably. In the past year, the number of rechargeable cars, entitled to a climate bonus, has grown from 130 models in January 2020 to 160 in January 2021. It is judged that availability will continue to grow. More and more models that are approved to run on HVO100 are also coming onto the market, both passenger cars and light goods vehicles.

Industry challenges

Charging infrastructure

The network of public charging stations must be expanded and it must also be easier for drivers of electric cars to find the nearest charging point, and to start, stop and pay for their charging. At the same time, it is still difficult for people living in apartment blocks and community associations to access charging points for home charging.

Changes in policy instruments risk inhibiting sales

Policy instruments for cars and light goods vehicles have changed rapidly over a short period of time. So as not to slow the positive rate of change, it is important not to taper off to early the support that makes it easier for private car owners and companies to buy and drive rechargeable cars or cars run on sustainable biofuel.

Targets and milestones

2020 ▶ Roadmap launched.

2030* ▶ 80 % of newly registered cars are rechargeable.

2045 ▶ Vehicle fleet entirely fossil free.

* The target has been updated to 80% a few years before 2030 as progress is faster than anticipated.

Light goods vehicles dealt with as cars

Light goods vehicles are at a disadvantage because they are dealt with as cars in the bonus-malus system, whereby their vehicle tax has increased by an average of more than 400 percent since 2018. Because the range of electric light goods vehicles is limited, there is a risk that many drivers will choose to keep their older vehicle instead of replacing it, which would have a negative effect on emissions.



Aviation industry

Aviation is an important part of the national and international transport infrastructure for people and goods. In 2019, aviation accounted for approximately five percent of Sweden's greenhouse gas emissions, with domestic flights making up a fifth of this and foreign flights four fifths.

To implement the roadmap, the industry is mainly working on

- **improving the energy efficiency of planes, in airspace and at airports.**
- **fossil free liquid fuels.**
- **hydrogen and electrification.**

The Swedish Air Transport Society is responsible for the process of following up the roadmap, which has also given rise to a number of collaborative projects. One such project is the innovation cluster Fossil Free Aviation 2045, which has produced the report "The route to fossil free aviation 2045", a more detailed and broader analysis of how the targets in the roadmap are to be attained. Read more at www.svensktflyg.se/fardplanen.

” A reduction obligation for aviation was introduced in 2021, which is to produce at least a 27 % reduction in CO2 emissions by 2030.

Progress since the roadmap was launched

The Perfect Flight

In 2019 "The Perfect Flight" flew between Halmstad and Stockholm as a direct effect of the roadmap. The aim was to show how much emissions can be reduced using existing technology within current regulations. The flight's emissions were 46 percent lower per passenger km compared with an ordinary flight.

Procurement of fossil-free aviation fuel

Swedavia and a number of regional airports and municipalities have procured fossil-free aviation fuel to meet the needs of their own business travel. The amount of fossil-free fuel procured replaced an equivalent amount of fossil fuel. Determined efforts to invite other actors to join in coordinated procurement of fossil-free aviation fuel has led to a number of companies and organisations receiving help in reducing their climate impact from business travel.

Reduction obligation introduced

The reduction obligation for aviation was introduced in 2021 with the aim of producing at least a 27 percent cut in CO2 emissions by 2030. A number of airlines operating in Sweden have also made it possible for passengers to purchase fossil-free fuel, so reducing their own emissions by up to 80 percent.

Investments in hydrogen flight and electrification

A number of investments in planes, powertrains and energy supply have seen Sweden taking the lead in developing and implementing the technology. One of the most powerful electricity supplies in the world for electrified aviation is based at a Swedish airport.

Industry challenges

Need for support mechanisms for investment in aviation fuel production

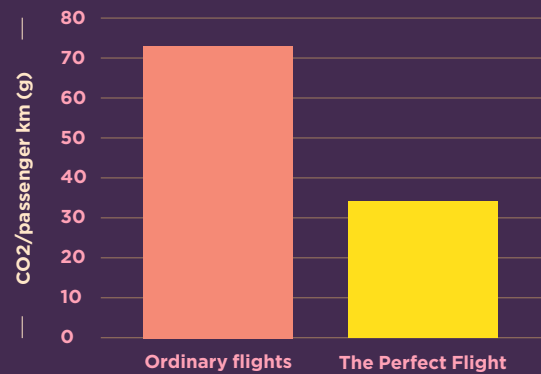
There is a need for a functioning market for fossil-free fuel and for large-scale production capacity based on waste flows, including from the forest and pulp industry to switch to fossil-free aviation. This will demand financial mechanisms in place to limit the risk to those who invest at an early stage, plus business models capable of handling demand and willingness to pay. The increasing levels of the reduction obligation post-2025 demand significant investment in the immediate future.

The complexity of measures and investments impede the pace of development

Attaining the target of fossil-free aviation by 2045 will require developments in technology as well as in legislation, regulation, risk management and business development. This will require broad-based collaboration with the forest industry, fuel producers, finance bodies, research and politicians. On top of this, aviation is a global industry where legislation and competition questions need to be addressed in an international context.

Targets and milestones

- 2018 ▶ Roadmap launched.
- 2030 ▶ Domestic flights to be fossil free (CO₂ emissions from aviation equivalent to domestic flights to be eliminated).
- 2045 ▶ Domestic and foreign flights to be fossil free (all flights starting at Swedish airports to be fossil free and thus not to refuel with fossil fuel).



Type of plane: ATR-72

Reduction in emissions compared with an ordinary flight 46% Source: BRA.



Cement industry

Cement is the key component in our most common construction material, concrete. Today, cement manufacture accounts for four percent of Sweden's greenhouse gas emissions.

The key challenge for the cement industry is the carbon dioxide emissions that arise when the raw material limestone is turned into cement clinker at high temperatures. The first global steps are now being taken towards climate neutral cement production.

To implement the roadmap, the industry is working on

- **the transition from fossil energy to bioenergy.**
- **driving projects for CCS in Norway and Sweden with the aim of having the world's first climate-neutral cement factory up and running in Slite in 2030.**
- **using raw materials sparingly and limiting new production by increasing efficient use of resources, recycling and re-use.**

Cemeta is working to implement the roadmap.

” **The plant in Slite may be the first climate-neutral cement factory in the world with the potential to become a carbon sink.**

Progress since the roadmap was launched

Steps on the way to CCS and climate-neutral cement in the future

In June 2021, HeidelbergCement presented an initiative to make Cementa's plant in Slite the first carbon-neutral cement factory in the world with the potential to become a carbon sink. The world's first CCS plant for the cement industry is already being built on an industrial scale in Norway with operation set to start in 2024. In Sweden a pilot study is underway for a facility in Slite where up to 1.8 million tonnes of carbon dioxide are to be captured annually from 2030. This will cut Sweden's total emissions by three percent and also open up the opportunity of creating a carbon sink of more than 300,000 tonnes as a larger proportion of the fuel will be biobased..

Energy and material recovery of waste offers more benefits

The cement industry is taking over some of society's waste management burden. Waste can be sent for energy recovery as fuel in cement manufacture, replacing carbon, and be recycled in that waste products replace some virgin raw material.

- **Since 2018, the Slite plant, which accounts for 75 percent of Sweden's cement production, has increased the proportion of recycled fuel by 10 percentage points from 59 percent to 69 percent. About a quarter comes from biomass. Work is underway to be able to use only bioenergy or electricity in the future.**
- **The use of waste materials is growing, and since 2019 the cement industry has replaced parts of the virgin raw material with approximately 200,000 tonnes of slag from the steel industry, reducing emissions by about 60,000 tonnes as less limestone needs to be used.**

Industry challenges

The importance of safeguarded and efficient permit processes

Environmental permits are critical to the transition of the cement industry both in terms of access to raw materials and the industrial transition. The bottlenecks are long lead times, unpredictability and a lack of a holistic approach in decision-making processes. Long-term permits would enable the supply of cement in Sweden to be safeguarded.

Access to a robust electricity supply

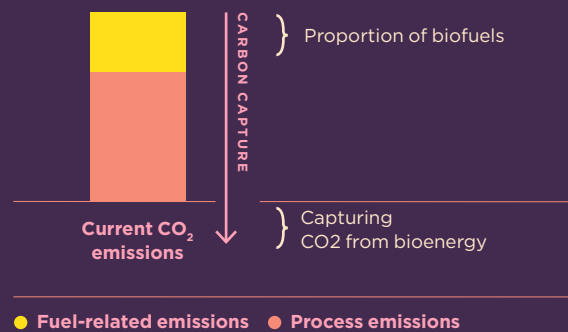
The transition of the cement industry means a multi-million kronor investment in Gotland. Such an investment also requires a long-term approach from the authorities. The existing electricity system to and on the island is approaching the end of its life and an upgrade needs to take into account the capacity that will be needed for this industrial transition, and to be capable of functioning with the increasing expansion of renewable power. However, the lack of a robust electricity network and the trend towards rising electricity costs in southern Sweden risk putting the brakes on an urgent climate transition.

Targets and milestones

2018 ▶ Roadmap launched.

2030 ▶ The world's first climate-neutral cement plant Scope 1–3 to come on stream in Gotland where a carbon sink of more than 300,000 tonnes of carbon dioxide will also be created.

CARBON CAPTURE WILL ENABLE US TO CREATE A CARBON SINK!



Up to 1.8 million tonnes of CO₂ will be captured every year. Source: Cementsa.

Photo: Cementsa



The plant in Slette ships two million tonnes of cement a year. Once the CCS plant is up and running, 1.8 million tonnes of CO₂ will be shipped out as well.

Concrete industry

Concrete is the most used construction material in the world and it has enabled urban development across practically the whole of our society. The roadmap for climate neutral concrete is closely linked to the roadmap for cement because cement accounts for about 90 per cent of the climate impact of concrete.

To implement the roadmap, the industry is working on

- **using cement that has been developed with a lower climate impact.**
- **optimising the composition of concrete, replacing parts of the cement with alternative binders.**
- **contributing towards resource-efficient construction with material optimisation.**
- **contributing towards ensuring that the right concrete is used in the right place, i.e. avoiding higher concrete quality than necessary for the bearing capacity and durability of the building.**
- **lower climate impact from transport.**

To achieve the aim of climate neutral concrete, there is also a need for technological advances in the cement industry, with carbon capture and storage/utilisation (CCS/CCU).

