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Part 2

Emissions and Energy

Linn-Maren Kristiansen &
Casper van der Eijk

NTNU, Institutt for
materialteknologi, SFI,
Trondheim

metal production

NTNU
Kunnskap for en bedre verden

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Introduction

This report provides information about greenhouse gas emissions and other emissions such as SO_2, NOx and PAHs in the metal industry in Norway. It gives an overview different measures to reduce the emissions, and concepts as climate allowances, carbon leakage and green competitiveness. The report shows how the authorities and the industry work to reduce the emissions, as well as the work on utilization of waste heat and energy.

Emissions of Greenhouse Gases in the Metallurgical Industry

The Climate Targets in Norway

Norway has the intention to become a low-emission society by 2050, with a couple of sub-goals on the way there. One of them is that the country's emissions of greenhouse gases will be reduced by 30% in 2020, compared to 1990. Another is that Norway will be climate neutral by 2030.[1]

In addition to that, Norway has committed to reduce their emissions of CO_2 with at least 50% by 2030, compared to the emissions in 1990. The reduction goal was originally 40%, but the goal was strengthened in February 2020.[1]

The Industry

In May 2016, an expert committee from the industry delivered a plan for the work towards green competitiveness in the Norwegian process industry. The committee was appointed by the government. "Green competitiveness" is the term used by the Norwegian government for their vision for Norway's industrial future. Similar plans were delivered by a number of different sectors in Norway. The plans describe an overall strategy for increased value creation and employment for the different industries in a society with reduced emissions of greenhouse gases.[2]

Important parts in the plan for the process industry is that an infrastructure for transport and storage of CO_2 is established and that there is sufficient access to sustainable biomass. Emphasis is placed on equal terms in Norway and the EEA, as well as the access to renewable energy with good prices and conditions. Support for research, pilot projects and investment in industrial parks and clusters is also mentioned in the report.[3]

The Government

The government published their strategy for green competitiveness in 2017. It states, among other things, that it will be focus on publicly funded research, innovation and technology development, while the principle that the polluter must pay is emphasized. Putting on a price tag on the emissions makes it more attractive to develop environmental technology. It will also be facilitated for the industry to choose green solutions.[4]

The adjustment from the government is that the Norwegian metal industry should reduce the emissions quickly and efficiently through research, innovation and collaboration. It is emphasized that it should be valuable to run a green business and that the government's rules and articles of association should be predictable.[4]

The Responsibility of the Metal Industry as a Source of Emissions

In Norway, the land based industry accounts for about 23% of the total greenhouse gas emissions, with annually emissions of 12 million metric tons of CO_2-equivalents in 2018. Metal production accounts for the largest emissions of greenhouse gases from industry. Production of mineral products such as cement, oil refineries as well as mineral fertilizer production, petrochemicals and other chemical industries are other important sources of emissions. Industry has larger emissions than, among other things, agriculture, but lower than extraction of oil and gas, which accounts for most of the emissions. In the metal industry, the emissions come from the sources of energy, such as coke and coal, and from the use of carbon as a reductant in the industrial processes.[5] Figure 1 shows the distribution of greenhouse gas emissions between the various industries in Norway in 2018.

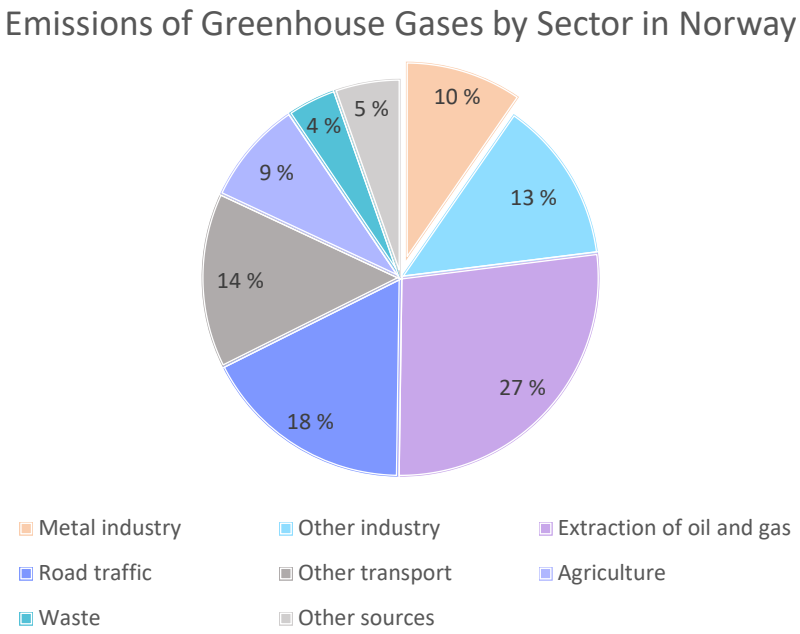

Figure 1: The diagram shows the different sectors' emissions of greenhouse gases to air in Norway in percent. The diagram does not include international flights or imported products. Data from Miljøstatus (2020).[5]

