

EN ROUTE TO THE LOW AND ZERO EMISSIONS SOCIETY

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Preface

Norwegians have always been intimately connected with challenging and spectacular nature; from rough oceans to rugged landscapes and jagged mountains. Over thousands of years, Norwegians have developed skills to not only control nature, but to survive and thrive with nature. Norway has been blessed with rich natural beauty, as well as an abundance of natural resources.

However, we have also witnessed drastic changes caused by global warming and climate change in our own backyard. Glaciers are retreating. Arctic sea ice is melting. Floods are more frequent, and there is more extreme weather.

We are realizing the need for a change; a change that does not consider the industry as the problem, but an important part of the solution. Developing future green and sustainable industries is an important task for Norway, and the development is starting now.

Nations around the globe are looking to Norway to learn how to utilize natural resources in a sustainable way for the benefit of the population. This includes energy production, fisheries and aquaculture, as well as responsible management of oil and gas resources.

Innovation Norway, the Norwegian Government's most important tool for developing trade and industry, will actively contribute to our country's sustainable growth.

Oslo, 2 December 2015

A handwritten signature in black ink, appearing to read 'Anita Krohn Traaseth'.

Anita Krohn Traaseth
CEO, Innovation Norway

The Norwegian baseline

Norway has large renewable resources. As a result of enormous hydro power capacity and infrastructure, Norway is closer to the 2050 ambitions and goals than most. Nearly 99% of the electricity production comes from hydropower, and the industry dates back to the early 1900s. In recent years, expertise gained from this sector has been exported to other markets. Norwegian companies develop new projects and install new plants around the world.

In the last 40 years, Norway has become a plentiful oil exporter. This has made Norway's pension fund enviably large, which is a great benefit to the Norwegian

citizens. Yet, in the face of global warming, Norway admits responsibility. We realize that measures need to be taken by authorities and industry alike for our carbon footprint and global emissions. The Norwegian government is committed to cooperate with the industry to mitigate the effect of the oil industry.

Though Norway is abundant in natural resources, Norway has only just started to exploit the energy generation possibilities that lie in other renewable sources. The way forward for Norway will include several facets of sustainable development.

Sustainable economic development

Norwegian ambitions are high and may be challenging to achieve in the short term. **The goals for sustainable development not only include reduced environmental footprint, but also comprise value creation, jobs and prosperity to benefit the whole society.** Norway's drive towards sustainable development is by contributing competence and technologies in response to increasing global needs for food and energy security.

The route to zero-emissions is a long and tough one, but the Norwegian government is committed to providing instruments to

smooth the journey. Innovation Norway is ready to operationalize some of these instruments for the benefit of tomorrow's industry.

Norway will focus on areas where our contribution will have the highest global impact, based to competence, experience and current strength:

- Norway has one of the most intensive processing industries with the smallest carbon footprint in the world. As a measure to keep global carbon emissions

from mineral production at a minimum, ensuring the competitiveness of this industry in Norway is essential. Shutting down facilities in Norway would most likely mean establishing less green capacity elsewhere.

- Norway is gold-standard when it comes to the maritime sector. Norwegian ship owners control one of the largest fleets in the world considering both tonnage and value; it is also one of the most modern and green. In addition, the supplier industry is in the lead when it comes to developing and manufacturing green solutions. Norwegian innovations in the maritime sector are exported widely and will have increasing global impact.
- The oil and gas industry in Norway is amongst those with lowest environmental footprint when it comes to emissions per barrel of oil equivalent (BOE) due to the fact that the industry has been subject to requirements of responsible development. These advanced and energy efficient solutions are being increasingly deployed around the world, which will contribute to the reduction of the global footprint from oil and gas exploration and development.
- Norway is a large producer of seafood, both wild catch and aquaculture. The industry is among the most efficient and sustainable in the world. Many seafood nations around the world are looking to Norway for technical solutions and competence within sustainable management of the seafood resources.

To reach Norway's future ambitions, it is important to focus jointly on industrial, market and technology development.