The industry organisation Svensk Betong is responsible for the roadmap implementation process. The roadmap was produced with a number of actors from the whole value chain in the Swedish Concrete Initiative, working together for climate-neutral concrete.

Progress since the roadmap was launched

Climate-improved concrete for a 50 % cut in climate impact today

Depending on the type of construction, it is already possible to achieve a 50 percent reduction in climate impact from concrete by using climate-improved concrete. The concrete industry is now working on a knowledge boost to encourage other actors in the value chain to use climate-improved concrete in projects.

Revised concrete standard

The revision of the Swedish application standard for concrete (SS137003) to be completed in autumn 2021 will open up wider opportunities to use alternative binders to cement in the further development of climate-improved concrete.

Research project for more rapid implementation of the roadmap

BetCrete 2.0 is a research project that is co-funded by Sweden's innovation agency Vinnova for two years (2020-2022) Vinnova. The purpose of the project is to support and increase the pace of implementation of the roadmaps for concrete and cement, for example through research into alternative binders such as calcined clays.

The technological transition of the cement industry

Cementa has made a decision to invest in introducing CCS (carbon capture and storage) throughout its

“ Depending on the type of construction, it is already possible to achieve a 50 % reduction in climate impact from concrete by using climate-improved concrete.

cement factory in Slite from 2030, which will enable climate-neutral cement manufacture.

Industry challenges

Lack of requirements in procurement

In many cases, the target of a 50 percent reduction in climate impact for concrete used in house building by 2023 can already be met today. The challenge lies in ensuring that climate-improved concrete is really ordered and that procurements make climate requirements based on a lifecycle perspective. The Riksdag has decided to introduce a statutory requirement for climate declarations on buildings from January 2022 but the requirement only involves declaring the manufacturing and construction processes and not the whole lifecycle.

Obstacles to technological transformation in the cement industry

The technological transformation in the cement industry depends on Cementa's opportunities to run its operations on Gotland, which is currently uncertain. Even with

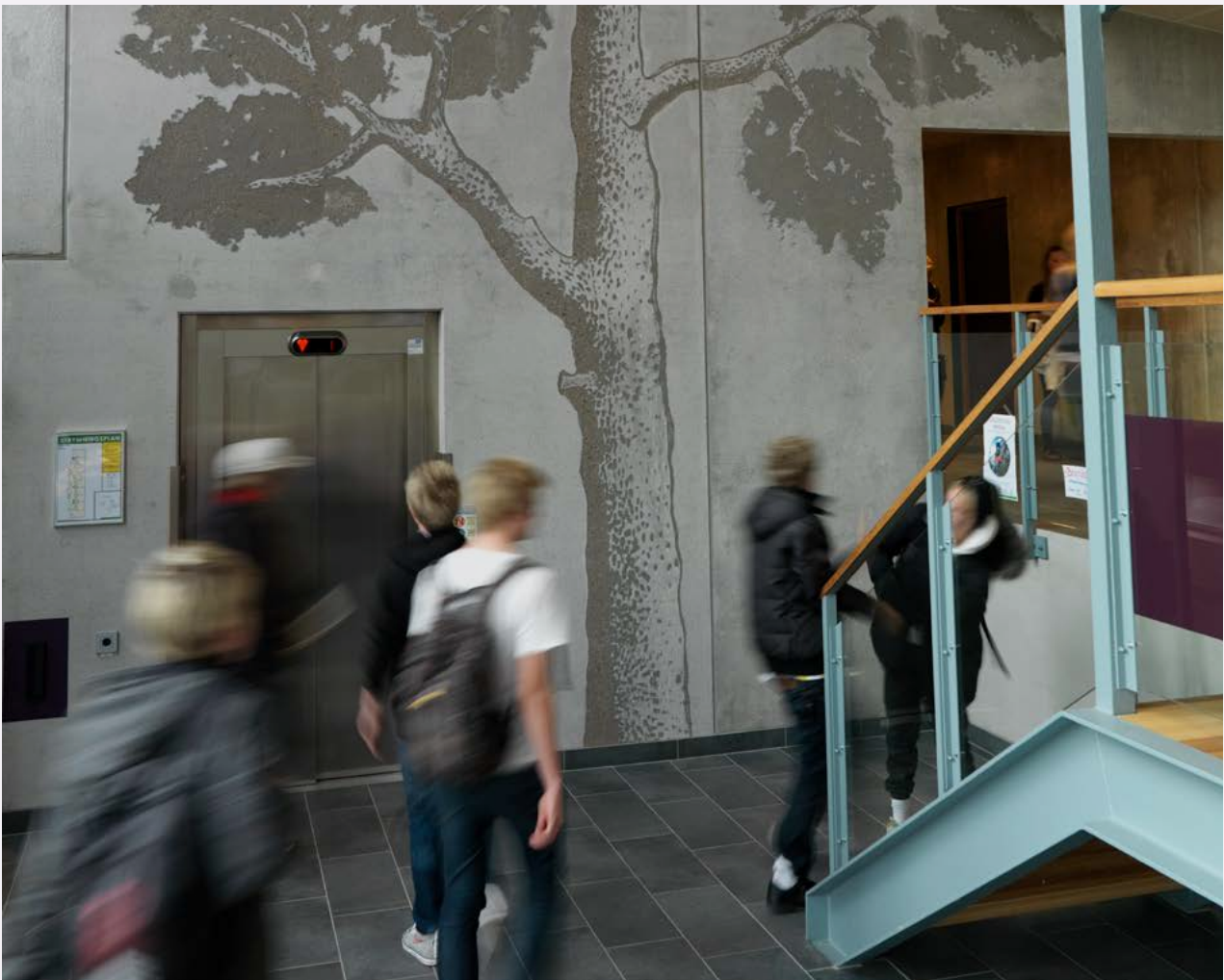
Targets and milestones

- 2018 ▶ Roadmap launched.
- 2023 ▶ Possible to achieve a 50 % reduction in the climate impact of concrete for house building.
- 2030 ▶ Climate-neutral concrete on the market.
- 2045 ▶ All concrete in Sweden climate neutral.

a renewed permit, the development of CCS technology introduces a number of questions linked to risks and funding. The technological transformation demands major investments and risktaking and risks being slowed by slow and unpredictable permit processes for the business and for access to electricity.

Regulations and standards

Standards and regulations govern the proportion of alternative binders that can be used. Because continuous development is underway to safeguard the durability of concrete, regulations and standards need to keep pace so as not to slow progress.



Construction and civil engineering sector

The construction and civil engineering sector accounts for approximately 20 percent of Sweden's climate emissions. Climate impact mainly comes from manufacturing materials and products and from emissions related to energy use in the operating phase. The roadmap spans the entire value chain from manufacturing material and products to operation and management of properties.

To implement the roadmap, the industry is working on

- **changed composition of raw materials.**
- **electrification and efficiency improvements in production and transport processes.**
- **greater use of renewable fuels in production and transport processes.**
- **more efficient transport.**
- **planning for circular flows and efficient use of resources.**
- **optimisation of energy and climate performance from a lifecycle perspective, in the construction and operation phase.**

Eight industry organisations in the urban development sector are jointly taking responsibility for the process of implementing the roadmap with the around 170 companies, organisations and municipalities involved. The Swedish Construction Federation is the process owner.

” In June 2021, House of Choice was opened in Solna, the first hotel in Scandinavia built as a zero-energy project that produces as much energy as it consumes.

Progress since the roadmap was launched

LFM 30 – local roadmaps drive development

The local roadmap for Malmö, LFM 30, is an example of how local companies together with the municipality, organisations and research institutes have come together to drive development towards climate-neutral construction. Similar initiatives are also being carried out in Östergötland and Uppsala.

Climate requirements in procurement enabled at a reasonable cost

The project “Climate requirements at reasonable cost” has produced guidance aimed at making it easier for housing companies to set climate requirements for construction projects, enabling procurement with clear specifications of requirements and reliable climate calculations.

Climate-improved asphalt and concrete

Climate-improved asphalt made with input of re-used asphalt and using renewable fuel in asphalt production is becoming increasingly common. “Green asphalt BioZero” is a totally unique product in the world that also has a new bio-based binding agent that produces net zero emissions. Climate-improved concrete is currently available for housing, roads and civil engineering and provides a 10–50 percent lower climate impact.

House of Choice – zero energy hotel

In June 2021, House of Choice was opened in Solna, the first hotel in Scandinavia built as a zero-energy project that produces as much energy as it consumes. New technology reduces consumption by 80 percent, while the hotel will have the highest proportion of solar panels in the world.

Fossil free construction sites

Several construction companies are working on fossil free construction sites. One example is Skanska, which has approximately ten construction sites in Sweden of different types and sizes that use at least 90 percent electricity and fossil free fuels for work vehicles, machinery, major transport of materials and heating/drying.

Industry challenges

Obstacles in current regulations and classification of waste

Resources and the built stock must be used effectively and a circular approach must become a natural element of all processes in construction and civil engineering. Today, however, there are both legal obstacles and a lack of clarity as to how waste is classified, making it difficult to exploit opportunities for recycling and re-use.

Procurement requirements too low

To facilitate business models that build on efficient re-use of construction elements and large-scale material re-

Targets and milestones

- 2018 ▶ Roadmap launched.
- 2022 ▶ Actors in the construction and civil engineering sector have mapped their emissions and set climate targets.
- 2025 ▶ Greenhouse gas emissions clearly demonstrate a declining trend.
- 2030 ▶ 50 % reduction in greenhouse gas emissions (compared with 2015).
- 2040 ▶ 75 % reduction in greenhouse gas emissions (compared with 2015).
- 2045 ▶ Net zero greenhouse gas emissions.

cycling, strict requirements must be set with incentives in all procurement. In public procurement, requirements for re-use and climate neutral materials must be made immediately.

Lack of accurate statistical basis

Today there is no correct statistical basis regarding emissions from the construction and civil engineering sector and joint values for calculating climate emissions, which is necessary in order to make correct decisions and ensure equal competitive conditions in procurement, for example.



Digitalisation consultancy industry

Work by the digitalisation consultancy industry on the roadmap mainly focuses on how digitalisation can enable major cuts in emissions in all sectors of society.