The Development

Major changes have been done in the Norwegian metal industry in the last decades. The greenhouse gas emissions have been reduced with about 52% since 1990. The decrease was greatest in the years before the millennium. Figure 2 shows the development of emissions of greenhouse gases.

The greenhouse gas emissions by the metal producing industry in Norway has been relatively stable in the recent years. There has been a small increase, but this can be related to increased production quantity. Table 1 provides information about the emissions by the different companies and metal producing plants in Norway.

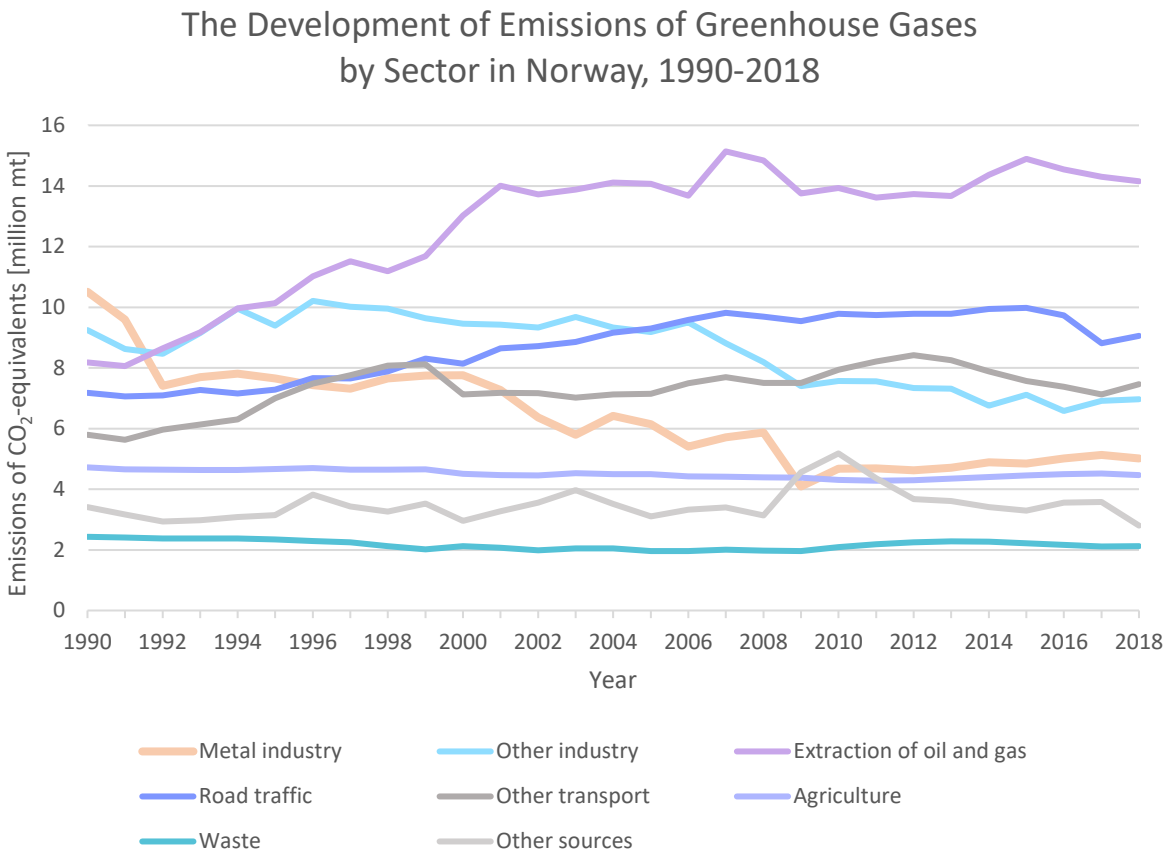

Figure 2: The graph shows the development of greenhouse gas emissions to air from the different sectors in the Norwegian economic activity. The diagram does not include international flights or imported products. Data from Miljøstatus (2020).[6]

Table 1: The development of emissions of CO_2-equivalents for the different metal producing companies in Norway, from 2016-2019. The values are given in metric kilotons.

