Roadmap for fossil free competitiveness Summaries 2018–2020



»The roadmaps demonstrate a change of mindset that has taken place in many parts of the business world in recent years, where reducing greenhouse gas emissions is no longer considered a burden; instead, it is a natural step towards strengthening competitiveness.«

National coordinator, Fossil Free Sweden

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Foreword

After a year burdoned by crises the world is in need of an economic restart. That is why it is immensly rewarding to be able to present a report in which 22 different business sectors show how Sweden's competitiveness can be increased by becoming fossil-free or climate neutral by 2045.

But what do reduced emissions in Sweden matter when global emissions continue to increase? The reasons for not decreasing emissions seem to be that many countries are more afraid of societal change than climate change. They are more afraid of the medicine than the disease. Sweden and the EU are reversing this logic and are seeing the business advantages of going first in a change that all countries ultimately need to go through. The European Commission wants to make Europe the first climate neutral continent and Sweden wants to become the world's first fossil-free welfare country. If Sweden and other countries can demonstrate a positive link between going fossil free and a country's prosperity there may eventually be a rush to exit the fossil economy. The roadmaps give hope that such development is possible.

The roadmaps show that if the politicians provide the right conditions the business sectors are able and willing to make the transition to become fossil free. This is unique! Sweden is the first country in the world where industry sectors voluntarily show how to become fossil-free already in 2045, while at the same time strengthening their competitiveness. And that's not all. They want to accelerate the pace of climate change adaptation through faster decision-making processes that make it possible to meet the growing climate market and to reach the Swedish climate target of net zero greenhouse gas emissions by 2045.

The role of Fossil Free Sweden in developing Sweden into the world's first fossil-free welfare nation is to strengthen interaction between business and politics so that the pace of climate action can increase. Through interaction, our small export-dependent country in northernmost Europe has the potential to compete globally. That capacity is one of our comparative advantages in a globally open economy.

The demand from the business community for a faster transition creates in itself unique opportunities for policymakers to take courageous and necessary decisions. Not all countries have such a cheering section, which also makes it easier for political parties in the Swedish parliament to agree.

»If Sweden and other countries can demonstrate a positive link between going fossil free and a country's prosperity there may eventually be a rush to exit the fossil economy.«

The challenge now is to get the pieces of the 22-roadmap puzzle to fall into place. As yet they do not. The solutions presented for becoming fossil free are primarily energy efficiency and replacing fossil fuels with electricity and biofuels. However, when Fossil Free Sweden adds up the need for bioresources in the various roadmaps, forests and agriculture are not sufficient. In the case of electricity, it is not so much the amount of electricity as the need to rapidly increase grid capacity and cut peak loads that are the bottleneck.

The homework for the politicians is to implement policies that generally reduce risks for investors. In the first instance, it is a matter of establishing long-term cross-party objectives, but also direct investment support. The economic incentives for becoming fossil free should be reinforced by introducing a green tax reform and ensuring that public procurement imposes high requirements for fossil-free services and goods. In addition, permit processes need to be speeded up in order to allow industry to achieve its objectives in time.

In conclusion, Sweden now has a unique opportunity to demonstrate to the world how welfare can improve while going fossil free. Cross-party shared climate objectives, a business sector that through its roadmaps shows that it is willing and able, trade unions that in all essentials are behind the vision of green industrialism and strong domestic opinion for accelerating climate transition create unique conditions for Sweden to be a permanent showcase to the world of new technologies.

FOSSIL FREE SWEDEN

The Riksdag (Swedish Parliament) adopted a climate policy framework consisting of a Climate Act and the goal that Sweden should have zero net emissions by 2045. To support this goal and hasten the work in different parts of society in 2015 the Government took the initiative of setting up Fossil Free Sweden. The Fossil Free Sweden initiative, led by a National Coordinator, is tasked with being a link between Government and business, municipalities, regions and organisations. The Coordinator is responsible for identifying and removing the obstacles to faster transition.



Svante Axelsson National coordinator, Fossil Free Sweden

Method

The Swedish Parliament has set the goal of zero net emissions of greenhouse gas by 2045. The Fossil Free Sweden initiative was launched by the Government to gather and accelerate the climate efforts being made in the business sector, municipalities and regions. The initiative operates through a small team led by a National Coordinator and has an independent status towards the Government The mission is to speed up climate action in industry and push the Government to remove obstacles that could slow the transformation.

»The process could be described as bottom-up and sector-led with broad participation and legitimacy in the respective sector.«

In 2017 Fossil Free Sweden initiated a programme to cooperate with business and industry sectors to develop their own roadmaps for fossil free competitiveness. The purpose of the roadmap process has been to support business and industry sectors in employing a new tonality in which the business community dares to declare its willingness and ability to be fossil free, provided that the politicians creates the right conditions. The process could be described as bottom-up and sector-led with broad participation and legitimacy in the respective sector.

Fossil Free Sweden has drawn up a framework for the content of the roadmaps, but the sectors themselves have led the process by gathering their sector together, producing the content and securing support for the work. In most sectors it is the industry organisations that have led the work.

A clear objective for the roadmaps has been that the

sector should start from where it is today, so that the roadmap is realistic from day one. The focus has been on the sectors' own measures and on enabling policy, which have been obligatory parts. There has also been a major focus on broad inclusion, both within and outside the specific sector.

The sectors were encouraged by Fossil Free Sweden to have transparent and open processes with several open workshops in which a wide range of actors could give their input. In that way more people could embrace the subsequent outcome, while other actors were also involved to enable them to take their responsibility in implementation.

THE IMPORTANCE OF AN ENABLING INSTITUTION WITH A MANDATE

With the Government's mandate and remit, while not being a part of Government, Fossil Free Sweden has been independent, with a clear purpose and role that has been important in achieving commitment to the roadmap process.

Fossil Free Sweden has also played an important part in the process as policy adviser with an overview of many business and industry sectors, knowledge of ongoing processes and understanding of the priorities and plans of the Government and state authorities. Thus Fossil Free Sweden's role has been to coach the industry and business sectors to formulate specific industry actions and policy proposals.

Fossil Free Sweden has also offered a new type of leadership in climate change mitigation. The activities and rhetoric are clearly focused on opportunities which has helped the sectors to create commitment from the companies within their own industries and to open up for constructive dialogues with other actors. Through Fossil Free Sweden new relations have been forged, both between sectors and between sectors and decision-makers.

DRIVERS FOR SECTORS TO IMPLEMENT A ROADMAP TOGETHER WITH FOSSIL FREE SWEDEN

An attractive part of the roadmap work for the industry and transport sectors was to be part of a greater narrative on how Sweden can be climate neutral by 2045. Showing why they are an important part of a future society and how profitability can grow through being fossil free has been a major driver for many sectors as they see the change coming.

Conscious and active communication of what the business and industry sectors are willing and able to do has been a clear motive for the decision of many of them to prepare a roadmap together with Fossil Free Sweden. Partly to communicate about the role of the sector in society and partly to form opinion to influence politicians to implement the policy envisaged by the roadmaps. Internal communication within a sector has also been a motivation for preparing a roadmap. Creating an inclusive working relationship within the industry organisation raises the minimum level of knowledge about the solutions and opportunities that exist.

Most sectors have also seen a need to address the increased demand for climate smart products and services that has already started, and that is expected to increase even more when all countries and industries must live up to the Paris Agreement. As an employer, attracting skilled staff is a challenge that is raised in many roadmaps and that drives the sector not only to discuss sustainability but also to create a sustainable business model that attracts students and other talent.

OUTCOME

The roadmaps show the opportunities and they pinpoint critical areas where reforms are needed to speed up the process. For the Government the roadmaps offer insight into the role that businesses and industry are willing to play. With that support brave decisions can be encouraged.

The result of the approach and methodology offered by Fossil Free Sweden is that a broad mass of companies has realised the value of becoming fossil-free and taken some steps in that direction. It has also led to common sectoral objectives and a minimum level for companies in a sector to relate to. Thanks to the clear sectoral ownership, the expectation is that it is up to each sector to implement its roadmap, provided that the Government carries out its part of the plan.

Swedish territorial greenhouse gas emissions

The long-term target for Sweden is zero net greenhouse gas emissions by 2045 at the latest. After 2045 Sweden is to achieve negative net emissions. Achieving zero net emissions of greenhouse gases means that the emissions of greenhouse gases from activities in Sweden shall be at least 85 per cent lower in 2045 compared to 1990. The remaining reductions down to zero can be achieved through supplementary measures in Sweden or in other countries.

»The roadmaps within Fossil Free Sweden cover more than 70 percent of the emissions in Sweden.«

The Swedish greenhouse gas emissions in 2018 was 52 million tonnes of carbon dioxide equivalents, whereof one third stem from the industry and one third from domestic transport.

The diagram to the right shows the Swedish territorial greenhouse gas emissions 2018. The 22 roadmaps for fossil free competitiveness presented in this report cover about 70 percent of these emissions. Several industries are closely coupled since they are included in each other's value chains, for example electricity, fuel and road haulage sectors that provide services to several industries.

EXAMPLES OF TARGETS PRESENTED IN THE ROADMAPS

The business sectors own their respective roadmaps and are responsible for the visions, goals, obstacles and solutions described. The roadmap processes have been managed by sector associations or companies. Here are some examples of targets and intentions presented in the roadmaps.

The aviation industry

All domestic flights will be fossil free 2030 and all flights originating from Sweden are fossil free 2045.

The concrete industry

Climate-neutral concrete available on the market 2030 and all concrete climate neutral 2045.

The construction industry

50 percent reduction in greenhouse gas emissions (cf. 2015) 2030, 75 percent reduction in greenhouse gas emissions (cf. 2015) 2040 and net zero greenhouse gas emissions 2045.

The gas industry

All gaseous vehicle fuels will be fossil free 2023, all energy gases in the electricity generation and heating sectors will be completely fossil free 2030 and all energy gases used in Sweden will be completely fossil free by 2045 at the latest.

The heating sector

Completely fossil fuel free heating sector in 2030 and, in addition, to be climate-positive in 2045.

The mining and minerals industry

Swedish mining industry is aiming at having the first fossil free mine before 2035.

The petroleum and biofuel industry

Invest in, develop, produce and distribute fuels demanded to meet the target for the transport sector to reduce the green house gas emissions by 70 percent by 2030 and reach climate neutrality by 2045 at the latest.

Swedish territorial greenhouse gas emissions in percent 2018



Roadmaps in industry covered by emissions from other industries:

• Aggregates industry

- Food retail sector
- Concrete industry
- Gas industry
- Construction and civil engineering sector
- Digitalisation consultancy industry
- Ski resort sector
- Source: Naturvårdsverket, 2020

25 april 2018 Submission of roadmaps to the Minister for Enterprise and Innovation MIKAEL DAMBERG and Deputy Prime Minister and Minister for Climate ISABELLA LÖVIN.

Aviation industry Cement industry Concrete industry Construction and civil engineering sector Food retail sector Forest sector Heavy road haulage Mining and minerals industry Steel industry

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The aviation industry

Summary of roadmap for fossil free competitiveness - Aviation

CURRENT SITUATION AND EMISSIONS TODAY

One of the prerequisites for national and regional competitiveness is that distances can be covered within an acceptable period of time. Air transport is, and will continue to be, the mode of transport that provides longrange accessibility with reasonable travel times.

Globally, aviation emissions of carbon dioxide account for around two percent of the world's carbon dioxide emissions. In Sweden, aviation emissions of carbon dioxide, domestic and international, account for around five percent of Sweden's total carbon dioxide output. In common with all other industries, emissions need to be reduced.

One of the solutions is that the aviation industry contributes to a fossil free future by switching to an alternative fuel. When fossil free fuel is produced, distributed and demanded in sufficient volumes, aviation can make a major contribution to the attainment of national and global climate goals. At the same time, a comprehensive improvement of energy efficiency and increased electrification are required, which contribute to limiting the demand for fuel regardless of its source. Domestic flights require approx. 200 000 m3 biofuel and international flights approx. 1 million m3, in other words approx. 2 and 10 TWh respectively.

The technology is available for producing fossil free fuel that can be used straight away in today's aircraft engines without the need for any technical modifications. But the limitations are largely due to the fact that there is currently no functioning market.

A transition to fossil free fuel within the aviation industry would have the effect of reducing aviation's climate impact, while also providing the opportunity to create more jobs in existing and new green industries. If Sweden leads the way in this development, many others will follow and the solutions would have the potential to drive a global transition.

THE NEED FOR A MARKET

The Government notes that the additional costs of fossil free fuel for aviation are high and that the incentives for airlines to demand biofuels are therefore low. In order for the aviation industry to contribute to the Government's goal of a fossil free future, an increase in fossil free fuel production is crucial. This requires a functioning market.

The market for fossil free fuel could be created by the aviation industry committing itself to buying a specific volume, although this is impossible at the moment as the cost is unknown. The producers are faced with a similar challenge, not knowing if they can get a return on their investments and therefore not daring to invest. Solving this dilemma is key. We must therefore find a model that creates a market where various parties are initially involved, sharing the risk as well as the difference in price between fossil and fossil free fuels.

These initiatives will mainly be at industrial and political levels. This means that lead times can be reasonably short and that the aviation industry can contribute considerably to a fossil free future with a relatively fast transition.

The strategic objective for 2030 is that all domestic flights are fossil free. For 2045 the strategic objective is that all flights originating from Sweden are fossil free. This is in line with the Government's goals.

OBSTACLES/CHALLENGES ON THE WAY

The roadmap identifies three main obstacles which need to be overcome in order to facilitate the transition. These relate to economic incentives and terms, commodity availability, prioritisation and competition, and political will, coherence and regulation. Common to all these areas is



the necessity for all stakeholders to play an active role in the creation and development of a fossil free aviation market, thus enabling Sweden to realise its objectives.

Economic incentives and conditions will need to be implemented if the volumes of fossil free fuel required to achieve the two strategic objectives are to be produced. Production of these volumes in a commercially viable setting requires a number of actions. The price gap between fossil and fossil free fuels is a strong deterrent to any would-be purchaser of the latter. Furthermore, insufficient evidence of its commercial viability has a negative effect on the availability of risk capital. Policy instruments are therefore necessary if a transition is to be made possible.

Commodity supply and prioritisation are needed to facilitate adequate access to biomass, especially if production is to be carried out locally. Political clarity is required to ensure long-term access to the relevant biomass. The necessary investments in more production facilities will not be made as long as the uncertainty surrounding the commercial viability and future remains.

Political will, coherence and regulation are necessary to enable a clear, long-term political plan detailing the way in which different industries, including aviation, should move from fossil to fossil free fuels. In order for investments to be made in Sweden, the market needs to know that a long-term demand exists. This requires clear political will, stable rules and clear objectives.

THREE SELECTED PROPOSALS FOR THE REMOVAL OF OBSTACLES

The roadmap identifies that the state has the ability to contribute to the creation of a market through a series of actions. Three of these are:

- The state should promptly decide on the direction of state aid for investment. Production capacity to provide the aviation industry with fuel required to attain the 2030 objective requires an investment of around SEK 5 billion.
- The state should formulate and communicate a public strategic objective for the transition to fossil free aviation, with the milestones 2030 and 2045, including a long-term goal of electric aviation.

• The state should conduct a public tender for the provision of the amount of fossil free fuel required for public sector air travel in Sweden.

Moreover, the roadmap identifies what opportunities the manufacturing and aviation industries have in terms of contributing to the creation of a functioning market for fossil free aviation.

Making a whole industry fossil free involves many players and value chains. The roadmap has been drawn up in a limited time and in a limited format. There are therefore aspects that need to be investigated more closely. However, the roadmap has taken as its starting point what can be done in a relatively short period of time to bring about a change. A primary conclusion is that if the market can be created, many of the conditions are already in place for a transition to fossil free aviation – a process in which Sweden can and should play a leading role.

- Swedavia carried out a procurement of biojet fuel with three external actors. The procurement will enable these companies to fly fossil-free.
- BRA performed the Perfect Flight, demonstrating that fossil CO2 emissions can be reduced by 46 per cent through a variety of measures available with today's technology.
- The Inquiry report on the obligation to reduce emissions was presented and received positive consultation responses, so now the industry is awaiting the Government Bill for the start in 2021.
- SAS and Airbus launched a partnership to develop an hybrid electric aircraft to be put into operation in 2030.
- Heart Aerospace in Gothenburg started the development of ES-19, which is an electric powered aircraft for 19 passengers with a range of 400 km.

The cement industry

Summary of roadmap for fossil free cement

POPULATION GROWTH AND DEMAND FOR CONSTRUCTION MATERIALS

The world is facing a decisive challenge: to limit global warming to a maximum of two degrees Celsius while at the same time mankind should have an effective, secure welfare system.

By the year 2050, the global population is expected to have increased from the current level of 7.6 billion to almost 10 billion. Twice as many people are expected to be living in metropolitan regions. This means that we need sustainable, robust and functional construction materials with a long service life. We must build in a resource-efficient, long-term way, recycle construction materials and convert to sustainable manufacturing processes for construction materials.