Digitalisation can facilitate significant reductions in greenhouse gas emissions by

- **optimising existing systems, e.g. transport route optimisation using AI.**
- **accelerated uptake of smart solutions, e.g. greater use of digital meeting solutions.**
- **transformative changes with new system solutions, e.g. by implementing digital tools that enable new resource-efficient business models and circular solutions, such as mobility as a service.**

The process for implementing the roadmap is run by the organisation Digitaliseringskonsulterna, read more at www.digitaliseringskonsulterna.se.

Progress since the roadmap was launched

Climate potential of digitalisation highlighted by the pandemic

When opportunities to travel and meet face to face were restricted during the pandemic, it became clear how digital technology could facilitate far-reaching behavioural changes and thus new business models. The results showed that the way people move, live, eat and work can be changed and that many activities can be moved online, with the consequences often being a reduction in greenhouse gas emissions. Figures from companies in the industry show, for example, that their own emissions fell by more than 70 percent in 2018–2020 due to remote working.

A promise to increase use of green digital technology

With 26 other European countries, Sweden has promised to implement and invest in more green digital technology to achieve climate neutrality and speed up the green and digital transformation in the Declaration on A Green and Digital Transformation of the EU. This includes supporting the deployment of green digital solutions that accelerate the decarbonisation of energy networks, enable precision farming, decrease pollution, combat the loss of biodiversity and optimise resource efficiency. Under the Declaration, the Government is to regularly evaluate progress and report back to the Commission.

Practical application of methodology to highlight the positive climate impact of innovation

In 2021, the deep-tech incubator LEAD in partnership with Knowit has applied a method to increase the visibility of, quantify and accelerate the positive impact of newly started companies by avoided emissions. The project showed that four new companies to-

“ Figures from companies in the industry showed that their own emissions fell by more than 70 % in 2018–2020 due to remote working.

gether have potential to cut global emissions by 14 million tonnes a year after 2030, equivalent to 25 percent of Sweden's annual emissions.

Industry challenges

Low awareness among clients

Awareness of the transformative potential of digitalisation in the climate transition is currently low among politicians, the business community and the public sector. The challenge is that optimising existing systems is relatively easy to explain, measure and provide with political support, while the major transformative system changes that result in radical cuts in emissions are often harder to measure, explain and order.

Lack of standards for calculating avoided emissions

There is currently no accepted way of calculating and

Targets and milestones

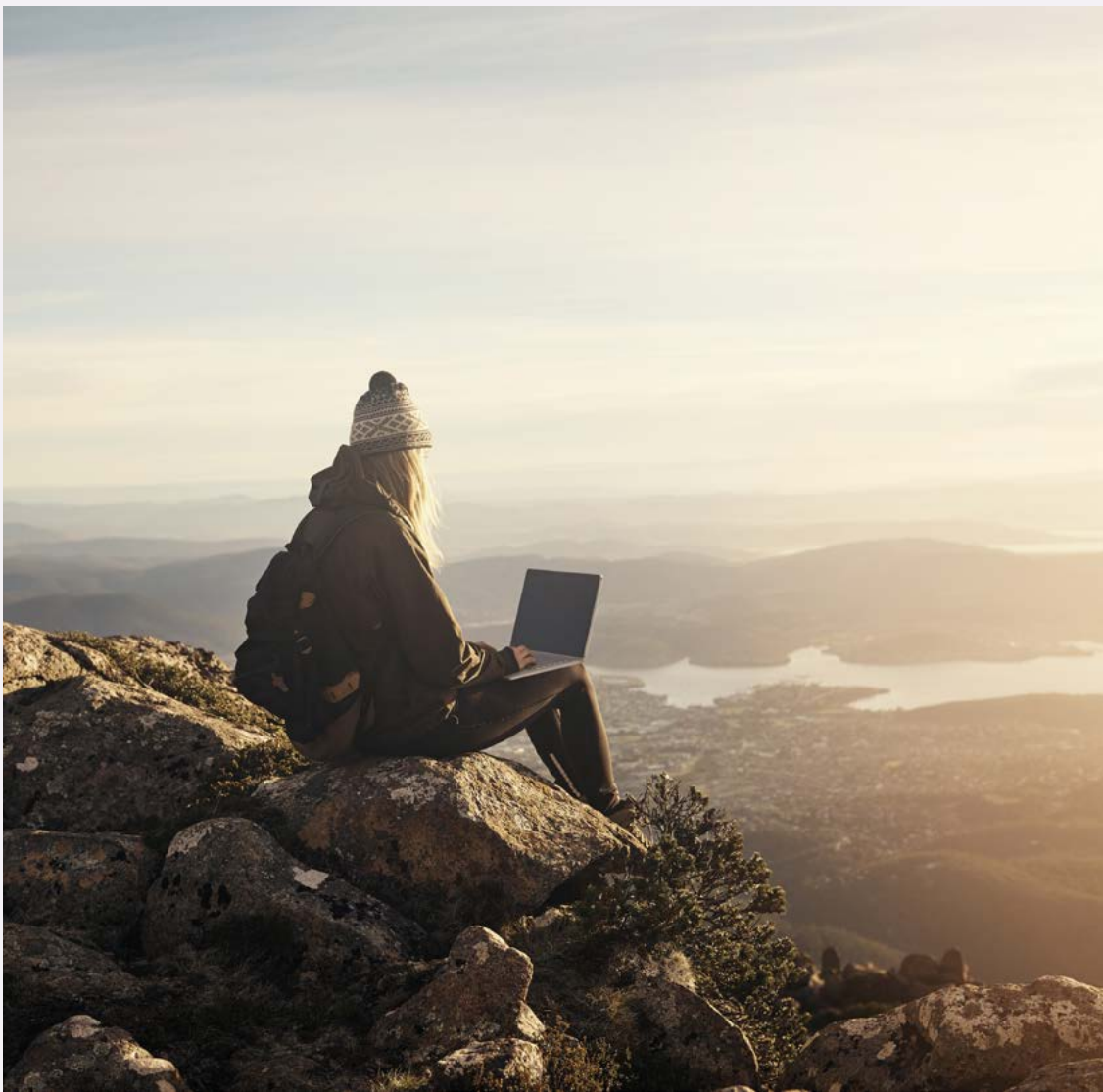
2019 ▶ Roadmap launched.

2030* ▶ Halve the industry's own greenhouse gas emissions and those of the value chain.

2045 ▶ Achieve zero emissions.

* The previous target of halving energy consumption by 2030 was updated in 2021 to be compatible with the Exponential Roadmap 1.5C Business Playbook and the Un's Race to Zero initiative.

expressing the avoided emissions that digital solutions and circular business models contribute towards. The established frameworks do not make it possible to calculate the potential a service has to reduce emissions from other sectors. Without an accepted calculation method, there is a risk that investments will not be made, and that investments that do not have any positive climate impact will be marketed as being green.



The pandemic made it clear how digital technology can enable major reductions in emissions in society. One clear example is the way that digital meeting solutions enabled us to avoid travel, and so avoid emissions.

Electricity sector

Swedish electricity production is 98 percent fossil free. The industry's efforts to implement the roadmap therefore largely involve examining how, by means of electrification, the energy sector can facilitate a national energy transition away from fossil fuels.

A number of major energy-intensive investments have been presented since the roadmap was drawn up. The latest scenario analysis by industry organisation Swedenergy (Energiföretagen Sverige) shows that demand for fossil free electricity may increase by 120 percent by 2045. In practice, this would mean that there is a need for a completely new electricity system in 25 years, while the existing system requires maintenance and reinvestment.

Swedenergy is responsible for the process of implementing the roadmap and in the Roadmap Energy project, we have worked further on clearly setting out the challenges for politicians regarding the regulations and the market models described in the roadmap for the electricity sector and the roadmap for the heating industry. Thirteen timelines have been produced in broad collaboration with stakeholders involved and based on a system perspective, concrete proposals are described for what needs to be done, by whom and when to be fossil free by 2045. Read more at <https://www.energiforetagen.se/fardplan-energi>.

Progress since the roadmap was launched

Major growth in wind power

Since January 2020, 439 wind turbines with an estimated annual electricity production of approximately 5 TWh have been taken into operation. Today, wind power accounts for approximately 20 percent of Sweden's electricity production and the many projects currently in the planning phase will see this proportion increase even further.

SWITCH – part of the solution to the capacity shortage

E.ON has developed the SWITCH platform, which allows power grid owners to create their own marketplace with connected electricity consumers and electricity producers – flex suppliers. The power grid owner can then purchase the power from the flex suppliers and use it to avoid overload or to resolve bottlenecks in the electricity grid.

Skellefteå Kraft expands power for hydropower

Power company Skellefteå Kraft is making big investments in the Rengård hydropower plant in the Skellefteälven river, where renovation and an additional turbine will double capacity from 35 MW to 70 MW. The investment will also improve the ability of other power stations to regulate flows in the river, giving Skellefteälven even greater capacity to contribute to the electrification of society.

Collaboration with industry

Many energy companies are deeply engaged in industrial investments such as HYBRIT (Vattenfall), Northvolt (Skellefteå Kraft) and Liquid Wind (Övik Energi and Uniper). The investments demand huge amounts of electricity but can also create value for the energy

“ Since January 2020, 439 wind turbines with a calculated annual electricity production of approximately 5 TWh have been brought into operation.

system by sending waste heat to district heating and through demand flexibility via hydrogen storage.

Industry challenges

Long lead times to build electricity grids

The current long permit processes for electricity grids pose a major obstacle to the expansion of the electricity system. Shorter lead times are essential to investments in electrifying industry and producing hydrogen gas.