Emissions of CO_2-equivalents [1000 mt]				
Company	**Year**			
	2016	2017	2018	2019
Aluminium				
Alcoa Lista	172	171	176	185
Alcoa Mosjøen	443	433	424	446
Hydro Holmestrand	27	24	24	25
Hydro Husnes	152	153	155	153
Hydro Høyanger	106	106	109	109
Hydro Karmøy	326	356	441	472
Hydro Sunndal	614	678	666	718
Hydro Årdal	534	358	358	374
Sum - Aluminium	**2374**	**2278**	**2353**	**2482**
Silicon and Ferrosilicon				
Elkem Bjølvefossen	156	154	168	147
Elkem Bremanger	229	246	244	198
Elkem Rana	301	282	271	238
Elkem Salten	315	325	309	296
Elkem Thamshavn	222	214	226	223
Finnfjord	291	269	271	305
REC Solar Norway	47	47	48	47
Wacker Chemicals Norway	257	249	243	313
Sum - Silicon and ferrosilicon	**1817**	**1785**	**1779**	**1766**
Ferromanganese				
Eramet Kvinesdal	228	228	212	208
Eramet Porsgrunn	131	185	146	189
Eramet Sauda	343	321	330	332
Ferroglobe Mangan Norge	92	150	90	99
Sum - Ferromanganese	**795**	**885**	**778**	**827**
Silicon carbide				
Fiven Norge	48	56	53	46
Washington Mills	0	1	7	5
Sum - silicon carbide	**48**	**57**	**60**	**51**
Other metal industry				
Boliden Odda	4	6	7	6
Celsa Armeringsstål	92	99	93	90
Glencore Nikkelverk	16	16	17	17
TiZir Titanium and Iron	146	261	251	258
Sum - other metal industry	**258**	**381**	**368**	**371**
Sum - total	5292	5386	5338	5497

Note: Data from the Norwegian Environment Agency (2020).[7]

Examples of Measures to Reduce Emissions

Glencore Nikkelverk: New Copper Electrolysis Technology

New copper electrolysis technology at Glencore Nikkelverk in Kristiansand will be able to reduce the energy consumption with over 30%, compared to the old technology. A pilot plant was built in 2012, and the pilot project has been developed to a demonstration plant.[8] The nickel plant applied for funding in 2018 and received approval. The plan is to implement the new copper electrolysis technology by 2022.[9] The new technology has been developed in Kristiansand with involvement from international partners and suppliers.

If the technology gets implemented at Glencore Nikkelverk and other international copper plants, it could result in a reduction in energy consumption of 7 TWh annually. This is equivalent to a reduction of 3.5-4 million metric tons of greenhouse gas emissions each year.[8]

TiZir: Hydrogen Technology

TiZir is planning to replace coal with hydrogen as a reducing agent in the production of titanium slag and pig iron.[10] The potential for the transition to hydrogen technology is a reduction in energy consumption and emissions of CO_2 of 40% and 90% respectively. It will be possible to transfer the technology to other industries.[8]

Eyde: Biocarbon

The project of the Eyde-cluster aims to establish production of biocarbon from Norwegian wood. The goal is to reduce greenhouse gas emissions from the Norwegian process industry by partially replace fossil raw materials, such as coke and coal, with charcoal. The potential for the reductions by 20% admixture will be 150 000 metric tons of CO_2-equivalents in the ferrosilicon industry and 220 000 metric tons of CO_2-equivalents in the ferromanganese industry.

A life cycle assessment is designed to look at the climate effect of biocarbon production. It shows, among other things, that the production of an amount of biocarbon corresponding to 40% of the reduction material in Elkem's silicon and ferrosilicon production will reduce the emissions with 500 000-600 000 metric tons of CO_2-equivalents. This reduction is due to the fact that the by-products from the production can be used as fuel and in pyrolysis processes in metal production.[8]

Elkem: Climate Neutral Metal Production

Elkem aimed to use 20% charcoal in the reduction material for the production of silicon and ferrosilicon alloys in Norway by 2021, and further increase to 40% by 2030. They reached the 20% goal in 2018 and are working to reach their 40% goal. They are currently working on a project called PyrOPT, which is a continuation of CNMP (Carbon Neutral Metal Production).[11]

The CNMP concept involves producing charcoal at the plant where the metal production takes place and connecting both production cycles to a thermal power plant. This symbiosis has the potential to go into excess power and it will be possible to produce bio-oil.[8]

PyrOPT's goals are to improve part of the CNMP and make it more economically beneficial, making the biocarbon more suitable for silicon production. The project will also look at how to reuse the gas and condensate from the process.[11]