Agenda 2030 and the UN's Sustainable Development Goals state that we must be able to manage all of the sustainability challenges that we face. Society having access to sustainable concrete products plays a decisive role in our ability to achieve these goals.

ZERO NET EMISSIONS FOR SWEDEN IN 2045

Sweden has an ambition of zero net emissions by 2045. At the same time, the current population of 10 million is expected to grow to just over 12 million by that date. Metropolitan regions become more densely populated and there will be a major need for housing and infrastructure. The way we deal with the climate challenge in Sweden has good prospects of having a global impact.

CEMENT FOR CLIMATE-NEUTRAL CONCRETE

Concrete is and will be decisive in the building of a climate-safe, sustainable Sweden of the future. Limebased cement will continue to be the main binding agent for the foreseeable future. If the built environment is to be sustainable, we must find a way to produce cement for climate-neutral concrete.

This roadmap links in with the roadmaps of concrete industry, the construction sector and the mining industry.

OUR CALL TO ACTION

If we are to work together to achieve climate neutrality by 2045 – and at the same time secure a high level of welfare in Sweden through strong industrial production – a conversion is required. We have identified a number of measures that are crucial for climate-neutral cement and concrete production and a climate-neutral built environment.

• A sustainable built environment requires a life cycle analysis

Investments in housing and infrastructure must take place with a long time horizon. Design and material selection need to be informed by scientific life cycle analyses. Avoid special municipal demands on construction and adopt instead a national approach for climate requirements in order to support the right choice of materials, the resource-efficient use of materials and continued efficiency improvement in the construction sector.

Sustainability requirements in public procurement

Make greater use of sustainability requirements in public procurement in order to drive demand and the availability of sustainable solutions in the whole built environment sector. This is key. Around one third of the cement produced and used in Sweden is currently procured indirectly using the requirements specified by the Swedish Transport Administration. Public actors need stronger ordering competence when it comes to climate impact and life cycle analysis.

• Support the transition to biofuels Develop instruments to support a faster transition to biofuels in industrial production. In this respect we in Sweden can make better use of residual products from forestry. At the same time we must guarantee sustainable forestry and protect wetlands and biodiversity. Biomass from the forest should be used primarily for highly processed products and in areas where there are no alternatives.

• Emission rights trading

Trading in emission rights should continue to be the main instrument to reduce carbon emissions in cement production. This system results in gradual improvements. Major technology shifts require supplementary and supporting instruments.



CEMENT INDUSTRY

• Carbon capture – public initiatives for research and development

Targeted, long-term public initiatives are required in order to support the highly competitive process industry as it strives to achieve greater technological advances in the field of low-carbon technology. For the cement industry, this primarily means the development of efficient, commercially available carbon capture technology. Significant initiatives will be required in research, development and demonstration.

• Create commercial solutions to utilise and store carbon dioxide

To prevent process emissions from industry from being released into the atmosphere, there is a need to develop commercial and large-scale solutions to utilise carbon dioxide in industrial processes (CCU) and to store carbon dioxide geologically (CCS).

National strategy for storing carbon dioxide

The Swedish Energy Agency should be mandated to draw up a national CCS strategy. It needs to include the need for instruments, an identification of system solutions including storage site(s), technological development in full-scale installations, market models, issues of risk and responsibility, legal considerations, international collaboration and issues of acceptance. The strategy should be developed in close dialogue with the process industry. Knowledge and collaboration in this respect may be obtained from places such as Norway, where, there are good storage conditions.

More clearly defined mandate for authorities

The transition process for more climate-friendly production is being slowed down partly by uncertainty about how environmental permits are issued and how environmental inspections are performed. Authorities responsible should be given a more clearly defined mandate to support a transition process.

Material-neutral allocation of public funds Allocation of public funds for development and innovation in the construction sector should be distributed in a broad, material-neutral way. This avoids incorrect priorities, sub-optimisation and

uneven competition. It also stimulates the opportunity to develop technical construction solutions with combinations of materials.

• Commercial conditions for a circular economy Concrete is a fully recyclable material, but handling and transport create financial thresholds for recycling in concrete production. Incentives are needed for a higher degree of recycling, including of whole concrete structures.

• Access to electricity

An increase in the electrification of transport solutions and industrial processes requires access to electricity with a minimal climate footprint at competitive prices. The conditions for indirect compensation in Sweden for increased electricity costs should be reviewed, and when electricity production changes, political vigilance is required in order to guarantee satisfactory supplies and an effective market.

- Final report submitted to the Norwegian State in autumn 2019 on how to establish a full-scale installation for carbon capture and storage (CCS) at HeidelbergCement's factory in Brevik.
- Investments made have made it possible to replace more than half of coal in production by alternative and bio-based fuels.
- Important steps in the environmental assessment process for continued limestone supply and supply of raw materials to the Slite plant – crucial for continued long-term climate action in the Swedish cement industry.
- The London Protocol now allows for the export of CO2 for storage in other countries. Now only ratification is needed.

The concrete industry

Summary of roadmap for climate-neutral concrete

Sweden faces two major challenges – building historically large volumes of both infrastructure and housing, and turning our society into a climate-neutral one by 2045. Combining these two challenges while maintaining competitiveness is nothing that one individual actor or the policy itself can achieve. We need to find common solutions where politics, academia, society and business interact.

Almost everywhere in our societies, concrete has made the building of society possible. The durability, life span and other characteristics of concrete make it difficult for all parts of the community to replace concrete to any great extent. However, concrete contributes to major carbon dioxide emissions, mainly from cement production. Those of us who work in different ways with concrete have decided to change this and therefore we have started the Swedish Concrete Initiative. Together with the Fossil Free Sweden initiative, the Swedish Concrete Initiative is now taking a holistic approach with this roadmap for climate-neutral concrete.

CLIMATE-NEUTRAL CONCRETE 2045 -AVAILABLE IN 2030

Our vision and goal is that all concrete in Sweden should be climate-neutral by 2045 and that there will be climate-neutral concrete on the market in 2030. Our work is based on a life-cycle perspective.

Climate-improved concrete is already available for concrete for building construction. Development work is also under way for the cement and concrete used for infrastructure construction. The work so far has resulted in concrete with 20 to 30 percent lower climate impact than conventional concrete. This has been achieved through the development of new cement types, concrete composition with a lower proportion of cement, the use of alternative binders and climate optimisation of design.

HALF THE CLIMATE IMPACT WITHIN FIVE YEARS

The concrete industry has set the target that the concre-

te for building construction shall reach half the climate impact within five years. This will primarily be due to the continued development of concrete composition, the use of alternative binders, optimisation of design and lower climate impact from transport. But to achieve this, it is also necessary that the market, both public and private, demands concrete that has a lower climate impact.

EDUCATION LEAP - USING CLIMATE-IM-PROVED CONCRETE TODAY

In addition to the concrete industry, politicians, builders and other actors have a responsibility for major changes in the short term. Efforts are needed for education and development, and from a political point of view, efforts must be material-neutral in order to enable the sustainable development of all materials.

FUNCTIONAL REQUIREMENTS AND LIFE-CYCLE PERSPECTIVES

Procurement regulations should be based on functional requirements from a life-cycle perspective. The starting point for assessment of climate impact for a building or infrastructure construction should be based on a life span of 100 years or more. Building materials with a long life span that allow flexible use of the structure over time should be prioritised to prevent waste. Recycling and re-use need to increase based on a circular economy perspective.

FOSSIL FREE TRANSPORT IS NEEDED

The concrete industry is dependent on the transport industry's climate work, with increased access to fossil free fuels and technological development of vehicles. For transportation, digitalisation also offers opportunities for management and optimisation of logistics. Control mechanisms also play an important role in several areas where they should be developed to stimulate step-by-step improvements and control the transition to biofuels.



FINANCING OF A TECHNOLOGY LEAP CCS/CCU

Cement accounts for about 90 percent of the climate impact of concrete. An extensive technology leap for cement manufacturing is therefore needed to achieve climate-neutral concrete by 2045, including geological storage of carbon dioxide (CCS) and utilisation of carbon dioxide in industrial processes (CCU). There are

»The concrete industry has set the target that the concrete for building construction shall reach half the climate impact within five years.«

a number of obstacles here that need to be removed politically. Today, it is technically possible to start using CCS/CCU, but this requires extensive investments where the state contributes funding and takes on part of the financial risk.

NATIONAL STRATEGY FOR CCS/CCU

Politicians need to show leadership and develop a national strategy for the development of CCS and CCU. Regulatory changes also need to be made to build a functioning infrastructure for CCS/CCU.

- Development in the short term with climateimproved concrete has moved forward, and particularly in 2019, many concrete suppliers presented different improved concrete options, cutting up to half of the climate footprint.
- Circulation of information with a focus on climate-improved concrete.
- Several companies are working to optimise resource efficient designs.

The construction and civil engineering sector

Summary of roadmap for the construction and civil engineering sector

The construction and civil engineering sector, including the property sector, currently accounts for one fifth of Sweden's climate impact. As Sweden reorganises to reach the agreed climate goals, we want to take responsibility for our part and provide solutions. Within the framework of the Government initiative Fossil Free Sweden, and under Skanska's project management, our sector has united around a common roadmap for a carbon-neutral and competitive sector. Working on the roadmap has united many key players throughout the entire value chain, and together with roadmaps from other industries, a unique and powerful force has come together for carbon transition.

Carbon emissions arise primarily from the manufacture of construction materials and buildings energy usage. There are, however, several positive trends:

- Digitalisation allows for new ways of working, services and markets, as well as more efficient, sustainable construction, operation and maintenance.
- The construction and civil engineering sector has potential to minimise waste and move towards circular resource usage.
- Access to financial capital can promote investments in new technology.
- Common goals can drive progress towards carbon neutrality.

The roadmap establishes goals to achieve a carbon-neutral value chain in the construction and civil engineering sector. Goals for the following years are:

 2020-2022: Key players within the construction and civil engineering sector have mapped their emissions and established carbon goals.

- 2025: Greenhouse gas emissions clearly demonstrate a declining trend.
- 2030: 50 percent reduction in greenhouse gas emissions (cf. 2015).
- 2040: 75 percent reduction in greenhouse gas emissions (cf. 2015)
- 2045: Net zero greenhouse gas emissions

Through current technology, the sector can potentially cut its carbon emissions in half by 2030, but technological shifts and innovation are necessary to reach net zero emissions. To achieve this, new incentives and tools and new ways of doing business are needed, as well as collaboration across the entire value chain.

We see five key factors for achieving a carbon-neutral value chain in the construction and civil engineering sector:

- Collaboration, leadership and knowledge.
- Long-term regulations that allow for investment in and conversion to carbon-neutral materials and processes.
- Development from linear to circular processes.
- Access to and efficient use of bio-based raw materials.
- Public procurement as an engine for transition.

To accomplish the goals of the roadmap, a life-cycle perspective is required in terms of planning, design, construction and utilisation of the built environment. Success will require clear leadership, new ways of thinking and everyone involved taking responsibility for





their part in the value chain. We need to change current legislation, regulations, planning procedures, design methods and material choices. We need to collaborate in new ways to succeed with innovations, solutions, methods and materials, as well as new business models. To manage carbon emissions while maintaining or even strengthening competitiveness, it must be profitable for key players to reduce their carbon emissions.

The construction and civil engineering sector has agreed on 26 points of action plan for politicians, authorities and key players in the value chain to accelerate the carbon transition. We agree that key players in the sector should set carbon goals, be transparent regarding their carbon emissions and set their own requirements, streamline materials utilisation, plan carbon-smart from the beginning, and digitalise the entire planning and construction process. We challenge politicians to do the following:

Recommendations of actions to the Parliament and the Government

- Introduce ambitious, long-term and predictable legal requirements for the construction and civil engineering sector based on Sweden's goals to be carbon-neutral to enable necessary investments for transition that maintain or strengthen competitiveness.
- Create conditions for transformation of the base industry to ensure carbon-neutral cement and steel through financing, risk-sharing, support for innovation and control instruments. Develop a strategy and action plan in consultation with key players on the market for access to and distribution of sustainable, fossil free fuels for the construction and civil engineering sector.
- Introduce requirements for carbon impact declarations from a life-cycle perspective for buildings, infrastructure and construction products available on the market.
- Utilise public procurement as an engine for carbon transition. Strengthen knowledge of the Swedish Public Procurement Act for those active in public procurement and ensure that follow-up is as strict as procurement requirements.
- Change regulations for the classification of waste to remove obstacles to - and instead drive - circular business models and increased re-use and recycling of excavation materials and building and demolition materials.
- Work for the possibility of lower capital adequacy requirements and other incentives for green financing solutions aimed at stimulating investments with lower carbon emissions.

- Introduce incentives that promote efficient use of energy and resources in the refurbishment of existing property holdings, requiring a life-cycle perspective and carbon-reducing motivation for renovation and investment decisions.
- Appoint appropriate organisation to provide and manage an open database of generic carbon data that is life-cycle-based, quality-assured and representative of the construction and civil engineering sector in Sweden.
- Appoint appropriate organisation to investigate a method for visualisation of carbon emissions in value chain transactions, from suppliers of raw materials to consumers.
- Appoint appropriate organisation to develop procurement criteria and definitions of carbon-neutral and carbon-positive buildings and infrastructure through dialogue with the market.

With this roadmap, we have taken a unified first step towards building our society competitively and without carbon emissions. We, the undersigned, agree that construction and utilisation phases must be carbon-neutral by 2045. It is now time for us to move from words to action on carbon transition, and with the shared intentions inherent in this roadmap and the recommendations of actions we direct at politicians and key players within the sector, we unite to create conditions for a market that values carbon-smart solutions.

- Climate impact from the construction phase is included in environmental certifications. Pilots are ongoing for »ZeroCO2« houses.
- Civil engineering projects have outperformed carbon requirements from the Swedish Transport Administration.
- Pilot projects with reuse of materials and fossil-free building sites.
- Asphalt plants converted to fossil-free and green concrete is more widely used.
- Legal requirement for climate declaration in 2022.

The food retail sector

Summary of roadmap for fossil free competitiveness – Food Retailers

The Swedish Food Retailers' Federation (Svensk Dagligvaruhandel, SvDH) has drawn up this roadmap within the framework of the Government's Fossil Free Sweden initiative. The SvDH Roadmap was submitted to the Government in April 2018.

BACKGROUND

The theme we have chosen for our roadmap is plastic consumer packaging. Because it extends the shelf-life of many foods and helps to reduce food waste, plastic is one of the most commonly used packaging materials for consumer food products. But using plastic in packaging materials also presents big challenges, since the raw materials used to make most plastics are fossil-based and the resulting packaging material has one

»Our goal is for all plastic packaging to be recyclable by 2022, and all plastic packages to be produced from renewable or recycled raw materials by 2030.«

of the lowest material recycling rates in Sweden. Rough estimates suggest that only 25 percent of the plastic packaging collected for recycling actually makes its way into new plastic products. One of the reasons for this is that the primary consideration has been protecting the food product and making it appealing from a consumer viewpoint rather than focus on the recyclability of the materials used in packaging. There has, in addition, not been a demand for the recycled plastic, and it has been difficult to find ways to dispose of it.

We want to change this, and the purpose of this roadmap is to help pave the way for increased recycling and a transition to plastic packaging made from renewable or recycled raw materials. The roadmap is thus part of our contribution to a circular economy and fossil free society.

THE GOAL

Our goal is for all plastic packaging to be recyclable by 2022, and all plastic packages to be produced from renewable or recycled raw materials by 2030.

We are aware that, based on today's requirements and conditions, this is a very challenging goal. The food retail industry is up for the challenge and will do everything it can to attain its goal and vision.

To succeed, however, we require a clear commitment from our politicians and long-term decisions that help to increase recycling and stimulate a demand for recycled materials, and clear incentives to develop domestic production of renewable plastic raw materials.

The measures that we will take in the food retail industry to reach this goal include:

- Investment in a new plastic sorting plant. The food retail and plastics industries are together investing a total of 260 million SEK in a new sorting plant that will be the most modern plant of its kind in Europe, with the capacity to cover all of Sweden's plastic package recycling needs.
- Introduction of cost-based fees for packaging based on the packaging's recyclability. There is at present no economic incentive for producers to



use recyclable packaging. We therefore plan, on our own initiative, to introduce a tiered system for packaging fees starting in 2019. Non-recyclable packaging costs more to handle and will therefore also be charged a higher fee.

»It has to be economically viable to use renewable and recycled raw materials rather than virgin, fossilbased raw materials«

 Analysis of the current situation and investigation of the amount of packaging that is currently recyclable. We will then work to successively increase this amount. This work will occur in close cooperation with the plastics industry and packaging producers. We will also work to increase the demand for recycled plastic materials.