Lack of incentives for support services

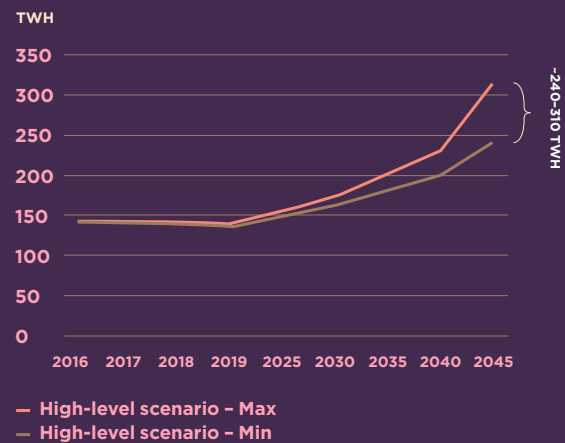
Today wind power is mainly being built in Sweden. Solar power is also increasing significantly, however from low levels. This creates a need for solutions capable of delivering critical weather-independent support services to create a balance to retain security of supply in the system. As the proportion of planable power falls, such services will become increasingly crucial to maintaining a balanced electricity system. There are no incentives for such services at the moment. In general terms, the function of the electricity market needs to be reviewed so as to ensure the investments in electricity production that are needed if customers are to risk investing in electrification.

“Major industrial investments demand large amounts of electricity but may also create value for the energy system.”

Targets and milestones

- 2020 ▶ Roadmap launched.
- 2030 ▶ Fossil-free electricity production.
- 2045 ▶ Meet demand for fossil-free electricity in balance with other societal targets: security of supply, competitiveness and sustainability. This means that the electricity sector will expand and develop the electricity system in pace with growing customer demand for electricity.

SCENARIO ANALYSIS, ELECTRICITY CONSUMPTION SWEDEN 2045



Swedenergy's updated scenario analysis presented in April 2021 shows that the need for electricity may increase to about 240–310 TWh by 2045 compared with approximately 140 TWh today. The wide span in the scenario is mainly due to the fact that today there is uncertainty about how much electricity will be needed to produce hydrogen for industrial processes. Source: Swedenergy

Sweden's energy is mainly produced using hydropower, nuclear power, wind power, combined heat and power (CHP) and district heating.



Fast-moving consumer goods industry

Data from a number of countries in the food retail sector indicates that primary production accounts for an estimated three-quarters of the sector's greenhouse gas emissions. Emissions also come from processing, packaging, transport and sale. The roadmap places the greatest emphasis on the climate emissions that the industry can influence directly, but also takes into account the total climate impact of the industry.

To implement the roadmap, the industry is working on:

- **Processes and technology: Replacing fossil-based electricity and energy, and coolants with global warming potential, improving energy efficiency, developing circular processes, switching to 100 % fossil free domestic transport.**
- **Packaging: Converting to 100 % recyclable plastic packaging and then to fossil-free packaging.**
- **Range: Produce industry-wide guidelines for sustainability data.**

The trade association DLF Sweden is responsible for the process of implementing the roadmap, partly by establishing a sustainability committee which brings together about twenty sustainability managers from DLF's member companies.

” DLF's transport initiative is seeing growing numbers of member companies switching to fossil free transport.

Progress since the roadmap was launched

Major investment in plastic sorting facility

Via its part-ownership of Swedish Plastic Recycling in Motala, DLF has invested in the plastic sorting plant Site Zero, which in 2023 will have the sorting capacity to meet all of Sweden's needs for sorting plastic packaging from Swedish households. The plant will be able to sort twelve different recyclable fractions compared with four today. In the next step, Swedish Plastic Recycling also plans to wash and granulate the sorted material.

Spreading knowledge for increased recycling

In 2020, 15.4 percent of plastic packaging from Swedish households was recycled into new plastic packaging or a new plastic product. To attain the target of recycling 55 percent of all plastic packaging by 2025, DLF has launched the Plastics Initiative 2025, while Swedish Plastic Recycling is running the "Plastsprånget" project, which seeks to increase knowledge and speed up the switch to recyclable packaging.

Replacing fossil-based electricity and energy

Several companies have switched from fossil electricity and energy to biogas and renewable district heating in their production. Several companies also produce their own biogas from waste products from their processes.

More fossil-free and coordinated transport

Under DLF's transport initiative, increasing numbers of member companies are converting to fossil-free

transport. Furthermore, several companies are working actively on coordinated transport to reduce the number of total journeys.

Industry challenges

Uncertainty regarding tax on fossil-free fuel

The Swedish tax exemption for liquid clean and high-mix biofuel is extended by one year at a time. Uncertainty about the position a couple of years down the line is an obstacle to long-term investment.

Need for investment in recyclable plastic packaging

Even once plastic sorting is improved with Site Zero, further investment will be needed in washing and granulation plants in order to be able to re-use the plastic in new products in a “closed loop” in Sweden.

More research and development needed in chemical recycling

Chemical recycling is now being developed to enable the recycling of plastic packaging that is not compatible

Targets and milestones

- 2020 ▶ Roadmap launched.
- 2025* ▶ 100 % recyclable plastic packaging.
- 2025 ▶ 100 % fossil-free domestic transport.
- 2035 ▶ 100 % climate-labelled products, at the latest.
- 2045 ▶ 100 % fossil-free packaging and net zero-greenhouse gas emissions.

* This target was first set at 2022 but was changed due to the challenge of new, innovative packaging materials (alternatives to laminates)

with the current system. However, major investments are also needed in developing new, innovative packaging material that is better adapted to recycling right now.

No common basis for calculating climate footprint

To make it easier for consumers and customers to make sustainable choices, there is a need for standardised sustainability calculations in the industry, which are largely lacking today.

Photo: Svensk Plaståtervinning



Swedish Plastic Recycling's sorting plant in Motala.

Food retail sector

There are many aspects of the food retail sector's operations that affect the climate and the environment. One important and high-priority question is phasing out fossil and non-recyclable plastic packaging, which was selected as the theme of the roadmap.

Today the industry uses approximately 220,000 tonnes of plastic for packaging. The majority of the collected plastic, about 72 percent, goes for energy recovery instead of material recycling. Material recycling accounts for 28 percent of all the plastic collected for recycling. When incinerated (no recycling) the plastic emits about 5.7 kilo CO₂ equivalents per kilo of plastic.

To implement the roadmap, the industry is working on

- **increasing material recycling of plastic packaging.**
- **switching to plastic packaging made from renewable or recycled raw materials, which demands access to renewable raw materials and building up a market and a demand for the recycled material.**

The Swedish Food Retailers' Federation (Svensk Dagligvaruhandel, SvDH) is responsible for the roadmap process and is coordinating a packaging group with representatives from each member company, which meets regularly to exchange experiences and information.

” In 2023 the facility in Motala will be able to take in all plastic packaging from Swedish households.

Progress since the roadmap was launched

Investments in Swedish plastic recycling

The Swedish Food Retailers' Federation together with DLF, the trade association for companies that produce or import goods, and the plastic industries are the owner of Swedish Plastic Recycling's new plastics sorting plant in Motala, which has been up and running since 2019. In August 2021 the decision was made to expand the plant, enabling it to handle 200,000 tonnes of plastic packaging and so take in all plastic packaging from Swedish households and sort it into twelve different recyclable fractions so that packaging made from composite materials can also be sorted. The expansion will be complete in 2023.

Strategy for 55% recycling by 2025

The Swedish Food Retailers' Federation (Svensk Dagligvaruhandel, SvDH) is working together on the Plastsprånget 2025 strategy to achieve the EU's recycling target for 2030 of 55 percent recycling of plastic packaging as early as 2025. The strategy involves putting measures in place throughout the value chain via three main elements: design for recycling, increased collection, and investment in the sorting plant in Motala.

Differentiated packaging fees

The industry has introduced differentiated packaging fees to steer development towards greater recyclability. Lower fees are charged for packaging suitable for material recycling compared with packaging where material recycling is not possible.

Industry challenges

There are no satisfactory alternatives to some sorts of plastic

Some sorts of plastic are hard to phase out. One example is laminate, a plastic material that is crucial for many products for food waste or health reasons. Today there are no sufficiently good alternatives to flexible laminates and additional technological development will be required before alternatives that enable material recycling are available. Due to a lack of options, the target of material recycling by 2022 has been pushed back to 2025.

Innovation and technical development

Plastic is a technical raw material and in many cases relatively complicated. Major demands are made of technological development to ensure that the replacement material is better than its predecessor and does not lead to higher food waste, more complex transport solutions

Targets and milestones

- 2018 ▶ Roadmap launched.
- 2025* ▶ Material recycling possible for all plastic consumer packaging.
- 2030 ▶ All plastic consumer packaging is produced from renewable or recycled raw materials.

* This target was first set at 2022 but was changed due to the challenge of new, innovative packaging materials (alternatives to laminates).

or poorer conditions for the product. Politicians need to create incentives to spur on the technological development of fossil-free, recycled plastics.

Too little packaging is recycled

Around half of plastic packaging is still thrown away in the household waste that is incinerated. One challenge is therefore to get consumers to be better at recycling their packaging.

Photo: Svensk Plastförpackning



Forest sector

The forest sector contributes to the transition to a fossil-free society in that bio-based products are able to replace fossil-based ones. The forest sector's industrial processes are already 95 percent fossil free. The roadmap shows how the industry can contribute to the climate transition of society, both by increasing deliveries of fossil-free products, which creates climate benefit, and by phasing fossil fuel out of their own processes.

To implement the roadmap, the industry is working on

- **creating climate benefit through increased deliveries of bio-based products able to replace fossil-based ones.**
- **binding carbon in products and in the forest itself.**
- **cutting their own use of fossil energy in machinery, transport and industrial processes.**

The Swedish Forest Industries Federation is responsible for the roadmap process.

” In September 2021 the Sara Cultural Centre, one of the tallest wooden buildings in the world was opened in Skellefteå.

Progress since the roadmap was launched

Building in wood - more wood-framed buildings being built

The number of wood-framed apartment blocks being built has increased from 14 to 20 percent since 2018, and other buildings are also increasingly being built with a wood frame. For example, September 2021 saw the opening of the Sara Cultural Centre in Skellefteå, which is one of the tallest wooden buildings in the world.

Wood is replacing fossil sources in new and traditional areas

The sector is developing several bio-based products such as packaging material, textile pulp, bio-based liquid barriers for food packaging, batteries and chemicals. The products will be easier to recycle, produce a lower carbon footprint and be suitable for industrial composting. A huge amount of resources are being put into research and innovation. Examples of innovation investments in new and more efficient use of the forest raw material include the collaboration platform Treesearch, which has produced transparent wood, the Wallenberg Wood Science Centre, which has produced bio-based rubber from industrial waste streams, plus several investments in developing new types of biofuel, e.g. by processing sawdust.