If Elkem manages to use 40% charcoal in the production process, it will correspond to a reduction in greenhouse gas emissions of 320 000 metric tons. The bio-oil from the production can be used as fuel and thus also reduce emissions. If closing the furnace becomes a possibility, an ideal, carbon-neutral and energy-negative process can be achieved.[8]

Emission Allowances in the Metal Industry

Norway is part of the EU's allowance system for greenhouse gases, which is a regulation to reduce the emissions. Buying climate allowances corresponds to buying a permit to emit greenhouse gases, one climate allowance is the same as one metric ton of CO_2-equivalents. In Norway, there are several industries that are required to buy climate allowances, i.a. the production of cast iron and steel, aluminium and ferroalloys. The companies are allocated a number of allowances annually, free of charge. The number of free allowances is reduced gradually every year. If they want to emit more greenhouse gases, they have to trade with others or buy more allowances on the market. Otherwise, they will be fined 100 euros per metric ton of emissions. There are just a few allowances available at the market, so the price will rise and fall with the demand.[12]

The allowance system is constantly changing. In the years to come, more countries in Europe and in the rest of the world will start using allowances, and many countries are in the process of introducing it. This includes China, which has a lot metal industry. The introduction of the system in China will have a major effect on the allowance market.[13] Another change is that the number of allowances available will decrease with 2.2% annually from 2021. This means that the emissions have to be reduced. New technology and adaptability will be the key to reduced emissions in the metal industry. It is difficult to reduce the emissions, but the industry works purposefully with both new technology and implementation of existing ones. Heat and energy recovery, as well as storage of CO_2, will be an important part of this because the industry must profit from all parts of the process and will not be able to afford to waste resources.[12]

Carbon Leakage

If a business becomes unprofitable in a country due to laws and taxes, e.g. in Norway, it can lead to closure. If the market demand remains unchanged, a similar industry is likely to be expanded in another country. This new business will usually emit more greenhouse gases than it would do in Norway, due to less strict climate regulations. Carbon leakage is defined as the transfer of emissions to other countries when a country implements measures that reduce its own emissions of CO_2. This can lead to an increase in the total emissions.[14]
The Norwegian government must be careful about making taxes and laws that make it more difficult operating industry in Norway than other countries, to prevent carbon leakage. It is also important to cooperate on emission reductions across national borders. The system with climate allowances can help this cooperation.

Other Emissions

Emissions of Sulphur Dioxide

Sulphur dioxide is formed by the combustion of substances containing sulphur, like certain coal qualities. This can lead to rain acidification and health problems, especially for people with respiratory illness and diseases. The largest source of emissions in Norway is industry and mining, which includes the metal industry, counting for 70% of the emissions in 2018. There has been no major decrease in sulphur dioxide emissions in recent years, but the emissions have been reduced with 67% since 1990. A total of 16 000 metric tons of sulphur dioxide was emitted in Norway in 2018.[15] The graph in Figure 3 shows the development of emissions of SO_2 from different sectors. "Other sources" includes extraction of oil and gas, and road traffic.

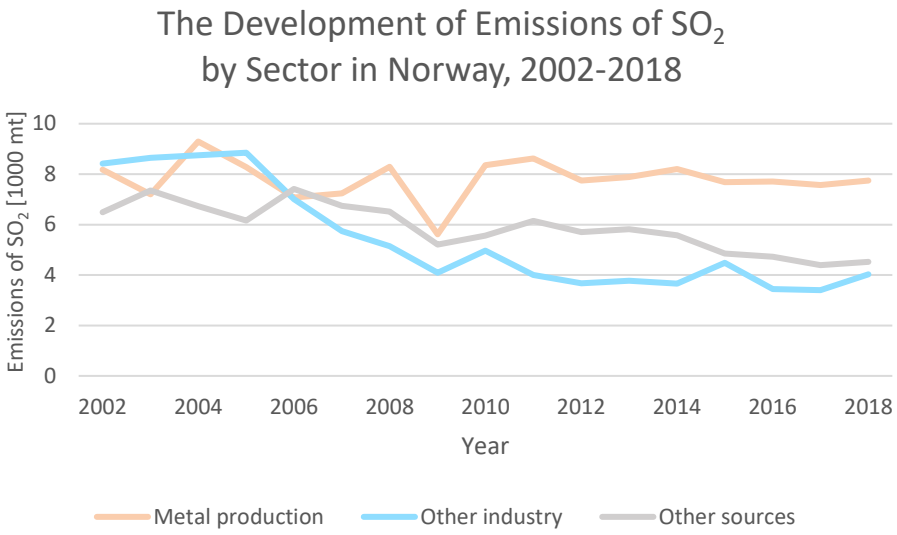

Figure 3: The graph shows the development of SO_2 emissions to air from the metal production industry and other sources in the Norwegian economic activity. Data for metal production from the Norwegian Environment Agency (2020), and for other industry and other sources from Miljøstatus (2020).[15,16]