Three important measures we would like to see from our politicians:

- A clear expression of political will in the form of support for innovative research projects and strategic investments aimed at increasing recycling and stimulating a demand for recycled plastic materials.
- Economic incentives to promote a successive increase in the use of renewable and recycled plastics. It has to be economically viable to use renewable and recycled raw materials rather than virgin, fossil-based raw materials. This could be achieved, for example, through state aid for the production of renewable raw materials.
- Broad agreements across political party lines on policy are needed to increase predictability for all actors, such as a long-term approach to producer responsibility.

- In May 2019 the plastic sorting plant in Motala came into operation.
- Differentiated packaging fees were introduced on 1 April 2019.
- The companies have carried out current status analyses of the proportion of plastic packaging that is recyclable and are working gradually to increase the percentage of recyclable packaging and increase the percentage of recycled and renewable material.
- In the category of plastic carrier bags, the food retail sector is already very close to the 2030 target of recycled and/or renewable raw materials.
- Worked actively to increase the sales and recycled value of recovered plastics.

The forest sector

Summary of the forest sector's roadmap for fossil free competitiveness – How the forest sector increases climate benifits in society

How can the forest sector create increased profitability, competitiveness and jobs across the country, while at the same time phasing out the use of fossil energy sources up to 2045? The forest sector's roadmap for fossil free competitiveness, shows how the sector can create even more climate benefits than it already does today. The roadmap is developed by the trade association The Swedish Forest Industries Federation.

THE VISION OF THE ROADMAP IS:

»The forest sector drives growth in the global bioeconomy«.

The vision goes beyond its own sector by including a transformation of society to a bio-based economy. In a growing bioeconomy, the forest sector today already contributes to climate change mitigation in three overall ways: by *substitution*, whereby biobased products replace other products that are produced from fossil raw materials or which cause major fossil emissions during production, by *carbon capture* in the forests and in biobased products as well as by *reducing the use of fossil energy sources*.

The goal of the roadmap is that the overall climate benefits of the forest sector and its contributions to a fossil free society will have increased by 2045 by contributing with more bio-based products and by phasing out fossil energy sources in its own operations.

GOALS FOR 2030

To increase the overall climate benefits of the forest sector and its contributions to a fossil free society, The Swedish Forest Industries has defined goals to be reached by 2030. The goals are divided between the two focus areas: *climate benefits and competitiveness through growth in bioeconomy* on the one hand, and *climate benefits through phasing out of fossil energy sources in the operations*, on the other.

CLIMATE BENEFITS AND COMPETITIVENESS THROUGH GROWTH IN BIOECONOMY

- The forest sector's share of the Swedish GDP has doubled, from 3 percent in 2013 to 6 percent in 2030.
- The market for wood products has expanded and the value of deliveries has increased – at least 50 percent of all new homes are built with wooden frameworks and an increasing proportion of other buildings are built with wooden frames.
- Investments in research, innovation and demonstration facilities linked to forestry and forest industry have doubled to SEK 8 billion per year.
- The forest sector's deliveries of bioenergy have increased.
- The production of biofuels based on forest raw material has increased – an estimate is an increase from 1 TWh to 10 TWh.

CLIMATE BENEFITS FROM THE PHASING OUT OF FOSSIL ENERGY SOURCES

- The use of fossil energy sources in processes within forest industries has decreased further. Today, processes in sawmills are almost entirely free of fossil energy sources and the processes in the paper and pulp industry are 96 percent free of fossil energy sources.
- No fossil fuels are used in vehicles in forest industries or in forestry.
- Fossil emissions from domestic transportation in the forest sector have been reduced.





WHAT IS NEEDED FOR THE IMPLEMENTATION OF THE ROADMAP?

Measures are needed in many areas if the forest sector is to fulfil the roadmap>s vision and goals. Here is a list of those we consider to be the most important and where politics need to contribute. • A clear political ambition to create a biobased society

A growing bioeconomy requires an increase in the production of forest industry products, bioenergy and biofuels. Politics must create conditions for this by, for example, removing the uncertainty with respect to views about forestry, taxes and fees linked to biobased products, transportation etc. There is also a need for increased state funding for R&I, at least in line with the industry's own initiatives.

• Competitive conditions for the forest sector The forest industries operate in global markets. This places high demands on competitive conditions when it comes to, for instance, electricity costs, permit processes, the investment climate and the burden of fees and taxes, which should be in line with the conditions that international competitors face.

• Assured access to biomass from sustainable forestry

For the forest sector to contribute to a fossil free Sweden, there must be an assured access to biomass from the forests. The ability to pursue efficient and sustainable forestry is crucial. The industry will demand more raw materials to enable an increase in current production of wood products, cardboard, paper and pulp. This is essential for increasing side-flows to energy, fuels and new bio-based products. Political instruments and subsidies that distort competition or control the use of raw materials must not be introduced.

Increased focus on goods transportation

Goods and the transportation of goods must be given higher priority when investing in infrastructure. Infrastructure initiatives based on the needs of the sector are a key factor, for example initiatives for transfer of goods. Many of the member companies of The Swedish Forest Industries are able and willing to transfer more goods to rail and maritime shipping if the Swedish Transport Administration sorts out transportation bottlenecks and other obstacles. The measures presented in the Industry Council's (Industrirådet) Introduction to Goods Strategy need to be implemented.

Improving efficiency of transportation Improving efficiency can, for example, be achieved by permitting trains and lorries that are both hea vier and longer. A first measure in the near future would be to ensure that the entire road network is adapted for lorries with a maximum weight of

»The forest sector has a key role in the transition into a fossil free society«

74 tons. The potential for improving efficiency through the possibilities of digitalisation, e.g. horizontal cooperation, increases if authorities push for digitisation in transport and infrastructure.

• Electrification

Electrification of road traffic can be increased, for example, through the use of battery operated small lorries and passenger vehicles. The electrification of major roads, such as the E-road network with lots of heavy traffic, or shorter distances with shuttle services should also be carried out.

• Continued investments in research and innovation

Investments in research and innovation from the state and the private sector must be intensified further. This is crucial to enable development towards a growing bio-based economy. Research needs to be targeted at the areas presented in the research agenda from the forest industries (Skogsnäringens Forskningsagenda 4.0).

- A research project on making the forest industry's heavy goods transport fossil-free has been started. At the centre of the project is the timber Pod, an automated and electrified logging truck developed by Einride.
- Under the Climate Action Plan, a bioeconomy strategy will be developed that will contribute to increased biomass availability as well as environmental and climate benefits.

The heavy road haulage industry

Summary of roadmap for fossil free competitiveness - heavy road haulage industry

TODAY

Road haulage is integral to trade, construction and industry throughout Sweden. Important measures to reduce emissions include the scaling up of renewable fuels, optimizing routes and increasing efficiency. In recent years, reductions in greenhouse gas emissions from heavy duty vehicles have been entirely due to renewable fuels.

»Haulers reduce emissions through optimising routes and increasing loads, practising eco-driving and investing in new and more efficient vehicles«

The primary driving forces behind companies working to reduce emissions include customer demand, cost reduction and an ambition to contribute to fighting global warming.

Heavy duty vehicles transport as much as two thirds of total freight in Sweden. Road transport routes are typically short: almost 80 percent of total tonne kilometres is on distances shorter than 500 kilometres. The road haulage industry is heterogenic, and can broadly be divided into long-distance transport, construction, distribution and waste transport. In 2016, the most common freight categories were ore and other extraction products, parcels and waste products.

In reducing emissions, the challenge and the solution lie in the heavy dependency on diesel. Some 97.5 percent of heavy lorries are driven on diesel. HVO (hydrated vegetable oil), a synthetic renewable diesel, requires no change in engines or infrastructure. Its surge accounts for emission reductions of 25 percent between 2010 and 2016, despite an increase in tonne kilometres.

In addition to emission reductions achieved by renewable diesel, road haulage companies reduce emissions by increasing loads per driven kilometre, practising eco-driving and investing in new and more efficient vehicles.

IN THE FUTURE

The conditions for working to decarbonise road transport in Sweden are in place. The political will has ensured the long-term goals and policy. Research and innovations in vehicle technology are available, and higher weights and dimensions enable more efficient transport. The potential for scaling up production of biodiesel and other renewable fuels is evident. However, cost structures across the European Union vary greatly and Swedish haulage companies are in direct competition with companies with up to 60 percent lower costs. Thus, establishing quality competition and increasing incentives for emission reductions is an important change that must take place to facilitate the greening of road transport. New business models and possibilities lead to climate-focused public procurements and transport commissions



Below are some of the different pathways that will transform the road haulage sector.

ENERGY

Ethanol

TECHNOLOGY

 Fuel-efficient vehicles

Emission reduc-

like VECTO etc.

tion schemes

Electrified roads

Electric vehicles

EFFECTIVE LOGISTICS

- ITS, intelligent transport systems
- High capacity
 vehicles
- Flexible time schedules rather than just in time

COMPETITION

- Quality competition
- Public sector act as role model
- Emission reductions as a requirement

OBSTACLES

The two most prominent challenges regarding the transformation of the road haulage sector are: rapidly increasing the production of sustainable renewable fuels, and Swedish policy having little or no bearing on international hauliers, which are increasingly transporting at lower prices than Swedish hauliers.

The road haulage industry is international, why national policy such as Sweden's climate policy has little or no bearing on many companies operating here. The market is currently characterized by price competition. Fuel is one of the highest single costs for Swedish road haulage companies, which pay 13 percent more than the EU average.

Road haulage companies are prepared, adept and motivated to contribute to the climate goals. Investing in new technology and more expensive fuels is an option, but one that affects the price of the transport assignment. The Swedish Society for Road Transport Companies is striving for the road haulage industry to be characterised by quality competition and companies living up to their responsibilities.

The biofuels development is crucial to reducing emissions. The share of biofuels, as well as the demand for it, will in 2030 depend on changes in demand for transport, vehicle efficiency, and the extent to which heavy transport is electrified. Freight transport by road is expected to increase by 1.8 percent per year between 2012 and 2040 – an increase of 39 percent between 2018 and 2040.

POLICY

The roadmap identifies several policy proposals to advance the greening of road transport. This summary presents three important ones.

1. The adaption of the Paris Agreement into EU policy

Sweden needs to push for higher climate standards in EU policy, and thus ensure EU Member States' policies are aligned with the Paris Agreement so as to ensure a level playing field.

2. Biofuels

Public investment contributes to the upscaling of bio-refineries for biofuels based on lignin and lignocellulose.

Biofuels should be reserved for the essential heavy road transport sector, also indispensable from a security and defence perspective

3. Eco-tax - a distance-based charging system

Fuel tax, only paid by those buying fuel in Sweden, is a suboptimal charging scheme. Fuel tax can be lowered to the EU-minimum level, allowing for a tax charged per distance and thus levelling out competition.

Eco-tax can be differentiated so that it incentivises the use of specific roads, vehicles and fuels.

Eco-tax should be administered automatically and safely, using GPS positioning technology.

Eco-tax should only be levied on trailers so as to

ensure higher-capacity vehicles are not charged more than less efficient lighter and shorter vehicle combinations.

- A number of major transport buyers are looking for better and more transparent emission data.
- A number of major transport buyers are taking steps to make logistics more efficient.
- A governemntal committe for Electrification of transports has been established.
- Investments in biogas: 32 companies have applied for and received support for a total of 159 heavy goods vehicles.

The mining and minerals industry

Summary of roadmap for a competitive fossil free mining and minerals industry in Sweden

MINING AND MINERALS - AN IMPORTANT PART OF THE SOLUTION

The Swedish mining and minerals sector will play an important part in a fossil free future. The simultaneous transitions towards fossil free energy and transport systems, a climate-smart built environment and increased recycling are all dependent on sustainably produced, high-quality metals and minerals, not least due to the demand for the metals and minerals required by modern batteries and infrastructure. The Swedish mining sector already generates benefits for the global fight against climate change via the export of climate- and environmentally effective products and equipment.

THE VIEW FROM 2018 - TAKING STOCK OF THE SITUATION TODAY

Today the mining and minerals sector generates about 8 percent of Sweden's total CO2 emissions. Fossil fuels are used in multiple parts of the industry's value chain, and greenhouse gas emissions arise from transport and mining operations and in part from the processing of iron ore, metal ores, limestone and cement. Most of the industry's emissions come from production of iron ore pellets, smelting of ore into metals, and limestone and cement production, though emissions from the Swedish sector are low relative to global competitors. At the same time, many of the industry's processes and technologies are already fossil free, especially in mining operations, and the transition towards fossil free alternatives is already underway. The sector has made significant progress in switching from diesel- to electricity-powered technologies, and digitalisation continues to drive optimization and efficiency, reducing overall energy and fuel requirements.

Processing of ore will require more to become fossil free,

and especially to deal with the process emissions that arise regardless of which fuel is used, for example when limestone is processed to lime and cement. Here development of existing technologies as well as a shift to new, currently undeployed technologies will be required. Biomass can replace some of the fossil fuels used today, but both fuel properties and supplies need development. Electric heating options can be a long-term solution but are immature technologically today. The ironand steel industry is investing in hydrogen as a reducing agent in its HYBRIT project; research and development is likewise needed to identify process routes and system configurations for fossil free production of other metals and minerals. Cementa has launched the initiative Cem-Zero to investigate the conditions for electrifying cement production and CO2-emissions. Process emissions, however, will require a strategy for and development of technologies for CO2-separation and sequestration, geological storage of CO2 (CCS) and industrial re-use of CO2 (CCU).

ROADMAP 2045 - THIS IS WHAT THE JOURNEY LOOKS LIKE

In 2045 modern mining of ores and minerals is a sustainable complement to recycling in meeting global demand. Improved product designs and value chains for reuse and recycling have made it possible to recycle much of the metals and minerals in use. Yet recycling is not sufficient to meet demand from a growing global population and increased living standards. Primary production of metals and minerals is needed even beyond 2045, and global competitiveness remains essential for the Swedish industry, since only profitable firms are able to make the necessary investments.

ROADMAP FOR FOSSIL FREE COMPETITIVENESS - SUMMARY REPORT



One of the most important paths to fossil free production is electrification.

One of the most important paths to fossil free production is electrification. With help from biofuels in cases where electricity cannot be used operation of machines and internal transport in the mining sector become fossil free as early as 2035. The transition to electricity has been driven primarily by technological progress and has mostly taken place via phasing out of old equipment and normal investment cycles. Competitive biofuels and/or hydrogen-based solutions have played a complementary role where mine geography or shorter lifetimes and smaller-scale operations hinder deployment of electricity-based solutions. Automation and digitalisation have decreased energy requirements by optimising production and making vehicles more efficient. Infrastructure for charging and hydrogen fueling is in place and necessary investments in the electricity grid have been completed.

Sweden has established a unique, world-class CO2-free system for processing iron ore. In part ore is processed by direct reduction using hydrogen. Iron ore pellets-production continues as well, with process heat from CO2 -free energy, either biomass or indirect heating via electricity. Hydrogen gas production, direct reduction and pellets production have been co-located for optimal energy use. Processing of other metals is also CO2-free. Lime and cement production likewise uses indirect heat from electricity and/or biomass, and process emissions are handled via CO2-separation and geological storage (CCS) or reuse (CCU), for example in methanol production or algae production. These investments have been expensive and have not been borne by individual companies - public and provide investments in technological progress have been essential. New pricing models have been introduced.

CRITICAL CONDITIONS AND BARRIERS

The mining and minerals industry is optimistic that the transition will be successful. Yet the necessary development will require time and capital. Farsighted political decisions that promote the industry's global competitiveness will be central to achieving success, as will effective and reliable approval processes for new investments.

The industry is prepared to invest but barriers along the way need to be cleared. Here politics has a clear responsibility to maintain a long-term and holistic view.

THE MOST IMPORTANT CONDITIONS WHERE POLITICS CAN MAKE A DIFFER-ENCE ARE:

- Effective and reliable permitting so that new, necessary and climate-smart investments are possible
- A holistic view in political decisions that avoids (for example) policies that sub-optimize and harm the industry's competitiveness and ability to invest in fossil free production
- Investment in research and development within fossil free production processes and CCS, including test sites and upscaling
- **4.** Conditions for access to fossil free electricity with a low total system cost and high realibility
- Strategic allocation of biomass and access to biofuels at competitive prices

The industry, the public sector and other actors need to work together to bear the cost of the transition, drive technological development and support the achievement of global and national climate goals.

Svemin is a national branch organization for mining, mineral, and metal producers in Sweden with more than 40 member companies active throughout Sweden. Members include mining companies, prospecting and exploration companies, limestone and cement companies and various equipment and service providers.