Greater knowledge of measures to increase forest growth

In its report on new opportunities for forestry, the Swedish Forest Agency describes measures to increase forest growth. The most important are using the best possible plant material, planting, clearing and thinning in time and in the right way, and reducing browsing damage from animals such as elk and deer. The current level of damage from wildlife results in losses of

between 5–7 m³ of forest per year, and the cost to society of browsing damage is estimated at SEK 7.2 billion. Damage from wildlife also means a loss of biodiversity as biologically important deciduous trees such as rowan, aspen, willow and oak are browsed so that they often cannot become fully grown trees. In October 2021 the Swedish Forest Agency is launching the Smart Forestry campaign as part of the Sustainable increased growth project to ensure that the measures are put into practice.

Industry challenges

Ongoing political processes

The political focus of many processes, in Sweden and at EU level, is largely geared towards preservation, with the forest in a climate context mainly being viewed as a carbon sink. This can lead to uncertainty among land owners and the forest industry, which risks leading to reduced investment in forestry and in the industry.

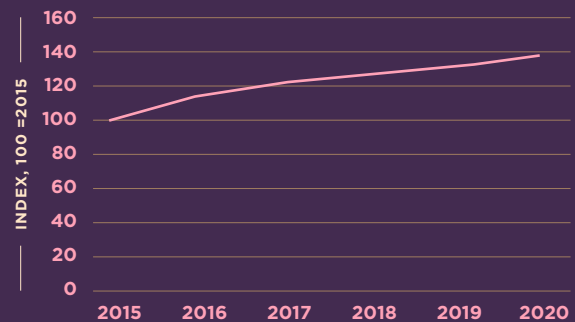
Resources for technological development and innovation

Rapid strides are being made in developing manufacturing processes and new materials and products, but there is a widespread lack of resources for research, development and innovation, especially regarding improving the efficiency of processes and bringing new products to market.

Targets and milestones

- 2018 ▶ Roadmap launched.
- 2030 ▶ Market for wood products has increased, at least 50 % of all newbuild homes are wood-framed.
- 2030 ▶ Higher investment from industry and society in research, innovation and demonstration facilities.
- 2030 ▶ No fossil fuels used in machinery in the forest industry or in forestry.
- 2045 ▶ Increase in the total climate benefit of the forest sector and its contribution to a fossil-free society.

GLULAM PRODUCTION



Glulam is a key component in industrial building in wood. The increase in production gives an indication of the growth in construction in wood.

Source: Swedish Wood

Photo: Lennart Durehed



More and more people are choosing to build wood-framed houses, not least for climate reasons. Transparent wood may be used in facades, simultaneously acting as solar panels.

Gas sector

Of the energy gases used in Sweden today, approximately 15 TWh are of fossil origin while 4 TWh are renewable. The roadmap for the gas sector shows how the industry will become fossil free and how increased use of energy gases can contribute to the transition of electricity and heating, industry, shipping and road transport.

To implement the roadmap, the industry is working on

- **investing in more production of renewable gas in Sweden.**
- **developing the market for renewable energy gases.**
- **Investments in gas distribution infrastructure, and facilitating the input of renewable gases into the gas network.**

Since the roadmap was launched, interest in hydrogen has grown significantly, both in the EU and in Sweden, and there are major plans in which the production and use of hydrogen is, or is planned to be, key in several value chains. The gas sector has been involved in Fossil Free Sweden's work to produce a strategy for how hydrogen can be used in Sweden to achieve the climate goals and develop industry.

The Swedish Gas Association is responsible for the process of implementing the roadmap. This work is conducted in close collaboration and in continuous dialogue with the gas sector, including through the Swedish Gas Association's working groups.

” The proportion of bio-gas in compressed gas in the transport sector is already 95 %.

Progress since the roadmap was launched

Gas is replacing diesel in goods transport

Looking at compressed gas in the transport sector, the proportion of biogas has already reached 95 percent, which means that the gas sector is well on track to meet the target for 2023. The proportion of biogas in liquefied natural gas in vehicles has increased significantly and now reaches 65–70 percent. Aided by initiatives such as Drive LBG, Klimatklivet and Klimatpremien, the gas sector has contributed towards 1,200 gas-powered lorries on the roads, and towards a rapid development of infrastructure. Interest in gas is also growing in the maritime industry, for example a couple of Destination Gotland's ferries are running on 10 percent liquefied biogas.

Increased demand fuelling new production facilities

Since tax was removed on bio-propane on 1 January 2021, demand has risen as several industries have chosen to switch either all or part of their production. The tax exemption on biogas has also gained EU approval for ten years. A total of 16 actors are now planning biogas production for a total one TWh. The Klimatklivet initiative has granted funding to several of these and most are now in the project planning phase.

The gas sector is planning for future development of the gas network

For the first time, the gas sector has produced a joint study, via the research and knowledge institute Energiforsk, into how the gas network can be developed and the needs that exist to invest in infrastructure for hydrogen. Links across the sector are becoming increasingly important and the deve-

lopment of gas infrastructure, together with expansion of the electricity grid, will facilitate a cost-effective transition.

Industry challenges

Long-term conditions

There is a risk that the production of renewable gases in Sweden will be inhibited by long-term conditions in the form of support and objectives. There is also a need for incentives to ensure that the industry is able to switch to renewable gas as an input raw material in products.

Regulations lack a holistic perspective on biogas

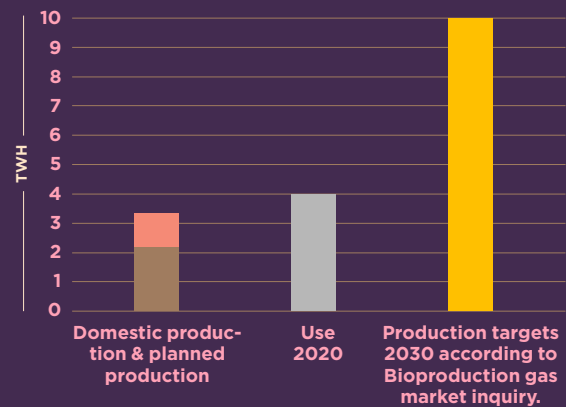
Biogas vehicles risk being phased out as EU regulations assess their climate footprint based on carbon dioxide emissions at the exhaust pipe rather than on a lifecycle perspective. This leads to biogas being equated with natural gas and its actual climate benefit being ignored. There is a risk that the same thing will happen with heavy goods transport.

Need for clear rules and policy instruments on hydrogen

The absence of clear rules and policy instruments on the production, distribution and use of hydrogen of various origins poses an obstacle to a growing hydrogen market. There are no clear definitions of hydrogen with different origins. EU law and Swedish law need to be developed in terms of policy instruments and regulation.

Targets and milestones

- 2020 ▶ Roadmap launched.
- 2023 ▶ All vehicle gas in gas form fossil free.
- 2030 ▶ Liquefied gas in vehicles reduces greenhouse gas emissions by an average 70-90 % compared with fossil petrol and diesel.
- 2030 ▶ All energy gases in the electricity and heating sector are completely fossil free.
- 2045 ▶ All energy gases used in Sweden are completely fossil free. Potential for production of renewable gas realised.



- Domestic biogas production 2020
- Planned increase in production 2021-2023

The production target in line with the Biogas market inquiry is 10 TWh. The Inquiry judges that there is technical potential to produce at least 30-37 TWh of biogas in Sweden by as early as 2030.

Source: Swedish Energy Agency and the Swedish Gas Association..



Heating sector

Background

The heating sector contributes a reliable heating and cooling supply to society and makes up a large proportion of the energy market. The heating sector uses approximately 100 TWh, half of which is district heating and half individual and small-scale heating. Direct emissions from district heating and own heating of homes and premises amounted to just under 3 Mtonnes CO₂ equivalents in 2019.

Previously characterised by a major dependence on oil, heating is currently dominated by district heating, heat pumps, electric heating and biofuel. The sector has already largely phased out the use of fossil fuel and is well placed to contribute negative emissions within a few years.

To implement the roadmap, the industry is mainly working on

- **measures to reduce the energy and power needs of buildings.**
- **broad-based measures along the entire value chain to reduce the amount of fossil plastic that goes to energy recovery.**
- **capture and storage of biogenic carbon dioxide so contributing negative emissions.**

The process of implementing the roadmap is run by about 30 organisations working in property management, district heating and heat pumps in a collaborative platform for exchanging experiences, read more at www.fardplanvarme.se.

“Several development and pilot projects in bio-CCS are in progress in the district heating sector. A pilot plant came on stream in 2019.

Progress since the roadmap was launched

Rapid phase-out of fossil fuels

80 percent of property owners have already phased out all local use of fossil fuels. Several district heating companies have also completed this process and many are looking to phase out fossil fuels completely in the next few years. The small volumes that remain today in the district heating sector (1% of input energy in 2020) are mainly used as back-up on extremely cold days, as starter fuel and in other rare operation cases.

Greater focus on reducing plastic in energy recovery

The issue of plastic is now high on the agenda among energy and energy recovery companies, municipalities and property owners. New sorting facilities for removing plastic are being built at locations including Stockholm and Motala. Another example is the property company for universities and colleges, Akademiska Hus which now includes the issue of using less plastic and insisting on recycled plastic in its partnership agreements with tenants.

The district heating sector has made great strides towards negative emissions

Bio-CCS can produce major negative emissions and several development and pilot projects are in progress in the district heating sector. Stockholm Exergi is one of the companies focusing on bio-CCS. A pilot plant came on stream in 2019. The aim is to take investment decisions on a full-scale facility in 2022 and to capture the first kilo of carbon dioxide for storage in 2025.

Industry challenges

Incentives for negative emissions

If the heating sector is to be able to provide a carbon sink, incentives are needed for “negative emissions” in the short and the long term. Major investments in, and financial support for, bio-CCS will be needed to make the technology competitive and established. In the longer term, there must be market-driven demand.