Emissions of NO_x

NO_x is a collective term for the nitrogen oxides NO and NO_2. These gases contribute to the formation of smog and acid rain.[17] The gases are usually produced from the reaction among nitrogen and oxygen during combustion of fuels in air; especially at high temperatures.
The Norwegian industry emitted 17 585 metric tons of NO_x in 2018, that is 10.7% of the total emissions of NO_x in Norway, which was 163 500 metric tons. The total emissions in Norway have been reduced with 19% compared to 1990. Today, transport is the largest source of emissions of NO_x.[17]

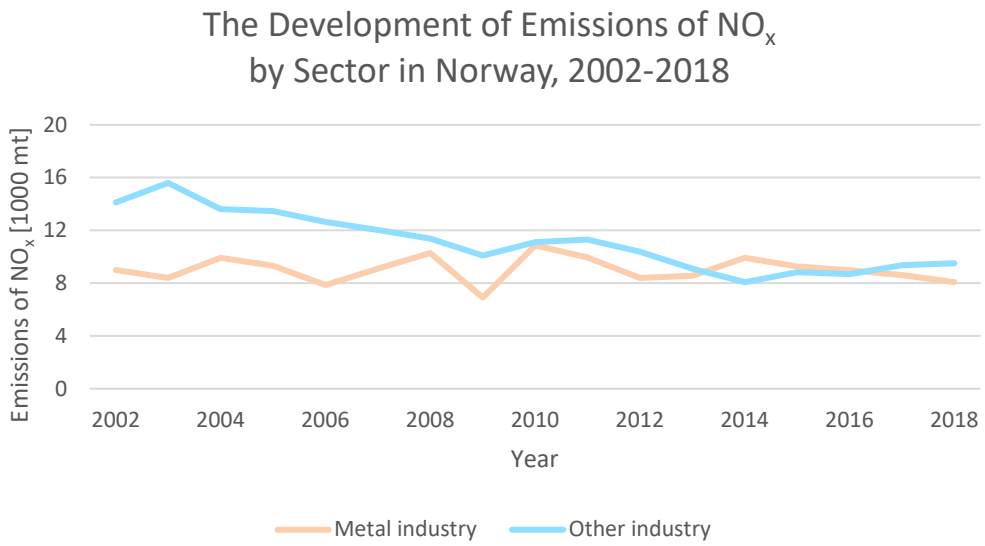

Figure 4: The graph shows the development of NO_x emissions to air from the metal production industry and other industry. Data for metal production from the Norwegian Environment Agency (2020), and for other industry from Miljøstatus (2020). [17,18]

Emissions of PAH

PAH (polycyclic aromatic hydrocarbons) is a common term for compounds that consists of two or more benzene rings. Some of these substances are toxic, genetically harmful or carcinogenic. PAHs are spread over large distances by air and sea currents. These are the reasons why PAHs are on the priority list over environmental toxins in Norway. There is a national objective that the emissions of the substances on the priority list are stopped or reduced significantly by 2020.[19]

In Norway, the aluminium industry has always been one of the major sources of emissions of PAHs. It has been a sharp decrease in the emissions of PAH since the 1990s, with a decrease of 70% of the emissions. The lower emissions is largely due to the phase-out of the Søderberg technology, which was widely used in the aluminium industry. Alcoa Lista is still using this technology and is currently the largest source of emissions. In the recent years, there has been no significant reduction in emissions. 77 metric tons of PAH were emitted in Norway in 2017.[19] Accurate measurement of PAH emissions is complex. Therefore a research project, called PAHssion, was started in 2019 to develop better methods to measure PAH emissions. In 2015, the Norwegian Environment Agency imposed a change in the reporting of emissions of PAH,

due to the Norwegian standard being replaced by two international standards. The levels measured by different methods are not comparable. The industry is now required to calculate emissions from previous years. Compared to the old reporting, the new one tends to show higher emissions, but the actual emissions have not changed.[19]