- LKAB together with industry actors have launched the SUM project — Sustainable Underground Mining with the aim of developing a new world standard for sustainable deep mining, which is carbon-free, digitalised and autonomous.
- LKAB is investing in the HYBRIT project to develop carbon free pellets and is currently converting a pelletizing plant for testing a bio-oil system from the summer of 2020. This is an important step in fossil-free steel production.
- Boliden is testing an electric trolley solution at the Aitik mine, which will reduce emissions from the mine trucks by 80 per cent.
The steel industry

Summary of climate roadmap – For a fossil free and competitive steel industry in Sweden

SUMMARY

The Swedish steel industry intends to make a difference for the global climate. Already, Swedish steel products have an internationally low climate footprint and create climate benefits during use. To achieve Sweden's aim to become one of the world's first fossil free welfare nations will require commitment from all stakeholders, and greater cooperation between the political arena and industry.

SWEDISH STEEL CREATES CLIMATE BENEFITS

The Swedish production of 4.5 million tonnes of crude steel places Sweden among the smaller players on the global market. Sweden's steel companies have strate-

»The global climate would benefit if the share of steel produced in Sweden could increase, because global emissions would be reduced«

gically developed higher levels of specialisation within selected market niches, aiming to grow faster than surrounding markets. Efficient and climate-smart steel products from Sweden contribute to reduced materials consumption, longer lifespan, less wear and increased energy efficiency. Through maximal use of recycled raw materials, such as scrap, large resources can be saved. Daily, the Swedish steel industry generates climate benefits, meeting the demands of modern society. Climate actions provide an opportunity to increase the value of these market offerings. The global climate would benefit if the share of steel produced in Sweden could increase, because global emissions would be reduced, even though emissions in Sweden might increase on a short- or medium-term basis. The best climate policy is to maintain full value chains in Sweden.

The Swedish steel industry will:

Continue to help its customers to create climate-smart and resource-effective solutions with Swedish steel so that their production, use and recycling become as efficient as possible.

The political agenda must ensure:

A solid base for global competitiveness through efficient transportation and infrastructure, secure power supply, top class competence supply and appropriate operating conditions such as harmonised taxes and duties.

LEADER IN TECHNICAL DEVELOPMENT

The emissions of fossil carbon dioxide from the steel industry are mainly direct emissions from production processes (5.8 Mtonnes CO2, 2016) and internal transport. The direct emissions emanate from the use of coal when iron ore is reduced to iron (85%), the use of fuel to heat and process the steel (12%) and from the coal content in raw materials and additives (3%). To handle the direct emissions, the most important potential solutions today are:

 The development of a brand-new process technique which uses hydrogen to reduce iron ore to iron. With this technique, the carbon dioxide emissions are eliminated from the reduction process

and instead the by-product would be water. This technological leap involves numerous challenges but a successful outcome would allow blast furnaces to be phased out. Potentially, the new technique could also be spread globally. At the current level of production, the technique means an increased need of about 15 TWh electricity.

- The development of bio coke for reduction of iron ore for powder production and for scrap melting processes. This requires a suitable source of carbon, processes for coke production and access to biomass for bio coke at a cost equal to that of fossil coke. At the current level of production, at least 1-1.5 TWh is required.
- The use of bio-based gas as a substitute for the fossil fuels used in heating and heat-treatment processes where electrification is not an alternative. This requires access to a gas of the same quality as natural gas and liquefied petroleum gas. The cost of the gas has to be competitive related to international energy costs. The estimated need is at least 2-3 TWh at the current level of production.

These measures demand extensive, long-term research efforts including testing at pilot- and demonstration levels.

The Swedish steel industry will:

Continue to actively focus on research within prioritised areas which result in reduced direct emissions of fossil carbon dioxide.

The political agenda must ensure:

Financing for long-term research and knowledge development, also ensuring that the government campaign Industriklivet (Industrial stride) is maintained over parliamentary terms.

Secured access to electricity and bio-based energy at internationally competitive costs.

RESPONSIBILITY FOR THE ENTIRE CHAIN

The steel industry also causes indirect emissions in other sectors, for example in the manufacturing of raw materials, such as alloys, generation of electricity and external transports. For a majority of the Swedish steel companies the indirect emissions represent a significant part of the total emissions. By choosing products, services and suppliers with low climate impact, the steel industry can influence the value chain, deliver more climate smart products and reduce the total emissions. The Swedish steel industry is already in the front line in this area.

Maximum use of recycled raw materials, for example scrap, is a key factor for a more efficient use of resources and a low level of emissions. Access to steel scrap globally is today the limiting factor for scrap based steel production. With an increased demand for high quality scrap and in a more circular future economy, products designed for recycling, more efficient collection of scrap and improved sorting of scrap are required to a higher extent. This means that valuable metals can be conserved and contamination minimised.

Transport can be developed primarily by streamlining the handling of goods, by optimising the entire transport system and the choice of transport methods. The development of new fuels or other fossil free means of transport is dealt with in other sectors.

The Swedish steel industry will:

Continue to evaluate its value chains to reduce the total emissions through active choices of transport, raw material and more efficient recvcling.

The political agenda must:

Facilitate increased collection of steel scrap and support the development of refined sorting of scrap. Invest more and faster in climate-smart means of transport such as railways. The steel industry also recommends development of more electric highways and 74 tonne trucks.



CONDITIONS FOR INVESTMENTS

The intention of the Swedish steel industry is to continue to develop its activities in Sweden. From a climate viewpoint, Sweden has advantages of electricity production which is close to emission free, iron ore which allows refining with low emissions and good availability of biomass compared to other countries.

In order to move towards fossil free steel production with retained competitiveness the companies must be able to invest at a pace adjusted to their production. Many steel companies have plants in other parts of the world and foreign owners, which means that competition for investments is also tough within the companies. It is essential that the conditions in Sweden are competitive compared to the conditions in other countries and that the time from development to market can be as short as possible.

The Swedish steel industry will:

Continue to implement new techniques for reduced emissions when commercially competitive.

The political agenda must ensure:

Efficient and predictable permit processes, including required time plans and adaption of legal frameworks to European legislation.

DECLARE CLIMATE FOOTPRINT

Competition is tough on the global steel market with significant price pressure even on the specialised products from the Swedish steel industry. Currently, the steel industry cannot pass on the cost of lower emissions to the customer, this lies far into the future, since the market is global. Greater transparency in carbon dioxide footprint for the end product may activate this process since important steel users will want to stand out by reducing their climate impact. In time, declarations of environmental impact will be requested more often and it is crucial that models and methods for relevant declaration of climate impact are further developed.

The Swedish steel industry will:

Further develop analysis and reporting models and declare relevant data so that the customers can evaluate the environmental performance of their suppliers' products. The political agenda must contribute to a larger visibility through:

Supporting further development of qualified life cycle based models for declaration of climate impact.

The Swedish steel industry has a vision for the year 2050, *Steel shapes a better future*, in which only products of value to the society will leave the companies. The vision is based on the prerequisite that the Swedish steel industry remains competitive all the way to 2050 and thereafter. With this Climate Roadmap, the Swedish steel industry points out difficulties and possible solutions to achieve a fossil free and competitive sector, also underlining the importance of co-operation between the industry and the political agenda to achieve success.

IMPLEMENTED YEAR 2018-2020

- A pilot plant for the reduction of iron ore to iron with the aid of hydrogen is being built and will start up in 2020.
- A pilot plant for the production of biogas through the gasification of biomass has started. The process also has the potential to produce biochar.
- The financing initiative, the Green Industry Leap, that targets process-related emissions has been given a larger budget.

20 mars 2019 Submission of roadmaps to the Deputy Prime Minister and Minister for Environment and Climate ISABELLA LÖVIN and Minister for Business, Industry and Innovation IBRAHIM BAYLAN.

Aggregates industry Digitalisation consultancy industry Heating sector Maritime industry



The aggregates industry

Summary of roadmap for fossil free aggregates industry

CURRENT STATE

Aggregates (sand, gravel and crushed rock) is an indispensable local Swedish raw material. Aggregates is necessary for a well-functioning infrastructure, housing construction, roads, railways, ports and airports and thus for business development and employment.

In 2017, about 100 million tonnes of aggregates was produced and delivered, making it the country's largest industrial product by weight. The value of the raw material is about 10 billion SEK and the aggregates industry employs about 5,000 people directly and amounts to approximately 30,000 people indirectly.

The fossil emissions from the aggregates industry amount to about 0.25-0.45 million tonnes of CO_2 -eq. for the production chain, and an additional approximately 0.2 million tonnes of CO_2 -eq. Emissions from the transport will be greater if the distance to the customer increases.

OBJECTIVE: EMISSION-FREE AGGREGATES INDUSTRY 2045

In 2045, the aggregate industry will be completely fossil-free and largely automated or remote-controlled. During the transition work, information and demonstration efforts will be required to implement and support this transition. By 2030, the greenhouse gas emissions of greenhouse gases from production processes will be reduced by 50 percent compared to the 2015 level. The industry's measures for the fossil-free aggregate industry The climate change in the aggregates industry is used mainly through development in four different areas:

 Electrification of the production process
 The electrification process will be carried out partly through connecting of crushers and machines in the production process to electricity network, and partly through increased battery operation of construction machines. Today, a large part of the work in the guarries is done with diesel-powered
 equipment, especially with mobile crushers and to move the heavy material in the area. By operating machines with renewable electricity instead, the production processes in the aggregate industry can be virtually emission-free.

2. Increased use of fossil-free fuels in the production process

An important part of the reduction of emissions will be carried out using biofuels in cases where electrification is not suitable/possible. The availability of biofuels at competitive prices is an important prerequisite for the industry's transition. Most of today's machines can run on biofuels without measures.

3. Smarter transports and more efficient location of quarries

Reduced emissions from transports to customer through optimized localization of quarries and material terminals, and increased proportion of climate-efficient transports. Material transport accounts for a large part of the industry's emissions. Big savings can be made by buyers and producers together planning the logistics to minimize transport. Even more important is to locate the quarries smart, that is, close to the place where the material will be used. To enable more urban-based investments of quarries, the aggregates producers are continuously working on developing production equipment with noise less and dust less.

4. Circular material flows

Increased circular material flows mean that the need for processing of the material is reduced and that the logistics process becomes more efficient, which reduces fossil emissions. Today, several EU countries have come further with recycling materials, and here are several good »best practices« to be inspired by.

WHAT IS NEEDED TO MEET THE GOALS

Ensure legal and effective licensing processes

Legal, effective and predictable permit processes are required to create a rational supply of raw materials. By planning smart and placing quarries closer to the building site, the climate impact can significantly decrease. Then the processes for obtaining permits must be made considerably more predictable, legally safe and uniform.

Give long permits with flexible terms for investment

In order to promote electrification, a long-term approach is required. Even if the profitability meets the company's demand for repayment time, climate investments are not carried out if the remaining license period is too short and it is uncertain whether the cover will be granted extended operating license with reasonable terms. Too short counting permits with too rigid conditions do not



give the operator the opportunities that are needed for long-term climate investments.

Produce End-of-Waste (EoW) criteria for ballast

It must become clear when waste ceases to be waste and the regulatory framework must promote recycling when it is environmentally justified. SBMI (Sveriges Bergmaterialindustri) considers that the Ministry of the Environment should give the Swedish Environmental Protection Agency the task of developing EoW criteria for ballast material.

Produce industry guides for what is NOT waste

In today's legal system there are big uncertainties about the recycling of aggregates. In many cases, a rational material handling and sound circular material flows are counteracted by an uncertainty regarding the outcome of government assessments. Clearer guidance is needed on what does not fall within the scope of the waste definition to ensure uniform assessments in the country.

Prioritize circular material flows during assessments

Today, too often restrictive authority assessments are made about where recycled materials may be used. This means great costs for society, long unnecessary transports, and counteracts circular material flows. The circular society needs site-specific government assessments that promote circular material flows, and where reasonable considerations regarding environmental protection are made.

Let public procurement be driving

A large proportion of the industry's production is sold to public procurers. These should be able to set higher climate requirements than private clients. It can, for example, reward recycled material. This could mean that the industry gets an opportunity to get more paid for products that meet higher requirements to promote climate investments.

Establish »Policylabs« for industry regulations

Many regulations have been developed in a society that was different from today. The regulations or instruments were relevant at the time of the introduction, but perhaps not today. Policylab is a form of cooperation where many different relevant stakeholder groups work closely together on the design of the regulations. This technique has proven to be effective and successful in many different ways.

Secure well-functioning market for biofuels

Electrification is not suitable everywhere. It is important that the industry can reduce fossil emissions through other measures. Demand for HVO will increase. There is a need for new policy instruments that enable the industry, together with authorities, to develop technology that encourages technology development and increased production of, for example, biofuels.

Speed up technology shifts with »The Climate Leap«

In larger plants, electrification is often more profitable, but in medium-sized revenues, for example, the governmental financial support is needed to create enough profitability for the conversion. A major change will require the support of society. With the support of, for example, the governmental investment program »The Climate Leap«, the return of investment period reduces to an acceptable level.

Consider the supply of aggregates early in the construction process

By considering the supply of aggregates early in the overview planning process, the conditions will be better for increased material recycling, efficient logistics and efficient material supply. Effective mass logistics require a holistic approach, collaboration between many actors and good planning.

IMPLEMENTED YEAR 2019-2020

- Several companies have already converted many of their production processes from diesel to electric power, thus reducing their emissions by around 30-50 per cent compared to their 2015 level.
- SBMI (Swedish Aggregates Producers Association) has launched the "Sustainable electrification of quarries" project. Some 30 activities are part of the project, aimed at speeding up the transition to electric power.
- SBMI has started the project "decision-support for increased recovery" to produce fact-based reference data for assessing surplus material that can be used for civil engineering purposes.

The digitalisation consultancy industry

Summary of digitalisation consultancy industry's roadmap to a fossil free future

By promoting new business models, behaviours, regulations and organisational approaches, strategic digitalisation has the potential to radically reduce greenhouse gas emissions, increase competitiveness and generate high growth in exports of transformative solutions.

Firms in the digitalisation consultancy industry that have joined forces behind this roadmap are united in their ambition to help society become aware of and tap the potential of digitalisation. We believe it is critical that one of the most powerful set of tools humankind has ever created are provided with a framework for promoting a smart and sustainable future.

The solutions enabled and implemented by digitalisation consultants have an enormous potential to reduce global greenhouse gas emissions. Studies that focus only on optimising current systems still show that digital solutions can contribute to an estimated 20 percent reduction of global emissions. But the opportunities to cut emissions is considerably larger if we also include the transformative potential of digitalisation, which can help meet the needs of society in entirely new ways.

Digitalisation should be considered a catalyst that can speed development in either a fossil free and resource efficient direction or a fossil intensive and resource intensive direction. This is why, in addition to adopting new technology, we also need to work with how it is used and for what, and ensure that business models, behaviours, regulations and organisational approaches are shaped in a way so they will contribute to sustainable and digitalised world.

VISION AND TARGETS

The vision of the digitalisation consultancy industry is: By 2045, we will have helped Sweden and the rest of the world reduce its energy consumption to the point where we have a chance of keeping the rise in temperature below 1.5 °C. In so doing, we will also support increased international collaboration. As a result, global sustainable solutions will enable sharper international competitiveness that leads to high growth in exports of transformative solutions (both products and services): solutions that deliver answers to societal needs through, resource-efficient and circular innovations.

Firms in the digitalisation consultancy industry have set a target for their own operations to be fossil free by 2045.

Accelerating the journey towards a fossil free digital infrastructure is an obvious focus of the industry. By taking a proactive role and guiding our clients towards the right infrastructure investments, we can promote the continued reduction of emissions from the underlying infrastructure that digitalisation requires. The target is zero emissions from that infrastructure by 2045, with the ambition of getting there earlier, by 2030. This will take place alongside the accelerating digitalisation of all sectors in society.

SCIENCE POINTS TO THE KEY ROLE OF DIGITALISATION

Digital solutions can help reduce emissions in three different ways. First, existing systems can be optimised. Second, the adoption of existing best practice sustainable solutions can be accelerated. Third, transformative changes with totally new system solutions can be achieved.

Transformative changes that lead to radical and rapid reductions of greenhouse gas emissions occur when the impacts of digitalisation at various levels work together. That is, when new technical solutions, business



models, economic incentives, new legislation, social planning, new financing models and methods for assessment and creating transparency, etc., are brought together.

A significant challenge is that the minor contributions of digitalisation (optimisation of individual products) are relatively easy to explain, measure and support politically, while the greater, transformative, systemic changes are often more difficult to measure and explain. They demand numerous interacting measures that are often based on multiple government ministries, public agencies and business sectors collaborating in a way that seldom occurs today. Consequently, focus is apt to end up on the minor contributions of digitalisation, with risk that the major contributions will be overlooked.

COMMITMENTS OF THE DIGITALISATION CONSULTANCY INDUSTRY

Firms in the digitalisation consultancy industry must assume greater responsibility for more actively contributing to global development and implementation of sustainable, fossil free solutions. We have prioritised the following strategic commitments.

By 2030:

 Cut the industry's energy use by at least half by 2030, with the ambition of reaching zero emissions by 2045 (in accordance with the IPCC's low-energy scenario).