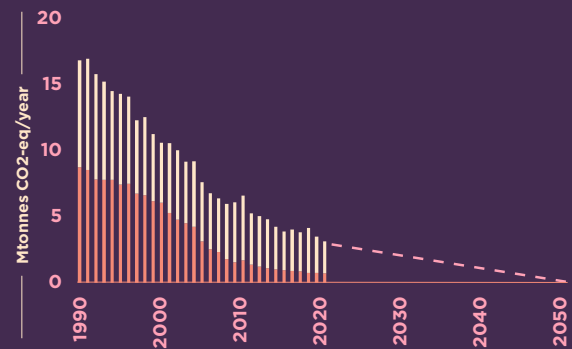
Everyone needs to help reduce plastic

Measures at the sorting stage and differentiated reception fees at incineration plants do not go far enough to reduce fossil emissions from energy recovery of waste. Other actors earlier in the material chain must do their bit by using renewable or recycled raw materials, re-use, material recycling and other measures to achieve more circular management of plastic. Initiatives must be carried out throughout the whole chain of actors from extraction to production, design, purchasing, use, sorting and waste management.

Targets and milestones

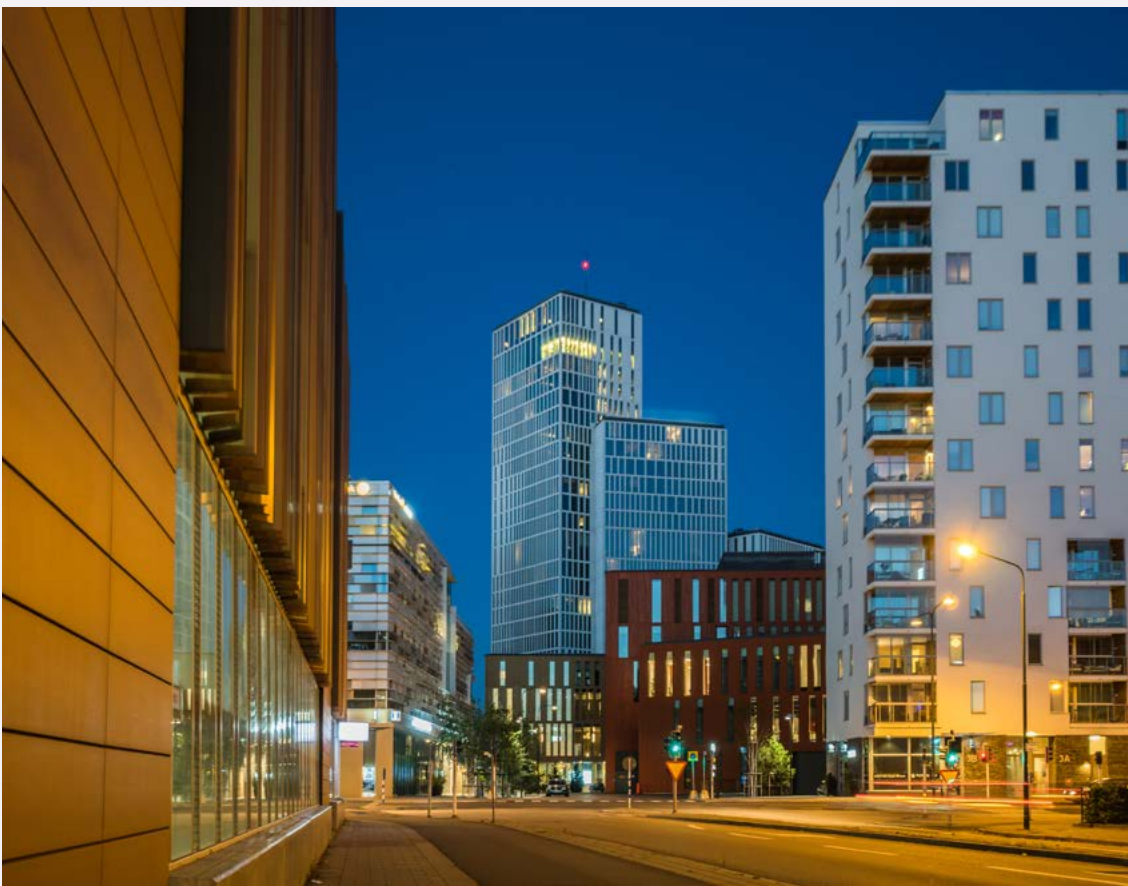
- 2019 ▶ Roadmap launched.
- 2030 ▶ Heating sector completely fossil fuel free.
- 2045 ▶ Additionally constitutes a carbon sink for society.

EMISSIONS FROM DISTRICT HEATING PRODUCTION AND PRIVATE HEATING



Source: Statistics Sweden and Swedenergy

Direct emissions of greenhouse gases from district heating production and private heating. Emissions from district heating production have developed from largely stemming from burning fossil fuels in 1990 to today mainly coming from burning plastic waste.



Heavy road haulage industry

The haulage industry plays a central role in enterprise and trade. Goods traffic, both heavy and light, emits the equivalent of about five million tonnes CO₂ equivalents a year, accounting for approximately a quarter of the emissions in the transport sector.

To implement the roadmap, the industry is working on the following priority areas:

- **Sustainable transport businesses. Haulage firms and customers working together to reduce the climate footprint of transport.**
- **Fossil-free fuel. Fuel choices adapted to the respective transport booking.**
- **Technological development. Minimising energy consumption and emissions through more efficient vehicles and technical aids.**
- **Improving transport efficiency. Carrying as large a load as possible and driving as efficiently as possible, both in terms of choice of route and driving methods.**

The Swedish Association of Road Transport Companies is responsible for the roadmap process.

” More and more haulage companies are currently switching to renewable fuel and there is also a growing interest in new technologies such as gas and electricity.

Progress since the roadmap was launched

Growing proportion of renewables

More and more haulage firms are currently switching to renewable fuel and there is also a growing interest in new technologies such as gas and electricity. Consumer-oriented businesses are often making far-reaching demands for transport with a low climate footprint. Some examples of companies ahead of the curve on the transition to fossil free operation are Ernst Express, which using HVO, RME and ED95 is now in principle fossil free, Alfredssons Transporter which was early to invest in liquid biogas, and Tommy Nordbergh åkeri, which ordered the first mass-produced electric lorry in Europe.

Heavier vehicles have cut emissions

A number of haulage companies have taken heavier goods vehicles into operation in the part of the road network that has been opened to transport with vehicles of more than 74 tonnes. This reduces the climate impact of this transport by about ten percent per transported tonne, and increases road safety due to fewer lorries on the roads.

Fair transport has been developed to become the sustainability certification for the haulage industry

All certified companies meet the requirements and criteria set to ensure that transport is responsible, road safety and climate-aware, and this is followed up on an ongoing basis via an independent third-party audit.

Industry challenges

Restrictions on heavier and longer vehicles

Using heavier vehicles of up to 74 tonnes and up

to 34.5 metres in length would facilitate more energy-efficient transport and both benefit the climate and cut costs. The current regulations do not allow such long vehicles and only a very limited part of the road network is approved for very heavy transport.

Access to competitive fossil-free fuel

Attaining the climate target for domestic transport depends on access to biofuel. Today the opportunity to fill up with fossil-free fuel is limited in much of Sweden and the tax exemption for liquid biofuel does not provide the long-term conditions required, creating uncertainty regarding future availability and inhibiting willingness to invest in new technology.

Targets and milestones

- 2018 ▶ Roadmap launched.
- 2030 ▶ 70 % lower emissions from heavy goods traffic in Sweden (compared with 2010).
- 2045 ▶ Domestic lorry transport completely fossil-free.

Electrification opportunities

Demand for electric lorries is currently limited by the high purchase price but also by the fact that at the moment there is not a sufficiently expanded charging infrastructure that meets the logistics needs of haulage firms on prioritised roads or at terminals.

Photo: Ryno Quantz



Fair Transport is the transport industry's sustainability certificate for goods transport by road.

Maritime industry

The maritime industry enables the transport of passengers and goods between continents and countries, and between regions and to islands, and thus is not only significant for Sweden's imports and exports but also the survival of the whole country. Domestic shipping emits approximately 700,000 tonnes CO₂ equivalents a year, amounting to approximately four percent of emissions from domestic transport overall.

A total energy transition is needed to achieve the targets. Historically, shipping has gone from sails and oars to coal and steam, to diesel and oil. This time ships need to go fossil free. Because ships have different characteristics and operating areas, the challenge lies in finding different solutions to ensure that all types of ship and shipping can become fossil free. The industry is working on energy efficiency, which has long been central, but more can be done. There is a need to switch fuel and for investments in adapting ships to different forms of new fuel and energy bearers.

To implement the roadmap, the industry is working on the following alternative fuels and energy sources:

- **gas (LNG/LBG and hydrogen)**
- **batteries**
- **biodiesel (e.g. HVO)**
- **methanol**
- **ammonia**
- **fossil-free electricity**

The Swedish Shipowners' Association is responsible for the process of implementing the roadmap together with the domestic shipping organisation Skärgårdsredarna and Sveriges Hamnar (Sweden's Ports).

” Several shipping lines have started to blend biogas in their gas-powered ships.

Progress since the roadmap was launched

Ordering new climate-smart ships

Members of the Swedish Shipowners' Association have ordered and taken delivery of about 50 new ships that are considerably more energy efficient than before and are adapted to run on alternative fuel and energy bearers, including biogas, batteries and methanol. Additionally, there are plans to order ships powered by sails, hydrogen, fuel cells and ammonia.

More biogas in the tank

Several shipping lines, including Destination Gotland, Furetank, Tärntank and Thunbolagen have started to blend in biogas in their gas-powered ships and are planning to gradually increase the amount in the blend. The industry is hoping for growing interest from passengers and freight customers in paying for green transport.

An emission-free port

The Tranzero Initiative is a joint venture between Stena Line, the Volvo Group, Scania, and the Port of Gothenburg which began in 2021 with the aim of reducing climate emissions in the port by 70 percent by 2030 and for transport to and from the port to be completely emission-free the same year. For Stena Line, the measure means two fossil-free ships which will sail in and out of Gothenburg. The expansion of opportunities for ships to connect to land-based power to reduce emissions from ships at the quay has also come a long way in several ports, as has electrification and the switch to fossil-free fuel in the ports' vehicle fleets.

Industry challenges

Availability of fossil-free fuel

The ability of shipping to go fossil-free depends on the availability of renewable fuel and alternative energy bearers.