Examples of Measures to Reduce Emissions

Closed Furnaces in the silicon industry

Closed furnaces in Si metal production is a technology that can reduce various types of emissions. CO and CO_2 can be collected, recycled and captured and it will be simpler to purify the exhaust gases of PAHs and sulphur emissions when their concentrations is higher. A «closed» furnace doesn't necessarily mean a completely closed furnace, but that the exhaust gases are collected and can be purified or used for other purposes. Some call this «semi-closed» furnaces. A completely closed furnace is more difficult to realise but can also provide greater benefits by being able to control the combustion in the furnaces in a better way. Some of the challenges associated with completely closed furnaces are that control and monitoring of the furnace process becomes more difficult.[20]

Closed Furnaces in the silicon carbide industry

The carbide industry has the potential for improvement by closing the furnaces. The emissions in the carbide industry are mainly CO gas and today it is ignited and converted to CO_2. In addition to that, the petroleum coke can be polluted with gases containing sulphur, and there can be particles containing PAHs and heavy metals in the furnace. If these furnaces are closed, the exhaust gases can potentially be cleaned of more particles and it can be possible to establish a «scrubber» system for purifying the petroleum coke. Furthermore, the purified CO gas can be used in energy-efficient ways.[20]

In 2019, Fiven constructed a full-scale pilot installation in Lillesand, which they have been developing for several years. The installation has the potential of significant reduction of the environmental footprint from the production process of silicon carbide. The new furnace technology includes covered furnaces and a gas cleaning facility.[21]

Use of Energy

The energy used in production in Norway comes from various sources such as natural gas, coal and coke or hydropower. The metal production processes that are powered by electricity gets it delivered from the Norwegian power grid. This electricity is mainly coming from hydropower, but there are also some fossil sources since Norway trades electricity abroad.

The Third Energy Market Package and ACER

In May 2017, the EEA Committee decided to expand the energy corporation with the EU, making EU's third energy market package a part of the EEA agreement, of which Norway is a part. The third energy market package is a set of common rules for the power and gas market within the EU. The aim of the package is to utilize the electricity capacity in the best possible way by creating a common energy market. ACER (Agency for the Cooperation of Energy Regulations) was established in 2009, together with the third energy market package. This is the agency that ensures that countries comply with obligations in the energy market package.[22]

Many were critical to the cooperation, including the Socialist Left Party (SV), the Centre Party (Sp) and the Norwegian Confederation of Trade Unions (LO). Critics are against the transfer of authority power to the EU and fear, among other things, that ACER may order Norway to build more power cables abroad and that this will rise the electricity prices in Norway. In the worst case, this could have consequences for power-intensive industry in Norway such as metal industry, which has cheap and renewable energy supply as an important competitive advantage. The trade union fears that this could lead to downsizing.[23]

The director in Norsk Industri's energy and environment department, Ole Børge Yttredal, represents large energy-intensive companies such as Hydro, Alcoa and Elkem. He does not believe that the new cooperation will have too much impact on the Norwegian industry. He points out that the energy market package and ACER in itself will not be associated with an increase in electricity prices. The eventual increase depends on how many connections that are built between Norway and European power grids, and this is not something ACER has the authority to decide.[23]

Stein Lier-Hansen, CEO of Norsk Industri, believes that Norway will benefit from the cooperation by having a greater influence on the decisions that affect the European energy market, and that the cooperation to reduce greenhouse gas emissions will be better.[24]

The EEA Committee in the Norwegian government decided to incorporate the EU's third energy market package into the EEA agreement in May 2017, and it was approved by the supreme legislature of Norway in March 2018.[25]

Heat and Energy Recovery

A potential study by Enova, Norsk Energi, NEPAS (New Energy Performance AS) and Norsk Industri from 2009 carried out for the utilization of heat from Norwegian industry. The study showed that there was around 19.4 TWh of waste heat with temperature over 25°C available. Some of this low temperature heat in cooling water is used today, but it is difficult to exploit this low exergy energy. More innovation in technologies, like heat pumps and thermoelectric materials, is necessary to use more of the waste heat from the process industry.[26]

How Can Heat Be Used?

Heat from all parts of the process in the metal industry can be used as district heating. The heat can be used to heat, among other things, homes, public buildings or roads that needs to be kept free of ice. District heating is the most efficient way to utilize the waste heat because the heat is used directly, which means there is no loss of power. This happens at many of the metal plants in Norway.