By 2020:

- Agree a minimum level of knowledge among our employees regarding the impacts of digitalisation from a climate and sustainability perspective.
- Carry out training initiatives to ensure that our employees meet the minimum level (above) within one year after they join the firm.
- Agree a framework to report positive and negative contributions (Scope 1-4, including avoided emissions).
- Find resources for building and launching a web platform where industry firms' capacity and contri-

butions to a national knowledge boost are made available to each other, clients, academia and government. We recommend that the platform should include:

- Presentation of cases including climate impact
- Training materials, methods and reports
- Information about joint initiatives
- Contact details for individuals with particular expertise
- **5.** Adopt new commitments up to 2022 based on conditions in 2020.

CHALLENGES TO THE SWEDISH PARLIAMENT AND GOVERNMENT

We have identified seven strategic measures within the framework of the roadmap process that can promote the central role of digitalisation in achieving a fossil free future:

1. Appoint a digital transformation committee with international ambitions

Appoint a committee tasked with identifying knowledge gaps, legal barriers, organisational lock-ins and incentives blocking Sweden's opportunities to accelerate the adoption of digital solutions for a fossil free future.

2. Update appropriation directions with requirements for digital low-energy strategies

Task all government agencies, via their appropriation directions, with developing strategies by which digitalisation can optimally create the prerequisites for a global, sustainable fossil free future by means of energy-smart scenarios.

3. Encourage reporting of Scope 4/avoided emissions that unpack the potential of digitalisation

Augment current incentives that encourage businesses to report their own emissions (Scope 1-3 emissions), including incentives to also report contributions to reduced emissions from the goods and services they provide (Scope 4/avoided emissions).

4. Appoint a fast-track inquiry into data that supports global sustainability

Appoint a fast-track inquiry to determine what data is currently available or can be made available to equip citizens, government agencies and businesses to develop new and innovative solutions from a global sustainability perspective.

5. Clarify the responsibility for digitalisation and sustainability within all government ministries

In order to facilitate coordination within the Government Offices of Sweden, we recommend that the responsibility for the impacts of digitalisation from a sustainability perspective is clarified within each ministry.

6. Allocate resources for a national knowledge boost

Implement a national knowledge boost by augmenting current knowledge-building initiatives in digitalisation and sustainability with focus on how digitalisation contributes to a sustainable fossil free future.

7. Establish testbed zones for sustainable digital transformation

Establish a national initiative in which zones and entire cities interested in acting as testbeds for transforming society in a fossil fuel-free, ecologically sustainable and socially equitable manner can be brought together.

IMPLEMENTED YEAR 2019-2020

- The industry has agreed on a minimum level of knowledge among our employees regarding the impact of digitalisation from a climate and sustainability perspective.
- A working group has been formed to act as purchaser of joint e-learning for training activities aimed at ensuring that all employees attain the above minimum level within one year of employment.
- The work of reaching agreement on a way to identify and report avoided emissions has started.

The heating sector

Summary of roadmap for a fossil free heating sector

The heating sector will be fossil fuel free by 2030. In 2045, it will be a carbon sink that helps reducing the total Swedish greenhouse gas emissions. Collaboration is an important tool to achieve this vision.

The roadmap for fossil free heating has been developed in collaboration between about fifty actors in the heating market (district heating companies, heat pump companies, biofuel companies, property owners and builders, municipalities, county councils and regions) with the consulting and research company Profu as the editor. In order to realize the vision, they have agreed on 42 commitments for the actors in the heating sector and 21 calls for actors outside the heating sector, primarily parliament and government.

»The goal is for the heating sector to be completely fossil fuel free in 2030 and, in addition, to be climatepositive in 2045«

The heating sector is a large part of the Swedish energy market. It has an annual turnover of almost 100 TWh of energy and 100 billion SEK (Värmemarknad Sverige, 2014). The heating sector in this context concerns heating and domestic hot water preparation in housing and premises. The roadmap also includes comfort cooling in buildings. Cooling is a smaller product than heating, about 5 percent of the heating's energy use, but can become of greater importance in the long run.

From a large oil dependency, the heating has been reversed and is today dominated by district heating, heat pumps, electric heating and biofuel. The direct use of fossil fuels in individual boilers in buildings amounted to 2 TWh in 2016, compared to 27 TWh in 1995. The use of fossil fuels has also decreased in the production of district heating and electricity, in district heating to 5 TWh in 2016 compared to 14 TWh in 1995. The heating sector has thus made a powerful contribution to the conversion of the Swedish energy system.

This roadmap is a first step in the continued work towards a fossil free heating sector. The signatories' ambition is to continue the cooperation on the roadmap and to use it as the basis for collaboration between different parties in the heating sector, which all participants see as valuable and want to strengthen. All actors in the heating sector who want to contribute to the development towards a fossil free heating are encouraged to join the vision and commitments by signing the road map.

The goal is for the heating sector to be completely fossil fuel free (no use of coal, fossil oil or natural gas) in 2030 and, in addition, to be climate-positive in 2045. To achieve this goal, the actors in the heating sector have, among other things, undertaken to:

- Completely phase out the use of remaining fossil fuels and base also this district heating production on recycled energy, such as residual heat from industries, businesses and buildings, energy recovery of waste and fossil free renewable fuels.
- Promote the development towards being fossil fuel free by setting ambitious energy and climate targets in municipalities, regions and county councils and implementing these, both in their own business and in collaboration with other actors.
- Integrate reduced climate impact into goals and strategies for different public functions, such as building of housing and premises, energy supply, transport, waste, resources, water and sewage,

and work strategically with procurement for reduced climate impact.

- Sort and/or facilitate sorting of waste, especially plastics, in order to minimize fossil content in residual waste that goes to energy recovery, in the construction process and in the management phase.
- Recover the energy from waste in an environmentally safe manner for as long as there will be waste that is not allowed to or not possible to recycle, and reduce the amount of plastics to energy recovery.
- Through technology development, make heat pumps and system solutions more efficient and, by means of increased control and new models for business and collaboration, reduce electricity consumption and peak power requirements.
- Follow and aim to surpass the regulations stating which refrigerants that are allowed and the handling of these. Refrigerants with low climate impact should be used.
- With the help of new, more efficient biofuel boilers and smart system solutions, reduce emissions of harmful substances and, through increased efficiency, achieve a better use of biofuel from our green forestry.
- Intensify work on energy efficiency that reduces the heating and power requirement in newly produced and renovated buildings. The actors in the housing and construction sector behind this roadmap will push technology development in terms of reduced power peaks, energy storage, solar energy and solar heat. It is also important to make better use of excess heat.

The latest IPCC report shows that elimination of greenhouse gas emissions in the world by 2050 will not be enough, the international community must also bind emissions and reduce the concentration of greenhouse gases in the atmosphere in order to limit the global temperature rise to 1.5 degrees.

The heating sector is ready to take on this challenge. This means that the industry needs to bind carbon dioxide emissions, for example by using CCS (Carbon Capture and Storage) technology. This could potentially neutralize the emissions from the remaining fossil-based content of the waste being energy recovered. For the bio-based fuel, the impact could be climate-positive since carbon atoms that are already included in the natural cycle are removed. In addition, it can contribute to climate-negative emissions in Sweden as a whole.

The signatories behind the roadmap have also agreed on a common approach to implement the plan, we:

- Are positive to local energy partnerships and cross-sectoral collaboration and to develop business models that support such development.
- Will work to phase out remaining oil boilers and electric boilers.
- Will act as an example within each business to encourage fossil free energy, energy efficiency, resource management and reduced greenhouse gas emissions.
- Premiere fossil free within procurements.
- Strive to avoid the use of fossil fuels in their own operations, e.g. during transport.
- Strive to engage in other challenges within "Fossil Free Sweden".
- Encourage the different parties within the heating sector to develop their own roadmaps on how to become fossil free, with explicit goals and sub-goals.
- Strive to create a common method for greenhouse gas calculation for different energy carriers.
- Strive to understand the overall consequences of our actions through a holistic view of the energy system and by assessments from a life cycle perspective, and act on these insights.

There are however obstacles that need to be eliminated for the roadmap to be realized. Therefore, the recommendation to the government, parliament and government agencies is to address the following proposals:

 After the energy agreement between five political parties, focus on the power/capacity issue in the entire energy system, including the heating sector and cogeneration, is needed.

- Redesign the building codes to stop them from controlling the choice of heating source.
- Create incentives for increased cogeneration of heat and power by valuing power and not just energy.
- Introduce policy instruments that provide incentives »early in the chain«, for example, already in product design and procurement, in order to steer away plastic from residual waste.
- Support research, development and demonstration of new technology such as bio- and waste-CCS, bio-coal, solar heat, seasonal heat storage, combined heat and power production with higher electricity exchange, small-scale combined heat and power technology, fourth generation district heating and recycling refinery for plastic waste.
- Ensure conversion from electric heating to district heating, heat pump or biofuel.

To implement the heating sectors roadmap for fossil fuel free heating successfully, the actors behind it clearly

see the need for increased collaboration throughout the value chain to continue the sustainable development and manage the complex challenges that it may entail. Together we have the power to change!

IMPLEMENTED YEAR 2019-2020

- Test site for Bio-CCS commissioned in December 2019.
- An installation for the elimination of plastic waste from residual waste submitted for incineration is under construction in the Stockholm region.
- Several district heating companies are phasing out the last fossil fuels, for example the largest coal-fired combined heat and power plant in the country will be decommissioned in 2020.
- Extensive calls for research on negative emissions, the Green Industry Leap support for negative emissions.



HEATING SECTOR

The maritime industry

Summary of roadmap for fossil free maritime industry

In the summer of 2017 the Swedish Government adopted a framework climate policy that included a climate law with the demand that emissions from national transport systems will be reduced by at least 70 percent by 2030 compared to 2010 levels. In order to achieve this goal Sweden needs to be a transport effective society through social planning, the use of fossil fuel free and energy effective road transport, and water born transportation that runs off renewable energy sources.

In April 2018 the International Maritime Organization, the UN body focused on shipping, adopted the goal of reducing greenhouse gases from international shipping by at least 50 percent by 2050, compared to 2008 emission levels, and to strive to phase out emissions totally by the end of the century in accordance with the goals of the Paris Agreement. Additionally, the IMO adopted a goal regarding further energy efficiency improvements and emissions per unit of transport work that shall be reduced by 40 percent by 2030. These goals were adopted with broad support from both IMO member states as well as within the shipping industry.

The Swedish shipping industry is a multi-faceted branch with actors operating locally, regionally, nationally and globally, with vessels that vary in size from small taxiboats to ocean-going vessels that are hundreds of meter in length. Common to all of these vessels is their ability to efficiently transport passengers and goods between the world's oceans, countries, regions, islands and within our own archipelagos which is of crucial importance for increased prosperity throughout Sweden.

Shipping can support the Swedish goal partly through absolute emissions onboard vessels, but maybe primarily through taking advantage of the efficiency of shipping by increasing the proportion of cargo carried by shipping compared to other modes, thus relieving other transport sectors through lower emissions of carbon dioxide per transported unit. Today the major obstacles are not primarily technical, although there are some of these problems to be resolved still. Rather, it is the availability of fossil-free fuels, the availability of well-functioning financial instruments which offer the possibilities for environmental and climate-investments, and the suitable use of economic instruments, in the form of taxes and fees, which would help push industry in the right direction. In order to accelerate this transition there needs to be an increase in profitability, costs need to be kept low, and economic models need to be customised or adapted.

Technologies already exist to convert vessels to use alternative fuels or energy sources such as gas (liquid natural gas, liquid bio gas), battery power, biodiesel, methanol, bio-methanol and other fuels, but with limitations. These limitations include the insufficient supply, or current lack of availability, of biofuels to meet shippings' overall needs, whether domestic or international. Similarly, batteries do not have the required power capacity for larger vessels which sail longer distances. Given the scarcity of biofuels, the shipping industry notes, just as the Swedish government points out in its April 2018 climate strategy document, that biofuel availability, in both the long and short term, is dependent on the development of both global and regional biofuel markets.

Research has however shown that from a societal perspective investment in new environmental technologies can have environmental and health benefits, as well as create new employment opportunities in companies developing and marketing new solutions.

When socio-economic gains are calculated, then payoff times of a few years are not uncommon. It is important therefore that society supports, in various ways, the introduction of new technologies. Different factors have differing levels of influence on the possibilities of reducing greenhouse gas emissions from shipping, both internationally and nationally.



There are important changes needed to achieve a fossil-fuel free shipping industry that the industry itself has no influence or control over, such as the availability of sustainable fuels, shaping of regulations, government instruments and incentives, or the transport buyers (passenger or charterer) willingness to pay for sustainable transport.

Essential changes which the shipping industry does have the resources to influence include giving passengers the possibility to climate compensate, improved capacity utilization, increasing transport buyers' knowledge or awareness of the benefits of cleaner shipping, as well as testing, developing and investing in new fuels and energy efficiency.

To achieve the changes that are needed to be free of fossil fuels, it is essential that there is cooperation between all main actors within transport buyers, harbours, academic institutions, marine technology firms, shipyards, energy suppliers, authorities, politicians, and shipowners and operators.

Through an analysis of the obstacles of achieving the goals of creating a fossil-fuel free shipping industry, the following main challenges have been identified.

- Shortage of fossil fuel free energy solutions and renewable energy sources
- Limited technology solutions
- Disadvantageous economic factors
- Insufficient investment into research
- Obstructive regulation

Today the Swedish shipping industry leads the development within various fields and sits at the cusp of climate and environmental work, a position already identified by the International Transport Forum of OECD.

Sweden has the qualified industry actors willing to invest in and contribute to innovation and show the road to change, an absolute necessity in meeting both international and national climate goals.

One challenge is to achieve a suitably high level of profitability during this period of transition. This requires a conscious strategic investment from both industry and the state, this means investment in the development of new technologies and new solutions. There is no alternative, climate change is not a negotiation.

Finally The roadmap presents a checklist of suggested actions, in part for the shipping sector, but also for politicians, authorities, local councils and others.

Since no single action on its own can help us achieve the end goals, it is impossible to create mutually acceptable priorities of actions. An over-riding interests of all those involved is however that the actions listed are addressed and that they are acted upon as soon as possible.

IMPLEMENTED YEAR 2019-2020

- The industry has invested in new vessels using gas and battery power.
- Shipping companies have ordered biogas that has been delivered at the port of Gothenburg.
- The Swedish shipping industry has contributed to a proposal made at global level on how the global industry will finance an R&D fund with SEK 50 billion over ten years.
- The Government has appointed a National Coordinator for domestic shipping at the Swedish Transport Administration.
- The Government has applied to the EU on an extension to the end of 2023 for tax reductions for shore-side electricity to vessels at berth in a port, called shore-side electricity.

8 oktober 2020 Submission of roadmaps to the Deputy Prime Minister and Minister for Environment and Climate ISABELLA LÖVIN and Minister for Business, Industry and Innovation IBRAHIM BAYLAN.

Agricultural sector Automotive industry passenger cars The automotive industry heavy transport Electricity sector Fast-moving consumer goods industry Gas sector Petroleum and biofuel industry Recycling sector Ski resort sector

Fossilf

The agricultural sector

Roadmap for fossil free agricultural sector

The work on the roadmap for the agricultural sector has involved industries in crop production, cereals, dairy, horticulture and slaughter. The contents of this and a number of other roadmaps overlap, because agricultural companies are active in a wide range of production and distribution chains.

The target vision for the agricultural sector's roadmap for fossil-free competitiveness is:

- Maintain and strengthen its leading role in the work of sustainability.
- Be a facilitator for other industries to become sustainably fossil-free.
- In line with the food strategy and in the best interest of the climate, production in the industry must be increased throughout the period.

The roadmap sets the milestones

- 25 % fossil-free on motor fuel, drying and heating in 2020.
- 40 % fossil free in 2025.
- 100 % fossil free in 2030.
- We intend in the long term to phase out the use of mineral fertilisers produced with fossil fuels. The relationship between the competitiveness and production costs of the agricultural sector, as well as the national economic and consumer market valuation of the sustainability benefits delivered, determines the pace of this transition.
- The transition is to be made on domestically produced fuels (solid fuels, biogas, biodiesel, ethanol, electricity etc). The extension of domestic production must take place in pace with the transition in order to keep to the timetable.

To achieve this transition, we identify the following opportunities and challenges:

- Swedish food production should be increased in line with the food strategy and increased climate benefit. The transition to become fossil free must be achieved by increasing competitiveness and strengthening the position of Swedish produce on the market.
- 2. For our industry's continued high level of credibility in the areas of sustainability and the circular economy, the transition to become fossil free must take place on domestically produced fuels and non-fossil inputs. The timetable of our roadmap will therefore depend on the availability of new technologies, Swedish sustainably produced biofuels and fossil-free inputs.