Lack of charging opportunities and tax rules slow electrification

Several Swedish shipping lines have invested in battery power but a lack of access to charging in ports and archipelagos plus tax rules that disadvantage ships under 400 gross register tonnage impede the development of electrification. On top of this, several ports suffer from a shortage of power, which limits the potential for ships with major power needs for cargo handling equipment.

Targets and milestones

- 2019 ▶ Roadmap launched.
- 2030 ▶ 70 % reduction in greenhouse gases from domestic shipping compared with 2010.
- 2045 ▶ No net greenhouse gas emissions from domestic shipping.

Need to invest in research and innovation

Government investment in research and innovation in the maritime industry is marginal compared with investment in other types of transport and needs to increase. An energy transformation on the scale the shipping industry faces is likely to take greater investment if the goals of climate policy are to be attained.

Photo: Wallenius Marine



The Ocean Bird concept.

Mining and minerals industry

Today, Sweden is one of the largest mining nations in the EU with the potential to mine new critical metals and minerals that are needed for batteries, wind turbines and solar panels. The mining and minerals industry accounts for seven percent of Sweden's emissions. Pelletising, metal production and limestone and cement manufacture account for the largest proportion while a smaller proportion comes from extraction itself and transport.

To implement the roadmap, the industry is working on

- **increased electrification. Both in terms of mining itself and certain processing processes.**
- **switching to biofuel. Mainly in a transitional phase where electricity cannot (yet) be used, in transport and machinery and in some processing.**
- **Further automation and digitalisation for more efficient vehicles and more optimised use.**
- **technological development in processing. For example, using hydrogen and CCS, also addressed in the roadmaps for the steel and cement industries.**

The Swedish Association of Mines, Mineral and Metal Producers (Svemin) is coordinating the process of implementing the roadmap and several companies have drawn on it to produce roadmaps of their own. Svemin is currently updating the roadmap with a planned launch in late 2021/early 2022. Read more on their [website](#).

By 2045 fossil-free sponge iron from LKAB is expected to reduce global emissions from steel manufacturing by 35 million tonnes a year.

Progress since the roadmap was launched

Fossil-free sponge iron and extracting strategic minerals from mining waste

LKAB is transforming its operations and by 2045 will be producing fossil-free sponge iron, removing the 700,000 tonnes of CO₂ it currently produces. This is expected to reduce global emissions from steel manufacturing by 35 million tonnes a year. New technology for extracting minerals from mining waste will also enable LKAB to increase Europe's self-sufficiency in phosphorus by 50 percent and meet up to 30 percent of Europe's current needs for rare earth metals.

Ongoing electrification of mines

Kaunis Iron will be switching to fossil-free and electrified mining at its iron ore mine in Pajala by as early as 2025. Pilot tests are underway of electrical heavy goods vehicles in Arctic climates, which may cut CO₂ emissions by 15,000 tonnes a year. A pilot project for electrified trucks at Boliden copper mine in Aitik shows that greenhouse gas emissions will fall by up to 80 percent on the routes where the technology is implemented.

The world's first green copper

Boliden has launched two green copper products which have less than half the carbon footprint compared with the global average. One is from the mine in Aitik, produced using green energy, while the other is 100 percent recycled from electronics waste.

Sweden's new global standard for sustainable mining at great depth

LKAB, ABB, Combitech, Epiroc and Sandvik are developing a global standard for carbon dioxide-free, digitalised, autonomous mining at great depth in the Sustainable Underground Mining project (SUM).

Industry challenges

Long and unpredictable permit processes

Efficient and appropriate permit processes are essential to the continued competitiveness of the mining and minerals industry. Today, they are unpredictable in terms of defining what is to be included in the permit examination, the documentation required for this and how long the permit are currently in expected to take.

Access to reliable fossil-free electricity

Access to fossil-free electricity where and when it is needed at competitive prices will be crucial to the mining and minerals industry successfully going fossil free as the industry will be one of Sweden's largest users of electricity.

Global competition

Metal prices are set on a global market and much of the Swedish mining industry's production is exported outside the EU. This aspect needs to be taken into account in Swedish and EU climate legislation.

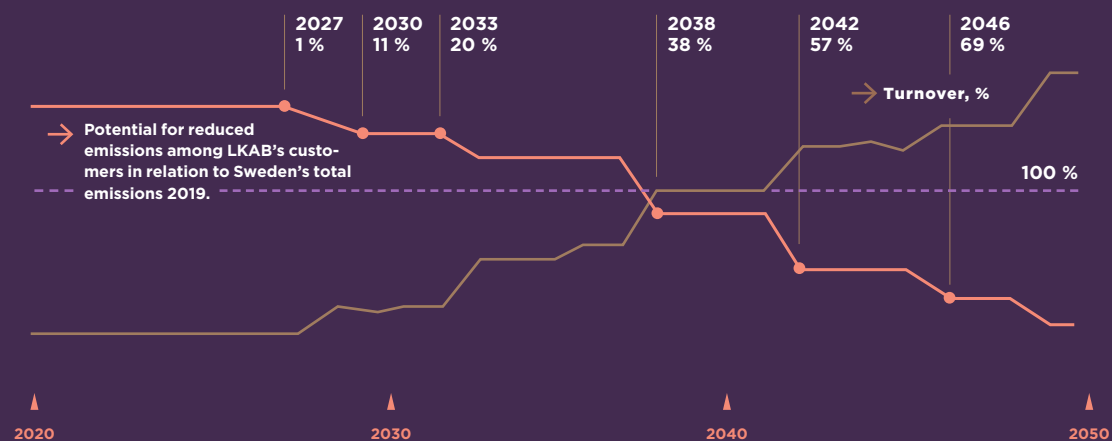
Targets and milestones

- 2018 ▶ Roadmap launched.
- 2035 ▶ Fossil free mining.
- 2045 ▶ All processing steps are climate neutral and all energy use is fossil free.



El-Trolley in Aitik. Source: Boliden

Lower CO₂ emissions and higher turnover



LKAB's switch to producing carbon dioxide-free sponge iron will open up an opportunity for LKAB's customers in the steel industry around the world to cut their emissions by a total of more than 35 million tonnes a year. At the same time, LKAB's turnover is expected to double thanks to more efficient extraction methods and higher income from a more processed product. Source: LKAB

Petroleum and biofuel industry

Carbon dioxide emissions from the processes and products in the petroleum and biofuels industry sold in Sweden amount to approximately 25 million tonnes, and approximately 50 percent of Sweden's total carbon dioxide emissions. Many of these emissions are also addressed in other roadmaps. Approximately 90 percent of CO₂ emissions come from use of the industry's products.

The starting point in the industry's roadmap is to create sustainable and innovative mobility, strengthen Swedish competitiveness and simultaneously attain the climate goals.

To implement the roadmap, the industry is working on:

- **replacing fossil fuels with renewables, both through increased inclusion of renewable fuel through the reduction obligation and by offering high-blend biofuels and electric charging.**
- **capturing CO₂ via CCS, and using the captured CO₂ in circular processes through CCU.**
- **researching all sustainable solutions and developing the innovative and sustainable mobility solutions and meeting places of the future for all means of transport based on market demand.**

Drivkraft Sverige is responsible for following up the industry's roadmap and publishes regular updates under the heading "Roadmap facts" (only in Swedish) at www.drivkraftsverige.se.

Progress since the roadmap was launched

The reduction obligation - an effective policy instrument

The reduction obligation was increased to 26 percent for diesel and 6 percent for petrol in August 2021. At that time E10 was introduced as a new petrol option. Drivkraft Sverige estimates that the reduction in carbon dioxide emissions amounts to approximately 230,000 tonnes a year if all cars able to drive on E10 do so.

Research and development of sustainable products and biofuel

The industry carries out research and development to enable it to offer biofuel from an increasing number of sustainable raw materials. Several companies have reached the commercial testing stage in developing renewable bio-petrol. Bio-petrol reduces greenhouse gas emissions by approximately 65 percent compared with ordinary petrol. The industry has also made a decision to put additional investment into HVO production covering a million cubic metres. Some companies have also developed and further improved the efficiency of carbon capture from production.

Expansion of charging infrastructure

The expansion of charging infrastructure across Sweden has gradually increased on the part of all fuel distributors. Superfast charging and charge-at-home packages are offered by several actors in the industry, often together with various partners.

” Drivkraft Sverige estimates that the reduction in CO₂ emissions amounts to approximately 230,000 tonnes a year if all cars able to drive on E10 do so.

Industry challenges

EU proposals make investing in biofuel more difficult

The view of biofuel in the EU risks limiting opportunities to invest in, develop and distribute renewable biofuel. During the year, the European Commission's proposed taxonomy for what is to be considered sustainable was presented, omitting raw materials from crops and forests. At the same time, the European Commission's proposal to review the renewability Directive, RED so as to too strictly narrow the raw material base for renewable, sustainable fuel, which poses obstacles to long-term investment.

Lack of political clarity

Although today biofuel is mainly used on the roads, in the

Targets and milestones

- 2020 ▶ Roadmap launched.
- 2030 ▶ CO₂ emissions will be reduced by 70 % compared with 2010.
- 2030 ▶ Industry's own operations in the form of stations and depots to be climate neutral. This also includes renewable electricity production.
- 2045 ▶ Climate-neutral competitiveness achieved.

future biofuel will be needed for heavy transport, machinery, aviation and the maritime industry. In Sweden and the EU there is a lack of a clear political direction as to the aims for biofuel after 2030, which creates obstacles to investment in renewable fuel in Sweden.



Recycling sector

The recycling sector's roadmap for a fossil-free and circular economy both addresses the recycling companies' own journey to becoming fossil free and how greater use of recycled materials can enable other operations to reduce their own emissions.

Only the material recycling of steel, aluminium, plastic, paper and glass reduce greenhouse gas emissions by more than 7 million tonnes a year. Because the majority of climate emissions from the production and the consumption stages are caused by linear material streams, there is great potential to reduce emissions through increased recycling. In the EU, more than 60 percent of emissions from the steel, chemicals and cement industries could be eliminated with the help of increased material efficiency and circular business models.