Another way a plant can utilize waste heat is to use it elsewhere in the industrial process, for example by using it to keep metal warm during transport and thus save energy. At Boliden, heat from exhaust gases is used elsewhere in the process. Sulphur is burned in roasting and this heat is captured in a steam boiler.[27] Another example is the cooling of manganese slag at Eramet in Porsgrunn. The water heated by this cooling is used to clean the mercury treatment plant.[28]

Organic Ranking Cycle (ORC) is a way to convert heat into electricity by using a type of heat exchanger that is connected to a generator through a motor. Many of the metal plant locations in Norway are places with few inhabitants, and thus there is consequently not so much need for district heating. It is appropriate to convert heat into electricity that can be supplied to the electricity grid. According to Rambøll, ORC is the most developed and currently the best way to convert heat into electricity, especially at power generation above 300kW. For less than 300 kW, ORC is the most efficient together with the Stirling engine. Rambøll is a company that provide consulting and engineering services.[29]

Out of the 19.4 TWh of waste heat that is potentially available in Norwegian industry, a large part is heat with a low temperature. New technology development is needed around power production from waste heat sources below 70-80°C because the present technology has too low efficiency. The heat can almost always be used for district heating, but it is not always appropriate.[26]

Examples of Heat and Energy Recovery

Mo Industrial Park

Mo industrial park focuses on heat and energy recovery. The park includes Celsa Armeringsstål, Elkem Rana and Ferroglobe Mangan Norge. Excess heat from the industrial park is used to heat houses in Mo i Rana and many public buildings. This is ensured by the company Mo Fjernvarme AS. About 94% of the heat comes from heat exchangers connected to the flue gas from Elkem Rana and about 5% of the energy is created by reusing the CO gas from Ferroglobe.[30]

In total, Mo industrial park reuses 400 GWh annually, much because they benefit from the presence of each other. In addition to supplying heat to houses and buildings, Ferroglobe supplies Celsa's neighbouring plant with CO gas. Heat from cooling at Elkem Rana is used to heat water that Rana Fiskeprodukter uses to produce salmon smolt. Theoretically, the entire park has the potential to reuse 900 GWh annually.[31]

Celsa Armeringsstål: Hot Charging

Celsa Armeringsstål's project «Hot Charging» started in 2015. Before the project, the steel blanks lost heat when transported in the open air and had to be reheated in the rolling mill. Celsa is now reusing energy by keeping the steel blanks warm before entering the rolling mill. This gives a gain of 30 GWh annually. The company has a strong focus on energy consumption and works a lot with energy recovery and energy reduction in the production process. These measures are supported by Enova.[32]

Eramet: District Heating

Eramet Sauda supplies waste heat to Sauda Fjernvarme AS, which turns it into a resource in the local community. The Saudahallen, including the outdoor pool, and Folkets Hus are heated with district heating and the stadium facilities and the city centre streets in the municipality are kept snow and ice free. Eramet and Sauda Fjernvarme have entered into a collaboration where they will look at several ways to use the waste heat from Eramet's production.[33]

Eramet: The NewERA Project

The NewERA project has been developed since 2015 and is about the development and implementation of technology with a significant potential for better energy utilization. The main goals with the project are to increase the energy recovery with 250 GWh, to reduce the energy consumption in the production of manganese alloys, to reduce the CO_2 emissions per thousand metric tons with at least 2%, and to ensure sustainable handling of by-products and waste materials.[34]

One of the feasibility studies coming from the NewERA project is about energy recovery at the plant in Sauda. This study is looking at the possibility of installing gas engines at the plants, powered by the CO gas from the production. This gas engine can be connected to a generator and produce electricity. If this is established at Sauda, the new energy source will correspond to the energy consumption of 15 000 homes.[35] The pilot project has an investment estimate of approximately NOK 50 million, partially supported by Enova as a part of their industrial pilot program. The aim is to install a 1.5 MW gas engine at the smelter in Sauda in the autumn of

2020, with a test period from the beginning of 2021. The pilot phase will be crucial for the further planning of a full-scale energy recovery plant.[34]

Finnfjord: Heat Recovery

At Finnfjord, heat is recovered from the flue gas of the process, which has a high temperature. This gas drives a generator with a turbine, which can produce up to 340 GWh. About 25% of the energy added is recovered. This means that some of the energy is lost compared to if the heat has been used directly in for example district heating, but there is great value in making energy that can be used in other ways than heating. Recovering energy and electricity can replace other, less environmentally friendly alternatives.[36]

Carbon Capture and Storage

Carbon capture and storage (CCS) involves capture CO_2 from the emission source and store or reuse it. Norway has stored CO_2 from gas production under the seabed since 1994, but there are no full-scale plants in the process industry yet.[37] A lot of research on CCS has been done in Norway and abroad, including at the Boundary Dam coal power plant in Canada.[38]