Messages to policymakers for implementation of the roadmap:

- Biofuel rebate Transition to fossil-free fuels should not entail economic disadvantage.
- **2.** Incentives for domestic production of sustainable renewable fuels.
- Endeavour to achieve level conditions for production and consumption in the EU. Better production support in other EU countries must not eliminate Swedish production (e.g. biogas) and consumption support disadvantage domestically produced fuels (e.g. ethanol).
- 4. Energy efficiency throughout the whole chain.
- 5. Increased investment in research and development.

NATIONAL FOOD STRATEGY TO ACHIEVE POTENTIAL

The national food strategy, adopted by the Riksdag (Swedish Parliament) in 2017, is important for the longterm investments in the industry needed to achieve the potential for Swedish food production. In recent years,





food production in Sweden has found it more and more difficult to hold its own in the market with more and more food from countries where the cost of production is lower. In an international perspective, Swedish food production is more environmentally and climate efficient and has high standards of animal welfare and animal health. The benefits of this production, beyond increased food production, cannot be realised unless the trend is reversed so that more food is produced in the country.

In the roadmap, companies like Arla, HKSan and Lantmännen present their respective targets for reduced environmental and climate impact.

CURRENT SITUATION AND DIRECTION

Swedish agriculture has advanced a long way in the transition to renewable energy in heating and electricity. What remains is to convert tractors and working machines to renewable fuels and electricity.

In 2018, the use of energy in agriculture was 5.9 TWh, of which 2.4 TWh came from diesel fuel and 1.3 TWh from biofuel.

The work of the agricultural sector in the field of renewable energy is divided into three areas: streamlining, producing/ selling and transition to renewable energy. Energy efficiency on farms is a developing process that has been going on for many years. Technical adaptation, new equipment and major investments contribute to this development. Renewable energy production is growing and the greatest increase just now at farm level is investment in solar cells. Interest in biogas is also strong and the potential is high but unfortunately there has been a slowdown in expansion of installations in recent years. As the production of biogas is stimulated, for example, in Denmark and the use of biogas is stimulated in Sweden – regardless of where the gas is produced — the use of biogas is increasing without any increase in the domestic production of biogas. Renewable energy transition is well advanced in the area of heating of farm buildings and houses. In the case of fuel for tractors and drying of cereals, there is still much to be done.

Production of solar electricity is steadily increasing and in 2018 production amounted to 53 GWh and 2,500 agricultural companies have installed solar cells. In 2018 there were 44 on-farm plants producing biogas. In addition to the on-farm plants, more than 100 farms deliver manure to 21 of the 36 co-digestion plants in the country. Biogas consumption is increasing in Sweden, but the increase consists of biogas from Denmark.

The potential for a sustainable increase in the extraction of agri-based biomass is currently estimated at an average of 18 to 20 TWh per year. The potential is estimated to increase to about 35 to 40 TWh, but the uncertainty is due to ecological constraints as well as to increased competition for arable land for food production.

IMPROVED COMPETITIVENESS NECESSARY FOR DEVELOPMENT

A requirement for increased domestic production of renewable energy types from agriculture as well as increased transition to become fossil free within the industry is the improvement of conditions for Swedish food production in line with the food strategy, while at the same time contributing increased climate benefits. The transition to become fossil free must be achieved by increasing competitiveness and strengthening the position of Swedish produce on the market.

In order to increase the use of biofuels in the agricultural sector, the incentives to run on renewables need to be reinforced. With the current policy instruments and tax systems it is more expensive for the farmer to use 100 per cent renewable fuels than to use fossil fuels.

The basic conditions for bio-based economic development here are good, and to accelerate progress, good policy conditions and synergies are needed in the development of new knowledge about the new markets.

The potential of the agricultural sector means its place in the bioeconomy is as self-evident as that of the forestry sector. The potential to deliver biomass from agriculture is almost as great as from forests in Sweden. Achieving this potential requires substantially improved competitiveness. There are a number of laws and ordinances that are in conflict with the large-scale implementation of the bio-based economy. Consequently, harmonisation of laws and ordinances is required to remove obstacles to successful implementation of the bio-economy.

With the support of the roadmap, ongoing work on the transition to fossil-freedom in the agricultural sector will continue.

The automotive industry passenger cars

BIL Sweden's roadmap for passenger cars

The climate target for domestic transport is to reduce emissions by 70 per cent by 2030 (compared with 2010), and by 2045 the vehicle fleet should be totally fossil free. For passenger car manufacturers, electrification is the main strategy for achieving the climate targets, but biofuels are also required.

ELECTRIFICATION GAINING PACE IN THE COMING YEARS

Electrification of the transport sector is a global trend driven by the need to adapt society to fossil-free energy sources. The EU and Sweden have a high level of ambition and are at the forefront in this area. By stimulating electrification, the aim is not only to reduce their own emissions, but it is hoped that this will also lead to the development of technologies, strategies and policy instruments that could then be used by the rest of the world. It can thereby have a leverage effect that may in the long-term have a greater impact on global emissions than their own emission reductions alone. A strong contributory reason for the acceleration of electrification in the coming years is the EU requirement that average emissions from new vehicles need to be significantly reduced over the next decade. All manufacturers have to ensure that the average CO2 emissions for the vehicles they sell in the EU are below certain limits, failing which a very high fine is imposed. A unanimous assessment among manufacturers is that passenger car requirements for 2025 and 2030 are unlikely to be met without a significant percentage of rechargeable vehicles.

SCENARIOS FOR RECHARGEABLE CAR SALES IN THE EU AND SWEDEN

Based on the manufacturers' plans and strategies and EU vehicle requirements, a range of scenarios has been formulated for the European sales of rechargeable passenger cars between 2020 and 2030. In the low scenario, it is assumed that the EU's vehicle requirements are barely met. In the high scenario, it is assumed that the manufacturers' current production plans up to 2025 are achieved, and that market developments are then slightly faster in 2025-2030, as the purchase price of the rechargeable cars is then expected to have fallen to the level of fossil-fuelled cars. Based on this, scenarios are then constructed for Swedish sales of rechargeable cars. According to the high scenario, the fleet average emission decreases to 78 g/km in 2030, i.e. 59 per cent lower than in 2010. The industry will work to reach the higher scenario, i.e. that 80 per cent of new car sales will be rechargeable cars in 2030.

BIOFUELS ARE IMPORTANT, BUT SUPPLY IS A BOTTLENECK

Electrification is the main strategy of passenger car manufacturers to reduce climate impact, but in order to achieve the 70 per cent emissions reduction target for 2030, biofuels are also an important tool. In the case of liquid biofuels, supply is the primary limiting factor. Biogas has the advantage that it can be produced from food waste and similar residues on a relatively large scale.

POLICYINSTRUMENTS AND CHARGING-INFRASTRUCTURE ARE REQUIRED

In order to achieve the ambition of lower emission cars, it is not enough for passenger car manufacturers to provide such models: consumers and businesses must also want to buy them. The vehicles sold are also affected by several factors over which car manufacturers have no control, such as vehicle taxes and subsidies, regulations governing company cars for private use, fuel taxes and the development of a charging infrastructure. In particular, it is estimated that the deployment of fast-charging infrastructure along national main roads is a prerequisite for achieving a broad uptake of rechargeable vehicles,



making it easy also to carry out longer journeys and transportation. Otherwise, the rechargeable vehicles will risk becoming a niche market for vehicles intended only for short distances, such as 'second car' and 'urban transport'.

The automotive industry will work towards:

- Achieving the higher scenario, i.e. that 80 per cent of new car sales will be rechargeable cars in 2030.
- Ensuring that the supply of vehicles is in line with demand.
- Ensuring that skills exist in the industry to cope with the transition.
- Becoming fossil free in both production systems and products, i.e. the whole life-cycle perspective.
- The introduction in Sweden of energy labelling on new vehicles.
- Cooperation with all actors in the ecosystem in the transition to electrification.
- Being a partner for the Government and authorities to achieve the targets.

RECOMMENDATIONS TO THE POLITICIANS

The automotive industry cannot manage the transition alone; the Government needs to assist with:

Infrastructure

- Develop on-road electricity, capacity and output in line with the roll-out of the vehicles.
- Support coordination of public and private charging.
- Influence the EU and selected bilateral agreements so that the charging infrastructure is developed by the Member States and work towards standardisation of technology.
- Continued support in the form of, for example, the Climate Leap programme and the Charge at Home grant.
- Raise the ambitions of the National Board of Hou-

sing, Building and Planning's requirements concerning the proportion of charge points.

Policy instruments for purchases

- Adjust the bonus-malus system, for example by allocating the malus over 7 years instead of 3 years, taking into account all sustainable biofuels and taking into account transport benefits. The payment of the bonus should be adjusted so that the cars are not exported after 6 months.
- Extend the reduced taxable benefits for another 3 years and agreements entered into should apply for the duration of the agreement (normal lease period 36 months).

Policy instruments for use of the vehicle

- The Government should influence the EU so that car manufacturers can take biofuels into account in the emission requirements for 2025 and 2030 for passenger cars and vans.
- Treat plug-in hybrids as electric cars, for example by allowing plug-in hybrids in environmental zone class 3.
- Introduce additional incentives for vehicle owners to refuel with biofuels.
- Introduce differentiated congestion and bridge charges as well as parking costs.
- Introduce a smart kilometre tax in the long term to replace existing taxes and charges on vehicles.

Sweden's climate target for the transport sector is that total emissions should be reduced by 70 per cent from 2010 to 2030. With the measures we have suggested above, our starting point is that we can still reach the 70 per cent target by 2030. The lower CO2 emissions per kilometre from passenger cars, under the scenario that 80 per cent of new car sales consist of rechargeable cars, are expected to make a significant contribution to the target — around 60 per cent reduced emissions in 2030. In order to fully achieve the 70 per cent target, increased use of biofuels is also required. The reduction obligation is an important policy instrument, but we need more instruments to increase the share of biofuels and achieve a higher renewal rate.

The automotive industry heavy transport

BIL Sweden's roadmap for heavy transport

The climate target for domestic transport is to reduce emissions by 70 per cent by 2030 compared with 2010, and by 2045 the vehicle fleet should be totally fossil free. In order to reduce emissions from heavy transport, vehicle manufacturers work with three strategies: increased transport efficiency, increased share of biofuels, both low and high blends, and electrification of the vehicle fleet.

ELECTRIFICATION GAINING PACE IN THE COMING YEARS

Electrification of the transport sector is a global trend driven by the need to adapt society to fossil-free energy sources. The EU and Sweden have a high level of ambition and are at the forefront in this area. By stimulating electrification, the aim is not only to reduce their own emissions, but it is hoped that this will also lead to the development of technologies, strategies and policy instruments that could then be used by the rest of the world. It can thereby have a leverage effect that may in the long-term have a greater impact on global emissions than their own emission reductions alone. The EU has recently formulated average carbon dioxide emission requirements for newly registered heavy goods vehicles, over 16 tonnes, that must be met in 2025 and 2030. All manufacturers have to ensure that the average carbon dioxide emissions for the heavy vehicles they sell in the EU are below certain limits. A consistent assessment among the manufacturers of heavy vehicles is that the requirements for 2025 and 2030 can hardly be met without a proportion of electric goods vehicles.

HAVING ELECTRIC VEHICLES IN THE MARKET IS NOT ENOUGH - A CHARGING INFRASTRUCTURE AND POLICY INSTRU-MENTS ARE REQUIRED

O} The vehicles sold are also affected by several factors that vehicle manufacturers do not control, such as taxes

and subsidies, as well as the development of supporting infrastructure. Good access to charging infrastructure is highlighted by vehicle manufacturers as the single most important success factor for electric vehicles to be able to break through on a broad front.

SCENARIOS FOR ELECTRIFICATION OF HEAVY GOODS VEHICLES OVER 16 TONNES

Based on the manufacturers' plans and strategies and EU vehicle requirements, a range of scenarios has been formulated for the European sales of electric heavy goods vehicles between 2020 and 2030. The heavy vehicle manufacturers estimate that the Swedish share of electric heavy goods vehicles over 16 tonnes may be higher than the European average if the right conditions are put in place, i.e. there are both infrastructure and policy instruments for both the purchase and use of electric heavy goods vehicles. In the low scenario, 30 per cent of new heavy goods vehicle registrations in Sweden in 2030 is assumed to be electric vehicles. In the high scenario the assumption is 50 per cent electric vehicles in 2030. In the high scenario the proportion of electric vehicles in the vehicle fleet is assumed to be just over 16 per cent in 2030. In the high scenario, the fleet's average carbon dioxide emissions will drop by about 30 per cent by 2030. One conclusion is that complementary solutions are needed to reach the target of 70 per cent reduction. In the second half of the decade, fuel cell-electric goods vehicles may become an important complementary technology for some long-distance heavy goods traffic.

LIQUID BIOFUELS AND BIOGAS WILL BE CRUCIAL TO ACHIEVING THE CLIMATE GOALS IN SWEDEN

Biofuels in heavy goods vehicles and busses are crucial for rapidly replacing fossil fuels, as a large part of the





THE AUTOMOTIVE INDUSTRY HEAVY TRANSPORT



current vehicle fleet is also included. In a global perspective, Sweden is at the top in terms of the proportion of biofuels in the road transport sector. There are currently a number of alternatives on the market; biodiesel (HVO100, FAME), compressed and liquid biogas and ethanol (ED95). Accessibility, but also predictability and long-term sustainability, must be ensured. There is a need to expand the production of biofuels, but also filling stations for biogas where needed.

The automotive industry will work towards:

- Up to 50 per cent of sales of new heavy goods vehicles, over 16 tonnes, being electric heavy goods vehicles in 2030, given a sufficiently developed infrastructure.
- Continued improvement of vehicle energy efficiency.
- Promotion of transport efficiency in the transport system.
- Ensuring that heavy vehicles with internal combustion engines can be driven 100 per cent on biofuels.
- Fossil freedom in both production systems and products, i.e. the whole life-cycle perspective.
- Being a forerunner as a sustainable transport buyer of both freight and passenger transport.
- Developing internal skills to cope with the transition.

This will be done by collaborating with all actors in the ecosystem in the transition and being a partner for the Government and authorities to achieve the goals.

RECOMMENDATIONS TO THE GOVERNMENT, RIKSDAG AND PUBLIC ADMINISTRATION

The vehicle industry cannot manage the transition on its own. We need to influence and harmonise with the EU in terms of taxation, electrification and infrastructure for both charging and biofuels, but the right conditions are also needed for the Swedish market.

Electrification requires expansion of infrastructure

The expansion of the infrastructure should be done by stages. We welcome the announced Electrification Commission and the Government's electrification strategy. Clear and ambitious intermediate targets are needed for the electrification of heavy transport, showing the roles and responsibilities of different actors for rapid expansion of the charging infrastructure and for the power and capacity of the network. Successful expansion also requires that flexibility of driving and resting times be adapted to charging. In the first phase, which is here and now, heavy local and regional traffic will be electrified to be followed by long-distance traffic, where there are several alternative approaches. The technical solutions for long-distance traffic are expected to be commercially ready by 2025, which means that the planning of this traffic needs to be started immediately.

Central government needs to contribute to the financing of both charging infrastructure for heavy transport and for the purchase and use of the vehicle. Central government should also actively lead the work on a timed and resourced plan with clear goals for the expansion of charging points:

- At depot, "overnight charging", non-public charging.
- At loading and unloading areas, logistics centres/ terminals, charging during the day, - semi-public charging.
- On the road, truck stops, public charging.
- For long-haul traffic, i.e. long-distance transport, there are several alternative solutions based on electric vehicles:
- Expansion of fast chargers for heavy goods vehicles along our major transport routes.
- Expansion of dynamic charging/electrified roads for long-distance traffic along our major transport routes.
- Expansion of hydrogen infrastructure, similar to the investments in liquid biogas and sustainable hydrogen production.
- Technology and business development in these areas is moving very quickly and it is necessary for the Government and vehicle manufacturers to

work together and in close dialogue with other EU countries. To achieve the 2030 goal, it would be preferable to immediately formulate a main strategy for electrified long-distance transport.

Biofuels

- The availability of sustainable biofuels, but also predictability and sustainability, with about five to ten years of planning horizon must be ensured. For production and access to biogas, we see many important proposals in the government inquiry on biogas, Mer biogas för ett hållbart Sverige (More biogas for a sustainable Sweden) (Swedish Government Official Reports SOU 2019:63). The Government should work to promote the production and use of sustainable biofuels within the EU.
- Keep the tax exemption for clean and high-level biofuel blends.
- Expand production of biofuels and filling stations for biogas where needed.
- For liquid vehicle gas, a certificate system corresponding to that for gaseous fuels should be introduced, in the same way as green electricity certificates.

Transport efficiency

- Extend legislation that enables a coherent road network for longer and heavier vehicles.
- Enable a connected transport system, including the expansion of 5G.
- Enable legislation for an automated transport system.

We also need to increase attractiveness through different types of policy instruments for the use of vehicles:

- Use public procurement as an environmental policy instrument, where government agencies have a special responsibility for clear and offensive environmental and climate requirements in procurement.
- Retain green goods vehicle premium and ensure the necessary budget.
- Remove electricity tax for electric buses and heavy goods vehicles.