To implement the roadmap, the industry is working on

- **reducing the use of fossil fuel in transport and in treatment processes, instead switching to electricity or biofuel.**
- **encouraging more companies and procurement to use recycled materials instead of new.**
- **developing and investing in new recycling technologies.**
- **actively contributing to the development of new circular standards and regulations.**

The Industry Organisation for Private Recycling Companies in Sweden, Återvinningsindustrierna, is responsible for the process of implementing the roadmap by, among other things, producing data for industry-wide climate calculations that form the basis for future action.

” **The demand for recycled content in procurement is key in the transition to a fossil-free, circular economy.**

Progress since the roadmap was launched

New platform for climate-adapted and circular procurement

Clear environmental criteria in procurement is key in the transition to a fossil-free and circular economy. For this reason, Återvinningsindustrierna, IVL and the innovation programme Re:Source have launched a website for public procurement in an lifecycle perspective that provides support when drawing up procurement criteria.

Partnerships to increase recycling and use of recycled material

Återvinningsindustrierna's members have been involved in a number of different research and collaboration projects for increased recycling since the roadmap was launched. Several investments in new technology for sorting, recycling and using recycled materials have been made in the past year, as have partnerships with manufacturing companies to increase the recycling rate of products. Some examples of partnerships:

- **Renewcell is building a plant in Sundsvall using technology unique in the world for recycling textiles. The plant is expected to come on stream in the first half of 2022 and will be able to take 60,000 tonnes of textile waste annually.**
- **Ragn-Sells is building the Ash2Salt plant in Högbytorp, making it the only actor in the world capable of recovering commercial salts from fly ash. Operation is estimated to begin in summer 2022.**
- **Stena Recycling is working in partnership with Borealis, Sweden's first plastic refinery to chemically recycle plastic streams that cannot be**

recycle mechanically. The plant is expected to commence operation in 2024.

- Van Werven has built Sweden's largest facility for recycling hard plastic material. The plant in Sexdrega was completed in July 2021 with a capacity of 45,000 tonnes.
- Batteryloop has created a circular system in which batteries from electric vehicles are re-used as energy storage.

Industry challenges

No incentives to use recycled materials

There are currently no incentives to increase the proportion of recycled materials in new products. Without formal requirements from the EU or national level, the transition to a circular economy will move slowly because in many cases, virgin raw materials are still cheapest.

Targets and milestones

- 2020 ▶ Roadmap launched.
- 2025 ▶ 30 % reduction in greenhouse gas emissions compared with 2015.
- 2030 ▶ 50 % reduction in greenhouse gas emissions compared with 2015.
- 2040 ▶ Net zero greenhouse gas emissions.

Shortage of fossil-free vehicles and fuel

In many cases, there is still a lack of electric vehicles that are adapted to the needs of the recycling industry, and economically competitive compared with conventional vehicles. The same is true of access to renewable fuel for vehicles and machinery that cannot be electrified, and renewable fuel for some material recycle processes.



Ski resort sector

Ski resorts are part of the tourism industry and the economic engine in many communities, especially in sparsely populated areas. Between 2018 and 2020, the calculated greenhouse gas emissions from core activities (operating lifts and pistes) fell by 38 percent, from 12,000 to 7,500 tonnes of CO₂ equivalents, as a result of switching to renewable fuel. The greatest climate impact comes from tourists' journeys to and from the resorts, and the sector is working to make it easier for journeys to become fossil free.

To implement the roadmap, the industry is working on

- **continued investments in biofuel.**
- **introducing electric snowmobiles.**
- **greater awareness in procurement and purchasing, e.g. electricity contracts.**
- **recycling materials, spare parts, etc.**
- **charging infrastructure for journeys and encouraging public transport.**

The Swedish ski areas industry association, SLAO, is responsible for the process of implementing the roadmap. They have produced an industry-wide reporting and evaluation system aimed at obtaining concrete measurement figures for goals, priorities and follow-up for individual members and the industry as a whole.

“ Since 2018, emissions from the core operations of Sweden's 200 ski resorts have fallen by 38 %.

Progress since the roadmap was launched

Increased use of biofuel in snow groomers

Since 2018, emissions from the core operations of Sweden's 200 ski resorts have fallen by 38 percent, a reduction that has continued in 2021, mainly due to more resorts switching to biodiesel in their snow groomers. Hydrogen-powered snow groomers are also being tested in the Alps.

Electrification reaching the slopes

The first completely electric snow groomer was tested in Sweden. The first electric snowmobiles are now being tested at Swedish ski resorts and more have been ordered and are under production. The schedule has been delayed somewhat by the pandemic but it is hoped that more will be in place for the winter season 2021/2022.

More efficient snow management

Research and exchanging experiences of snow storage and snow manufacture are in progress. Technology is developing fast, with the focus on resource efficiency. The issues include measuring snow depth, better snow manufacturing systems and snow storage that means snow can be saved from year to year.

Work on charging infrastructure in progress

In 2021, the Swedish Transport Administration awarded a number of grants for public rapid charging points along the mountain chain in inland Norrland. Many ski resorts are supplementing this with chargers for their guests and at eight of the largest ski resorts, the number of charging points is increasing this year from 86 to 209.

Digital training package launched

In autumn 2021 all Swedish ski resorts will be able to access training courses on sustainability tailored to the sector. Several of the major ski resorts will be running these for all their staff.

Industry challenges

Charging infrastructure to and in ski resorts

Electrification of transport is utterly crucial to shrink the climate footprint from tourists' travel. However, the charging infrastructure is lagging behind in the sparsely populated areas in which many ski resorts are located. The issue that traffic flow and visitor frequency are unevenly distributed over the year poses a particular challenge.

Targets and milestones

- 2020 ▶ Roadmap launched.
- 2022 ▶ 100 % renewable electricity for ski-lifts and snow manufacture.
- 2025 ▶ 100 % fossil-free operation of snow groomers.
- 2027 ▶ Fossil-free operation of ski resorts.

Public transport and more overnight trains

Because there is a lack of rail infrastructure to many of the ski resorts and access to public transport is often limited, guests are often dependent on cars at their destinations. Local public transport is crucial to being able to offer public transport to ski resorts and local ski slopes in sparsely populated areas and local communities. For visitors travelling long distances, the frequency of trains and investments in track to Sweden's mountain regions is pivotal.

Photo Jens Elixth



GPS systems in snow groomers enable snow optimisation so it is laid where it is needed best.

Steel industry

Swedish steel products have a low climate footprint in international terms and efficient, climate-smart steel products contribute towards lower material consumption, longer lifetimes, less wear and improved energy efficiency. Carbon dioxide emissions from the Swedish iron and steel industry are approximately 6 Mtonnes/year. The highest proportion, approximately 85 percent, arises from the reduction of iron ore to form iron using coal. Other emissions come from the use of fuel for heating and heat treatment plus a smaller proportion from raw materials.

To implement the roadmap, the industry is working on:

- **Transitioning to reducing ore using hydrogen**
- **Using bio-coal for some reduction and as an alloying element**
- **Electrifying furnaces and using bio-based gas or hydrogen as fuel**

The Swedish Steel Producers' Association, Jernkontoret, is coordinating the follow-up of the roadmap and has launched the climate research project Samforsk klimat. Its aim is to coordinate and support the research, innovation and development initiatives needed to implement the measures prioritised in the roadmap. An initial follow-up of the roadmap was carried out in 2020, read more on their [website](#).

” In October, Volvo presented the world's first vehicle made from HYBRIT's fossil-free steel.

Progress since the roadmap was launched

Using hydrogen for iron ore reduction

Progress is being made in developing the new process technology to use hydrogen to reduce iron ore to iron. The pilot plant for producing sponge iron in Luleå started operation in 2020 and in parallel, preparations are being made to replace the blast furnace at SSAB in Oxelösund with an electric arc furnace to enable iron and waste reduced using hydrogen to be smelted in 2026. The first sponge iron has been further processed and in October, Volvo presented the world's first vehicle made from fossil-free steel from HYBRIT's pilot. Interest in manufacturing steel using hydrogen has grown and in Boden, H2 Green Steel is planning a completely new steelworks.

Replacing fossil fuel with electrification and hydrogen

In recent years, several steel companies have electrified their heating and heat treatment furnaces. Ovako has successfully electrified five furnaces and has also run trials of hydrogen as a fuel.

Biocoal replacing fossil coal

Höganäs AB has successfully tested bio-coal, made via pyrolysis of biomass, as the alloying element and process reagent in the scrap smelting process. Bio-coal could also replace fossil coal in the process of reducing iron ore in powder manufacture. This would require bio-coal that is adapted to the processes in terms of durability and reactivity.

Industry challenges

Ineffective permit processes for investing in new technology

Investments must be made in both new and existing

technology coordinated with the companies' investment cycles. More efficient permit processes are therefore crucial if measures to reduce emissions are to be implemented. To achieve this, industry and government agencies need to work together for an effective process for sustainable growth.

Access to fossil-free electricity and bio-based fuels

Measures to cut emissions in iron and steel production are leading to an increased need for electricity of between 20 and 60 TWh. This makes great demands for higher production and transfer capacity in the electricity system and for this to be achieved cost-effectively with security of supply. The need for bio-based raw materials and fuels is also growing but uncertainty about future access risks slowing development.

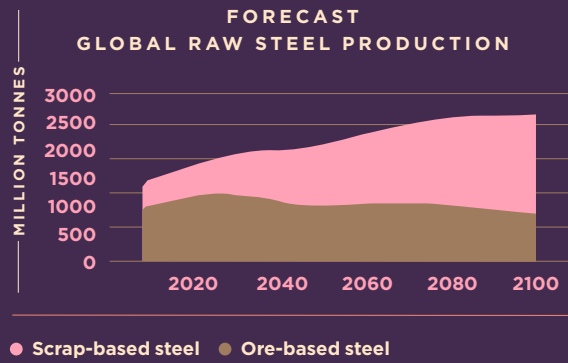
Competitiveness on a global market

Competition is tough on the global steel market but there are major differences in terms of climate requirements. Therefore, it is important that national and European regulations create a playing field that supports the companies' opportunities to invest in new technology during the transitional period.

Targets and milestones

2018 ▶ Roadmap launched.

2045 ▶ Fossil-free steel production.



Source: Paulik et al (2013), The steel scrap age.

Steel is 100 % recyclable but steel products have a long lifetime and the world's need for steel is growing. Therefore both ore and scrap will be needed for steel manufacturing for the rest of this century.



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