In the future, the potential for large reductions in CO_2 emissions in the process industry is small because the emissions are linked to the processes and the combustion. Thus, it is not enough to improve old technology, new ones must also be implemented.[38] According to the Intergovernmental Panel on Climate Change (IPCC) is capture, transport and storage of CO_2 a key measure in the work to reduce the world's greenhouse gas emissions.[37] This means that CCS and CCU should be installed on existing facilities and carbon capture should be a part of the processes. Transport and storage of CO_2 should be established, as well as doing more research on what CO_2 can be used for. This can for example be in biomass production, as chemical raw material or together with waste heat in algae farming.[38]

Norwegian Development

Several feasibility studies around CO_2 capture were conducted in Norway in 2015, including by Yara in Porsgrunn and Equinor. The conclusion was presented in the summer of 2016 and showed that it is entirely possible to establish a CO_2 chain management in Norway. This is most efficient if it consists of ships carrying the CO_2 out to a collection point that is connected to the storage space.[37]

On the basis of these feasibility studies, the Norwegian government has decided to create a full-scale demonstration plant in Norway. In 2017 and 2018, several studies on storage and transport of CO_2 were carried out on behalf of the government.[37] Norway is currently working on finding a good solution for CCS, but it is expensive and requires that the authorities dare to invest, a decision that is likely to come during the autumn of 2020.[39]

CO_2 in Nordland

Several companies in the process industry in Nordland have started the collaboration «CO_2-hub Nordland» under project owner Mo industrial park and project manager SINTEF. Elkem Rana, Alcoa Mosjøen, Elkem Salten, Celsa Armeringsstål and Ferroglobe Mangan Norge are all involved in this. The project will look at opportunities for CO_2 capture, utilization and storage.

A study from 2017 shows that the region has good conditions for this, mainly because the companies are located close to each other. The project can provide innovation and new establishments in the region.[40]

CO_2 For Algae Feeding at Finnfjord and in Brevik

Finnfjord is testing out algae feeding with the exhaust gas from the ferrosilicon production in a collaboration with the University of Tromsø. This exhaust gas mainly contains CO_2, but also NOx, SO_2 and some microsilica that has not been filtered out. Algae are plants that need CO_2 to drive photosynthesis and thus they can potentially be fed by the exhaust gas. This is profitable because the algae can be sold to, for example, salmon farming, and it is also a way to eliminate greenhouse gas emissions. If half of the CO_2 produced by Finnfjord smelteverk is consumed by algaes, they are able to cover 10% of the salmon industry's need for algae. Finnfjord is at step 4 out of 5 in the development of an algae facility. Step 4 is a small test facility, while stage 5 will be an industrial scale plant. Finnfjord's waste heat could also be used to adjust the temperature in the algae facility.[36]

Green Competitiveness

"Green competitiveness" is the term used by the Norwegian Government for their vision for Norway's industrial future. The term implies that green industry should be an advantage and a competitiveness.[41]

It will definitely pay off for metal producers to operate as efficient and energy-saving as possible. This is something they work with on a daily basis. It will pay off to utilize all raw materials, including waste and gases. Examples that have been mentioned are Eramet's sale of CO gas and Finnfjord's supply of algae. Heat and energy recovery can also be crucial for income and also provide great benefits to the society. In these cases, green industrial activity is profitable, and it is important for companies to see some reasons to invest in implementing new technology.

Green competitiveness can be very profitable for the industry, like in the cases above. The companies are fully aware of this and there are many projects going on around them, often supported by Enova, but the measures require a lot of research and testing. In addition, the companies often need money and support to carry out pilot projects. The industry itself points out these challenges themselves.[42]

That green industry provides a competitive advantage in the market is not necessarily true. It is basically how much the product costs that matters, at least provisionally. But green measures provide publicity that can be very positive. This can make people want to work for the company, and it can help the company's reputation and the relationship with the local community.

Will We Reach Our Climate Goals?

It can be possible to achieve the climate goals that have been set if investment in technology and restructuring is implemented. The examples that have been mentioned shows that much is being done at several industrial plants. The development is at least going in the right direction, both on greenhouse gas emissions and other emissions. To continue this trend, climate allowances must be tightened, so the price of emissions increases. But it should also pay off to reduce the emissions and financial support from the authorities for measures and research will be important.

Green competitiveness will be important if the metal industry in Norway wants to continue with the same production volume and competitiveness, and at the same time continue to reduce emissions. Keywords are energy and heat recovery and streamlining of the processes. It will also be important to research new production methods such as using charcoal or close the furnaces. CCS can also prove to be important. In any case, the industry must be open to new ideas and be quick to try out new measures. It will be crucial that technology and knowledge on emissions reduction are shared.

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