 Introduce a smart environmental policy kilometre tax covering all traffic in Sweden, including foreign, replacing existing taxes and charges but retaining the green goods vehicle premium.

Sweden's climate target for the transport sector is that total emissions should be reduced by 70 per cent from 2010 to 2030. With the measures we have suggested above, our starting point is that we can still reach the 70 per cent target by 2030. To fully succeed, apart from the above-mentioned measures, we need to continue to invest in R&D and demonstration, and to scale up demo projects from technology to also cover systems and business models.

The electricity sector

The "Roadmap for Electricity – for a fossil-free society" is significantly different from the other roadmaps produced together with the government initiative "Fossil Free Sweden". The Roadmap for Electricity focuses on how the energy industry will enable a national energy transition away from fossil fuels in all sectors. At the same time, the industry undertakes to phase out the last 2 per cent of fossil fuels in Swedish electricity production by 2030 at the latest. The energy sector is understood here to mean Swedenergy (Energiföretagen Sverige) and our member companies.

Fossil Free Sweden's roadmaps show that moving away from fossil fuels involves a major transition to fossil-free electricity. Demand for electricity from fossil-free fuels will increase substantially to allow Sweden to reach the net-zero emissions target by 2045. Our analysis suggests that Sweden will have an annual electricity consumption of 190 TWh in 2045 compared to today's 140 TWh. The analysis is based on the roadmaps of other industry sectors, which include an extensive electrification of industry and transport and the establishment of new electricity-intensive industry, such as data halls.

Sweden has experienced strong expansion of the electricity system on previous occasions, but then under completely different conditions. This time, it will take place in a deregulated electricity market, with more stringent environmental legislation, where Swedish legislation is closely integrated with EU legislation, at the same time as the electricity system is undergoing major changes with fast growth in renewable electricity production.

Our country was early to build a nationally coherent electricity system. We therefore have one of the oldest transmission grids in Europe. Also, our distribution grids have been in place for many years, so there is an extensive need for new and re-investment in electricity grids. Most of today's electricity generation plants will also need to be renewed or replaced before 2045.

Given the substantial investments that need to be made, long permit processes and investment cycles, 2045 is not far off. Many barriers need to be removed to enable and facilitate the transformation of society, such as the long permit processes. This requires action – and urgently. At the same time, changes in the regulatory framework must be implemented in a holistic way, to ensure the most cost-effective transition as possible for society, while maintaining our high security of supply and competitiveness. As other industries point to electricity as the key to the transformation of society, the electricity sector must lead the way and be at the forefront in order to have time to create the conditions for the transition. It is therefore essential that as soon as possible the energy sector is given the right conditions to become the driver of the transition that we want to and should be.

The overall commitment of the energy industry for a fossil-free society is to meet the growing demand for fossil-free electricity in balance with other societal objectives: security of supply, competitiveness and sustainability. This is crucial for enabling other sectors of society to meet their climate objectives.

In order to meet our overall commitment, among other things the energy industry will:

- Engage with different actors in society in order to increase confidence that all parties are doing what is necessary to achieve the climate objectives. We will create a platform to increase dialogue and knowledge in society and stimulate and shape partnerships with other actors.
- Participate in enhanced cooperation at distribution grid level around planning and prioritising grids and grid capacity to respond to the needs of the fossil-free society. At the same time, electricity network operators will develop Sweden's high level of security of supply through continuous modernisation and development of the grid.
- Analyse the design requirements for the electricity market and the regulatory framework in order to enable the investments necessary to become fossil free. In the course of our work, we will seek broad interaction with stakeholders in the energy sector and beyond in order to contribute qualified input to policy makers.



In order for the energy sector to be able to meet its commitments, the right conditions are needed. We want to be clear that our commitments will not be achievable under current conditions, and hence not the climate objectives either. But what we ask is by no means impossible. What is needed is a long-term perspective, consistent policy and courage.

The problem of limited availability of electric power and shortage of capacity in the electricity grid is particularly noticeable on cold winter days. District heating has a key role to play there. By heating buildings with district heating rather than electricity, while producing electricity in CHP (combined heat and power) plants, the electricity system is relieved in the critical hours.

The Swedish parliamentary parties need to conclude a broad energy agreement with a holistic approach to the energy system. As part of this, we want the energy sector, customers, politicians and other actors in society to come together in a broad framework to ensure an effective transition. A framework that aims to do what is good for the climate, good for the economy and good for Sweden — and to act accordingly. We present below our main calls to politicians, that need to be started as soon as possible:

- Shorten permit processes radically for electricity grids, power generation and industries that are to switch from fossil fuels. Long and unpredictable permit processes are one of the main obstacles to transition. In particular, the Environmental Code needs to be aligned with national climate objectives and resources provided to review authorities and courts.
- Instruct the Swedish Transmission System Operator (Svenska kraftnät) to cooperate on a broad basis with different actors in society in the planning and prioritisation of the transmission grid and grid capacity. This should result in an electricity grid plan that takes into account the climate issue and responds to the needs of the fossil-free society at both national and Nordic level.
- Commission a state public or similar on developing sustainable, predictable and long-term electricity network fees that will stimulate economically efficient development of electricity grids, both

flexibility and grid development, with a balance between and acceptance by the different interests of society.

The energy sector has fantastic potential to make a major contribution to the transition to the fossil-free society so that Sweden continues to be the leader we want to and can be. It is with great enthusiasm we take on the continued development of Sweden's energy system, which is already one of the world's foremost, for and with our customers.

The fast-moving consumer goods industry

The Fast-moving Consumer Goods Industry's Roadmap for Climate-Neutral competitiveness

The Swedish fast-moving consumer goods sector (FMCG) has a chance to transition to climate neutrality while remaining economically competitive, but success will be dependent on developments outside the sector's control as well as developments beyond Sweden.

FUTURE SCENARIO

By 2045, market forces will drive sustainable FMCG production. Price, convenience, taste, quality, healthiness and experiences are still the most important attributes to customers and consumers making purchasing decisions, but sustainability has by now become a hygiene factor.

Swedish FMCG industry operations are completely fossil-free, having achieved their goal of net-zero greenhouse gas emissions. Energy-intensive processes and transports have been optimized and are running entirely on renewable energy. All packaging products are 100 percent fossil-free and recyclable. The collection and analysis of data throughout the value chain has facilitated the industry's successful transition to renewables, something which in turn will help spur competition among companies to develop best-in-class products.

The industry did not embark on the path to climate neutrality alone; the goal was reached by staying in tune with changes in the market and the industry as well as the introduction of new policies and infrastructure. The spirit of collaboration is strong within the FMCG industry, both between fishermen/growers and manufacturers, as well as between suppliers and retailers.

THE SITUATION TODAY

The Swedish fast-moving consumer goods sector is composed of companies that sell food, drink, healthand self-care products, magazines, tobacco and specialty goods to retailers, restaurants and large businesses and households in Sweden. Its companies have a wide range of products, but also a variety of business models, and organise their operations in different ways and across different geographies. Many handle products from several categories. These companies use fossil fuels and affect the climate in different ways, and as such have different options for influencing the climate impact associated with their businesses, depending on which operations they control and which they do not.

For the companies that sell food products, primary production – mainly agriculture and animal husbandry – generates the majority of their climate impact. Processing and production of these companies' goods generates a smaller part of their climate impact, via the energy used to power a range of industrial processes. The climate impact of the industry's packaging comes mostly from primary production – mostly production of petrochemicals for plastics, but also from the manufacture of the actual product packaging and the handling of waste (recycling, incineration). Transport of goods is done by rail and road, both upstream and downstream, and by sea and air for imported goods.

THE PATHWAY TO CLIMATE NEUTRALITY

The industry's own processes and transportation can be climate neutral by 2035. In these cases the transition will entail replacing fossil-fuelled heat sources and cooling agents that have a climate impact, while continuing to improve energy efficiency and develop circular processes for waste minimization. The industry's processes are already effective today, and many are based on climate-friendly electricity and/or bioenergy. To make the next steps possible the industry's roadmap recommends a comprehensive mapping of technologies and





processes and their climate impacts at the company level during the period 2019-2025. During the period 2025-2035 100 percentx fossil-free energy use and a 25 percent gain in energy efficiency should be achievable in Swedish production. Sometime during 2035-2045 production should achieve climate neutrality and new efforts should be focused on waste minimization and circularity.

Within transport the industry acts primarily as a purchaser. If its companies are to be able to procure climate-neutral transport, the use of fossil fuels in road, sea, air and rail transport must be eliminated.

In line with the industry's Transport Initiative, the roadmap recommends that all domestic transport – owned or ordered – should be fossil-free in 2025. The fuels in use should be based on sustainably produced raw materials, and the use of palm oil should be phased out. During the later phases electric and self-driving transport will play a bigger role, and the industry should be able to place gradually stricter requirements on international transport over time.

Packaging that is optimized for sustainability should be fossil-free, recyclable and recycled to the highest possible degree, without leading to food waste. In line with DLF's Plastics Initiative the roadmap recommends that 100 percent of plastic packaging should be recyclable by 2022. At the same time that recycling increases, the industry will have to begin using more fossil-free packaging materials, and the roadmap sets a goal of all packaging being recycled or fossil-free by 2035. By 2045 all packaging materials – including recycled materials – should be fossil-free. A circular economy also requires a decrease in the amount of packaging in use. The industry can also, in collaboration with the retail and restaurant sector, support the development of solutions that enable consumers to bring their own packaging.

The industry cannot directly steer the choice of input materials, processes, and technologies in primary production, where most of its climate impact arises. For this reason it is essential that the industry develop and manage a product portfolio that drives emission reductions in agriculture and the production of chemicals and materials. A key to this development is data.

BARRIERS AND CHALLENGES ALONG THE WAY

Shifting the industry's own processes and transport means avoiding bottlenecks in the provision of climate-neutral, sustainably produced energy.

Research and development are needed to ensure that new, sustainable packaging systems can meet hygiene requirements. A functioning market for recycled plastic must emerge, since the fast-moving consumer goods industry cannot make use of all recycled plastic fractions. R&D in the area of feedstock-recycling is important in the long-term to ensure a clean 'new' plastic for use with food products.

The industry needs to be able to measure, compare and follow up its products' climate impact. A good deal of usable information already exists, but to deliver on the roadmap new knowledge and more and better data will be required.

PRIORITISED POLICY RECOMMENDATIONS

A multifaceted policy effort and expanded collaboration across the entire value chain is needed if agriculture, animal husbandry, and production of chemicals and materials are to approach climate neutrality.

The EU's CAP (Common Agricultural Policy) needs to support the journey towards improved sustainability. An EU standard should be developed for climate data as well as common emission factors. The economics of agriculture should reflect the sustainability services provided, for example by compensating ecosystem services such as the sequestering of carbon in soil. Compensation should also cover the need for better climate data.

Financial support is needed in the area of plastic recycling. The industry has made investments in the first step – the sorting facilities. To deliver the next part of the recycling value chain – cleaning and granulation facilities – support from public financing will be needed.

The importance of increased investments enabling a faster transition to a climate neutral transport infrastructure can not be overstated. Long-term policies are needed to speed up the transition in Sweden.
The gas sector

Summary of roadmap for fossil free gas sector

ENERGY GASES ARE FACILITATING THE TRANSITION

Sweden has already made considerable headway in the transition to a sustainable, fossil free society. Nevertheless, there are still major challenges in a number of areas and energy gases can offer a solution.

Sweden is still using 122 TWh of fossil oil products that need to be phased out in areas like road transport, shipping, and industry. Industry is faced with the task of making the transition in line with Swedish climate goals and at the same time compete on the global market. The electricity system needs to be developed to meet the expected increase in demand, as well as the growing proportion of electricity from weather-dependent technologies. Our air needs to be clean and free of pollutants. Furthermore, we need to switch from a linear to a circular economy, where resource consumption and waste generation are minimised, and their potential is maximised. Agriculture must become more organic, and security of supply must increase to meet the country's need for fuel, raw materials, and crop nutrients.

Energy gases are needed to address the major challenges facing society.

OUR VISION AND OBJECTIVES

Through our trade organisation, the Swedish Gas Association, and within the framework of Fossil Free Sweden, we in the Swedish gas industry have drawn up this roadmap to show how energy gases can contribute to promoting fossil-free competitiveness. The roadmap is the result of the commitment and collaboration that has emerged between many of the companies and organisations responsible for the following vision:

THE GAS INDUSTRY'S JOINT VISION

All energy gases used in Sweden will be completely fossil free by 2045 at the latest.

The potential for producing renewable gas will be realised.

As part of the realisation of the vision, the climate roadmap includes the following objectives:

GAS INDUSTRY OBJECTIVES THROUGH TO 2023 AND 2030

2023: All CNG (Compressed Natural Gas) for transport will be biomethane.

2030: Liquefied gas used to power vehicles will reduce greenhouse gas emissions by an average of 70–90 per cent compared with fossil fuels such as petrol and diesel.

2030: All energy gases in the power and heating sectors will be completely fossil free.

INCREASED PRODUCTION OF RENEWABLE GASES IS REQUIRED

If current energy gas use is to become fossil free, 20 TWh of renewable gas is required. This can be compared with the current level of use of renewable gas, which is less than 4 TWh annually, and where approximately half is produced in Sweden. Even higher volumes of renewable gas will probably be required as industry and the transport sector continue to make the switch from oil to gas in a concerted effort to reduce emissions quickly and effectively.

The production potential exists in Sweden but needs to be realised more rapidly than is the case at present. During the build-up phase in particular we are aware that domestic production may need to be supplemented with imports of renewable gas.

THE GAS INDUSTRY'S UNDERTAKINGS

In the lead-up to our climate roadmap, we formulated 11 prioritised undertakings that the gas industry will work on to realise the vision and achieve the objectives:

• We will invest in increased production of renewable gas in Sweden

The first step is to achieve the national production target proposed by the governmental biogas market inquiry (Biogasmarknadsutredningen): 10 TWh biogas by 2030, of which 7 TWh biogas will be produced by means of anaerobic digestion, and 3 TWh will be in the form of biogas and other renewable gases produced using other technologies.

- We will retain our position as a world leader in the efficient production of renewable gas
 We have already made considerable progress and we intend to retain the leader jersey by constantly developing production technologies, both for renewable gases and the by-products that arise from the production process.
- We will run inter-sectoral projects to make the switch to industrial-scale production

The gas industry will assume an active role in promoting inter-sectoral collaboration, both in Sweden and globally, which will lead to the large-scale production of renewable gas.

• We will contribute to developing the market for renewable gas

We will support and actively contribute to the establishment of national and European registers and guarantees of origin for renewable gas.

• We will make it easy for our customers to choose renewable gas

We will support our customers when they choose from the renewable alternatives in our product portfolio.

• We will make use of digitisation to improve efficiency and hasten the transition

This will involve, for example, using digital tools to cope with fluctuating energy content in the gas networks, intensifying the dissemination of information to our customers, improving maintenance efficiency, and reinvesting in the infrastructure. • We will continue to invest in a gas distribution infrastructure

With increased demand for energy gases, parts of the infrastructure will need to be developed and expanded. We will build the necessary infrastructure and use the new and existing infrastructure to supply a growing proportion of renewable gas.

 We will facilitate the input of renewable gases into the gas network
 We will investigate opportunities and limitations

regarding the input of renewable gases other than biogas into the gas networks.

 We will work proactively to ensure that safe handling of energy gases continues
 Our safety programme will be developed continuously to meet new conditions due to new techno-

logy and a growing proportion of renewable gases.

- We will use our own operations as a model We will be at the forefront when it comes to demanding the best energy solutions on the market. We will undertake to map and minimise any methane emissions from our operations, and actively urge other organisations and companies—engine producers for example—to do the same.
- We will reinforce collaboration with industry around our joint climate roadmap

The Swedish Gas Association annual operating plan will be used as a platform to continuously break down the undertakings in the roadmap into concrete milestones and more detailed goals in the short term. We will also follow up and develop our joint climate roadmap as necessary. The first follow-up is scheduled for 2023.

OBSTACLES ALONG THE WAY TO DEPLOYING RENEWABLE GASES

The most central and challenging undertaking is that as an industry we need to invest to bring about a substantial increase in the production of renewable gas. We have identified a number of obstacles that need to be eliminated if we are to boost production. The most obvious obstacles are:

- Many of our customers want to be free of fossil fuels but cannot afford to do so.
- The demand for renewable gas is uncertain.

- Distorted competition is impeding Swedish biogas production.
- Policy instruments are channelling certain raw materials towards end-products other than renewable gas.
- We are dependent on other sectors for the production of bioLPG.
- There is a considerable economic risk when investing on an industrial scale.
- The market for renewable gas is still undeveloped.

THE GAS INDUSTRY'S CALL FOR POLITICAL ACTION

We urge the Government and Parliament to introduce the following concrete measures immediately:

 Implement the proposals and assessments from the governmental biogas market inquiry (Biogasmarknadsutredningen).

- Develop the Green Gas Concept.
- Reinforce differentiation in shipping tariffs based on environmental considerations and apply fund solutions to stimulate environmental and climate measures.
- Promote a global price on climate emissions.

We can also see the need for new strategies and working methods within the political sphere:

- A national strategy is needed to improve the availability of renewable gases to industry.
- Sweden's planning of the electricity and gas infrastructure needs to take place on a collective basis.
- A plan of action is needed for Sweden as a net exporter within the circular bioeconomy.
- Climate policy measures need to be evaluated from a broader sustainability perspective.



The petroleum and biofuel industry

Roadmap for climate neutral petroleum and biofuel industry

A WORLD LEADING INDUSTRY THAT WANTS TO INCREASE THE PACE

The starting point is to show how the Swedish petroleum and biofuel industry, together with other industries, policymakers and society, jointly can create a climateneutral and competitive Sweden. Carbon dioxide emissions from the petroleum and biofuel industry's processes and products that are sold to consumers and businesses in Sweden are 25 million tonnes, which is about 50 percent of Sweden's total greenhouse gas emissions. The industry's own energy and climate impact from production and distribution is about one tenth of the total emissions from fuel consumption, and around 90 percent of the climate impact arises from the use of the industry's products. The Swedish petroleum and biofuel industry have for a long time been a world leader in finding new, sustainable solutions, improving the efficiency of refineries and plants and replacing fossil with renewable sources where possible. With the right policy conditions, the pace can increase.

INCREASED DEMAND FOR RENEWABLE PRODUCTS AND REDUCED DEMAND FOR FOSSIL

All sustainable solutions will be needed now and in the future, to achieve the climate objectives. There are areas where immediate electrification is preferable and there are areas where biofuels play an important role for the foreseeable future or where biofuels are a valid final objective.

Biofuels and synthetic fuels, which can be used in vehicles equipped with an internal combustion engine, are a cost-effective solution of reducing greenhouse gas emissions and creating immediate emission reductions.

The gradual increase of sustainable biofuels in Europe's fuels will require a significant increase in the volume of

sustainable biofuels. When larger EU countries increase carbon dioxide reduction requirements, demand for biofuels rises dramatically.

GREAT POTENTIAL IN RENEWABLE FUELS

Raw materials currently used for biofuels include tall oil, oilseed rape, animal residues and food and cooking oils from the food industry. Three quarters of global biofuel production of 150 Mm 3 (2017) is ethanol. Sweden produces ethanol with very good environmental properties from crops such as wheat, maize and sugar beet as well as food residues and cereals.

Member companies in the industry are continuously investing in research and development on renewable fuels, more efficient refineries with improved climate and environmental performance, and in finding new sustainable raw material base for liquid fuel production.

By investing heavily in Sweden and abroad, member companies' production of renewable fuels is estimated to grow from today's 4 Mm 3 to 10-12 Mm 3 (90-110 TWh) by 2030. In the longer term, the industry will further double production. A significant part of this volume has a growing international market.

Many additional future raw materials are being investigated, such as recycled plastics and algae. Processes are also being developed to enable the use of lignin, sawdust and cellulose. The industry also sees carbon dioxide as an important future raw material, a view generally shared by the chemical industry.

Swedish producers of fuels have for several years been capturing significant volumes of carbon dioxide from ethanol production, which contributes, among other



things, to increased greenhouse gas performance for ethanol. Carbon dioxide is liquified to carbonic acid and is used in various industrial applications (CCU). In the future, storage in bedrock (CCS) or other locations may be relevant.

In spring 2020 a demonstration facility will be constructed to capture carbon dioxide and to demonstrate its capacity to reduce greenhouse gas emissions, as well as how a complete CCS value chain can be created. The ambition is to develop full scale carbon capture and storage (CCS) facilities at several refineries.

NOT ONLY FUEL

Of all fossil crude oil used, approximately 95 percent is for fuel production and 5 percent for production of bitumen and base oil and other special oils. In its main use as an adhesive in asphalt, bitumen is 100 percent reusable. The development of non-fossil replacement raw material for bitumen is still at the experimental stage. For insulating oils and base oils some renewal alternatives exist, but the efficiency of the oils based on fossil raw materials is a requirement in future for the estimated increase in electrification of society.

INDUSTRY COMMITMENTS

- Meet the climate policy objectives for 2030 and 2045 — Invest, develop, produce and distribute fuels demanded by consumers, industry and public society, in order to meet the 70 percent target for the transport sector by 2030 and climate neutrality by 2045 at the latest.
- Create sustainable mobility Secure Swedish welfare and competitiveness by creating economic, sustainable and secure mobility with profitability throughout the industry's value chain. This includes roads, airports, ports, and power transmission facilities.
- Make its own activities climate neutral Investing and working for the industry to become climate neutral in its own activities in the form of depots, logistics and marketplaces by 2030. This also includes its own renewable production of electricity.
- Reduce the environmental footprint of production

 Through adjustments and investments in refineries and production facilities for fuels, meet to

day's high environmental requirements and further develop them to reduce the climate footprint of its own production.

- Supply the products in demand To offer consumers and other actors in society (the transport sector, including aviation and shipping) biofuels and renewable electricity, as demanded by the respective industries and required by legislation.
- Contribute skills and knowledge sharing Contribute to the transition to a sustainable society in relation to politicians, consumers, customers and members of the public, and provide information about the impact of decisions on benefits to the climate.
- Contribute to a global perspective on climate benefits and climate goals – Work with global organisations and networks such as ACEA, WEC and FuelsEurope to effectively address the climate goals from a global perspective as well. Liaise with Swedish politicians and authorities with regard to the work on international agreements.
- Research and develop for climate neutrality 2045

 Maintain and further develop Swedish excellence and carry out research and development as part of achieving climate neutrality by 2045.

ENCOURAGING POLICIES TO REMOVE OBSTACLES

The transition that is now required is the greatest in the history of the industry. Smooth implementation will benefit the industry on the international market and the potential of Sweden as a whole to achieve the climate goals. The Parliament and Government now need to take critical decisions in order to make this transition a reality. Therefore, the industry calls for the following political action:

- Take a more prominent place in Europe and give Sweden more influence on the European stage.
- Ensure technology neutrality and a long-term approach in policy instruments for energy for transport and appoint a biofuel commission.
- **3.** Simplify the regulatory environment and speed up the licensing process.
- 4. Develop a national plan for security of fuels supply.

The recycling sector

Roadmap for fossil free recycling sector and circular economy

Society is facing a paradigm shift where fossil raw materials need to be replaced by renewable or recycled raw materials, and where linear resource flows must be replaced by circular. The recycling sector plays a key role in this transition.

The Swedish Recycling Industries' Association's roadmap towards a fossil-free and circular economy fulfils two important functions: on the one hand, to describe the industry's own journey towards fossil-freedom and a more circular economy, and, on the other hand, to show how the recycling industry could be developed to enable other organisations to achieve the same objectives.

The recycling industry consists of a wide range of operations which have in common that they work to increase recycling and resource efficiency in society. According to national statistics, material recovery reduced greenhouse gas emissions by more than 7 million tonnes in 2016. However, fossil fuels are currently used in transport, for heating and electricity consumption and in various recovery and treatment processes. In addition, society has a historical debt which the industry can contribute to resolving, which concerns the leakage of methane from old landfills. In total, the entire industry's greenhouse gas emissions were estimated to be 1.2 million tonnes in 2016 according to the Swedish Environmental Protection Agency, most of which is generated from landfills. Although the focus of this roadmap is forward-looking, the industry needs to help assume responsibility for emissions that still arise as a consequence of historical debts.

The transition to a circular economy and fossil-freedom are closely linked. According to a report by the Ellen MacArthur Foundation of September 2019, up to 50 per cent of society's climate emissions are the direct result of linear management of our material flows. When resource efficiency and recycling increase, emissions from difficult-to-manage sources in global material production (mining, cement and steel production etc.) are moved to emission sources that are easier to influence through the use of renewable energy. But the challenges in the way forward are partly different. In the transition from fossil to renewable, accessibility and costs may be clear barriers. As regards the transition to a circular economy, it is in the immediate economic interest of society and businesses to make use of existing resources more effectively. This requires substantial changes in design (to facilitate recycling), production methods, consumption patterns, regulatory frameworks and market functions.

For the recycling industry, the transition is closely linked to how waste is viewed, and requires a fundamental change in the regulatory framework of the waste market and a new focus on resources. Competition between private and municipal actors must take place on an equal footing, and ownership and responsibility for the waste must be clarified. Together with policy instruments and targets that are directed higher up in the waste hierarchy and which reward recovered raw materials, conditions can be created to give companies the courage to invest in innovative solutions.

The roadmap sets out objectives and commitments for the members of the Swedish Recycling Industries' Association and calls on other industry actors and politicians to achieve a fossil-free and circular economy.

OUR GOALS

Our first goal is that by 2021 recycling actors should have identified their climate impact emissions and set their own climate targets, in line with or more ambitious than these long-term targets:

- 2025: 30 per cent reduction in greenhouse gas emissions compared to 2015.
- 2030: 50 per cent reduction in greenhouse gas emissions compared to 2015.
- 2040: Zero net greenhouse gas emissions.





OUR COMMITMENTS

The roadmap contains 9 measures to become fossil free and 6 measures for a more circular economy. The agenda includes:

- 2022: Action plans to be developed to improve energy efficiency of processes and switch from fossil to renewable fuels or electrify.
- 2022: Sorting of waste for material recovery and biological treatment to be increased and measurable targets set for 2025, 2030 and 2040.
- 2025: New or developed standards for recycled materials to have been produced in cooperation with different industries.
- 2030: All own and purchased transport must be fossil-free.

OUR CALLS

The roadmap contains 20 calls for politicians and EU institutions, with 5 focusing on becoming fossil free and 15 on a circular economy. These calls include:

- Ensure the availability and competitiveness of high-level blends or pure biofuels for transport that is not reasonable to electrify in the short term.
- Introduce requirements and investment support for managing leaking methane from landfills.
- Implement the January Agreement proposal for "a broad review of the regulatory frameworks for recycling and management of waste and residues to promote innovation and entrepreneurship in the circular economy."
- Review all relevant legislation to promote a circular economy and not a linear society.
- Introduce general economic incentives that make recycled materials more competitive on the market.

The ski resort sector

Roadmap for fossil free Swedish ski resorts

The Swedish ski resort sector is closely associated with an active outdoor lifestyle. Every year, two million Swedes go downhill skiing. Skiing is part of a growing fundamental industry. At the same time, it finds itself in the middle of climate change with the challenge of giving a true and fair view of skiing in the future.

The sector has been working to reduce its greenhouse gas emissions for some time. It is natural that the industry should be an active part of the profound societal shift to fossil-free fuel. The purpose of this roadmap is for the ski industry to adopt a unified approach, as effectively as possible.

SLAO, the Swedish Ski Areas Industry Association is an industry and interest organisation representing 200 ski resorts with operations in large parts of Sweden. The circumstances of the members are varied. The large resorts are found in or near the mountain areas. The smallest members often operate close to urban areas, frequently run as non-profit organisations.

In the mountain areas, the ski resort is often the engine of the local economy and proximity to a ski resort may be a pre-requisite for tourism in rural areas. Many young people get their first work experience in a ski resort. Such resorts are also arenas for sports and health for children and adolescents.

The ski industry is dependent on cold winters. A changing climate increases the likelihood of fewer days of natural snow, but increasingly efficient snow-making capacity is helping to maintain the length of the winter season. To ensure good skiing conditions, careful preparation is required through snow making, snow distribution and grooming of slopes.

CURRENT SITUATION

All SLAO members have one or more ski lifts, ski slopes and snow groomers (perspective 1). Some also have ho-

tels and cabin rentals (perspective 2). In the roadmap, ski lifts and ski slopes have been prioritised based on the members' ability to directly influence how they are run. Perspective 3, i.e. travel to and from ski resorts, is included to provide a holistic view of fossil-free skiing. There are more than 800 ski lifts, 450 snow groomers, 1,100 snowmobiles and 5,000 snow guns in Swedish ski resorts. The fuel for grooming machines accounts for about 90 percent of the fuel consumption in the core business. The remaining 10 percent is used in snowmobiles and others.

Of the largest ski resorts, almost all use 100 percent renewable electricity for snow making and operating ski lifts. Snow-making technology has improved significantly since the 1970s when power consumption was approx. 7 kWh to produce 1m³ of snow. Today one seventh of that amount is needed.

For the 2019/2020 season, the total climate-impacting emissions from the core business of SLAO's members is estimated to be 7,500 tonnes of CO2e.

In 2017/2018, the same figure was 12,000 tonnes of CO2e. A switch to the bio-fuel HVO100 in snow groomers has helped to reduce the total climate impact by 40 percent in two years.

The extent of the ancillary businesses (perspective 2) differs between the various resorts. Many have external suppliers, while others own and operate these components themselves.

Today, travel to and from ski resorts (perspective 3) accounts for the greatest climate impact associated with skiing. Most often, guests travel by car, an estimated 90 percent and the resorts have been developed to accommodate this travel behaviour.



VISION AND GOALS

Swedish ski resorts' overall goal is fossil-free skiing with positive effects on public health, employment and circular resource usage.

Vision

It should be more climate-friendly to be in a Swedish ski resort than to be at home.

Objectives

By 2027, Swedish ski resorts will be international leaders in the ski industry's climate change mitigation. This work will focus on educating SLAO's members and also aims to inspire other parts of the hospitality industry.

Targets for the core business

- 2022: 100% renewable energy for ski lifts and snow making.
- 2025: 100% fossil-free operation of snow groomers.
- 2027: 100% fossil-free operation of ski resorts.
- After 2027 the focus will be on contributing to fossil-free operations within perspectives 2 and 3.

Targets for ancillary businesses and transport (perspectives 2 and 3)

- Enable fossil-free ancillary services through knowledge of procurement, increased circularity, changed behaviours, better waste management and labelling/certification.
- Enable fossil-free Swedish ski tourism by 2030 through analysis of transport, influencing concerned parties to follow through on their roadmaps, etc.
- After 2027, work will primarily involve influencing others.

OBSTACLES AND MITIGATING ACTIONS

Obstacles and possible actions for achieving fossil-free skiing in Sweden, including direct and indirect impact of the industry.

Snow groomers can already run on fossil-free biofuels, however, that is not yet the case for snowmobiles. Electric snowmobiles are gradually being introduced into the market. Availability of bio-fuels is an obstacle, as is access to capital for investments in new technology, for smaller resorts. The transition also involves overcoming knowledge barriers and stimulating changes in behaviour.

THE INDUSTRY'S ACTIONS FOR ANCILLARY BUSINESSES

SLAO trains 1,000 individuals every year. Sustainability is intensifying as a driver for change. Knowledge of snow storage techniques is a priority as is eco-driving etc.

A switch to bio-fuels in snow groomers is underway, as is collaboration with suppliers for testing electric snowmobiles.

The industry's activities for energy efficiency and conversion to renewable energy include:

- Encouraging members to switch to 100 percent renewable electricity for snow making and ski lift operation.
- Sharing knowledge about optimal snow distribution.
- Sharing knowledge of the opportunities of using micro-grids.
- Providing energy audits.
- Sharing best practice in a structured way.
- Offering supporting documentation for procurements.
- Mapping out and implementing potential eco-labels/certifications for ski resort operations.

Industry actions for ancillary businesses (perspectives 2 and 3)

In perspective 2, ski resorts can often set requirements via procurements. Therefore, their knowledge of procurement as a tool needs to increase. This includes investigating how to improve the provision of electricity and renewable fuels for visitors' vehicles in the resorts.

Expansion of charging stations at ski resorts and information to guests about sustainable accommodation packages and travel options are examples of activities in the coming years.

In order to switch to fossil-free travel together with visitors and other parties, knowledge about travel patterns needs to increase and a better adapted infrastructure needs to be built.

The ski industry's activities in the transport area (perspective 3) largely involve influencing.

Appeals to policy makers

- 1. Secure well-functioning markets for bio-fuels.
 - Continued tax exemption for fossil-free fuels
 - More stringent obligations to reduce greenhouse gas emissions
 - Bio-fuels included in all public procurement
- 2. Expand solar energy. Invest in targeted subsidies.
- **3.** Stimulate rapid technology shifts through targeted subsidies, e.g. for electric snowmobiles.
- **4.** Assign the responsible authority a mandate to create a centre of excellence for research and development of climate change and snow storage.
- Assign the appropriate authority the task of investigating travel patterns and climate change mitigation potential of the winter hospitality industry.
- Develop the structure for fast EV charging along major roads.
- 7. Double the night train capacity by 2025.
- Review the role of public transport in the hospitality industry.
- **9.** Strengthen domestic tourism through an expanded assignment to Visit Sweden.
- Allow the strategy of the hospitality industry to show Sweden as a pioneering country for climate initiatives and travel.

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