A competitive and sustainable industry sector is a crucial part of the solution. Success is dependent on a motivated work force, where all levels of organizations work together towards a low and zero emissions society. **Norway is at a privileged starting point, as both the industry and labor organizations recognize the need for a green shift, and they are willing to work hard to achieve it.**

A great amount of green solutions exist in the market, but there is a need to speed up deployment of advanced technologies. In this respect the authorities play an important role; as the regulator and the provider of instruments for development, but also as a buyer of services and equipment to influence the market. Industry requirements, in combination with a proactive public sector, will speed up the development of new solutions, and encourage implementation of current and future technologies.

In parallel, we need to encourage development of tomorrow's technologies. Through financial instruments for research and development, demonstration and implementation of new technology, the government is sharing risk and encouraging green technology development. Innovation Norway is one of the Norwegian government's main tools in doing so.

Emission Reduction in Norway: EU commitments and beyond

Considering the emission mix in Norway, all reductions cannot physically be achieved in Norway without putting a strain on the Norwegian industry. **Norway is a small, open economy, making it important for Norway to remain close to the EU.** Approximately 80% of our energy-related products today are exported to the EU, including products from the power intensive processing industry. A close link to the EU will increase the outcome of our climate measures, as well as strengthening Norway's competitiveness and market access.

The strategy for emission reductions is based on three major pillars:

- **Emission reductions within the non-ETS¹ sectors of 30-35%.** In 2013, the emissions were around 28 million tonnes of CO₂ equivalents, up from 24 million tonnes in 1990. Major contributions come from the transport sector. To reach the overall goal, this sector must reduce its emissions by 8,1 million tonnes in 2030 compared with 2013, amounting to a 47% cut. To achieve this, there must be zero increase in the amount of private cars, at least a 10% shift of goods transport from trucks to rail and ships, a substantial shift to electric and hydrogen powered cars and trucks, as well as an increase of 20% use of biofuel both in cars and ships. These high ambitions can only be met in close cooperation between the authorities and the industry, including the industries causing the emissions

as well as the industries providing the solutions for emission reductions.

- **Emission reductions within the common EU-ETS system of 43%.** Major contributions to Norwegian emissions originate from industry, including the petroleum sector. The important principle of emission cuts being made where most cost-effective, indicates that Norway ought to be fully integrated in the EU system rather than having domestic targets as of today. The major instrument for emissions reduction in Norway is the quota system. In order to be effective, it is essential that pricing models like these are predictable in the long term, providing the industry with the necessary framework to make adjustments and develop technology to achieve the desired reductions in 2030.
- **Emission reductions achieved via other flexible mechanisms.** Norway is making investments globally to minimize the impact of emissions, especially by providing funding for green projects in developing countries and pristine environments such as rainforests and polar regions. Similar investment tools are relevant nationally, as means of capturing and binding CO₂. Presently Norwegian forests capture around 27 million tonnes of CO₂ equivalent per year. If Norwegian forests were proactively managed, another 3 million tonnes CO₂ per year could be bound in the Norwegian forests.

¹ The EU emissions trading system (EU ETS) is a cornerstone of the European Union's policy to combat climate change and its key tool for reducing industrial greenhouse gas emissions cost-effectively.

Action plan for sustainable growth

To reach Norway's goals for sustainable growth it is important to develop both markets and technologies in parallel. Technology development will accelerate adoption of breakthroughs that will yield CO₂ reductions in a 10-20 year perspective.

At the same time, **timely development of infrastructure is crucial to support the shift to low and zero emissions energy use.** Market initiatives will contribute to faster exploitation of new technologies, by rewarding environmental corporate responsibility.

Technology development

The industry and the labor organizations in Norway have recently presented a plan pointing out that in the short and medium term, it will be important to focus on initiatives and activities already in the pipeline, including:

- **New energy carriers in the transport sector**, by developing technology for the transition to low- and zero emission vehicles and vessels. There is a need for pilot-demonstration of new technology and implementation of associated infrastructure: charging stations for electricity and filling stations for biogas/ natural gas, bio-propane, bioethanol, biodiesel and hydrogen.
- **New production processes in the industry sector**: This includes further improvement of the processes that reduce emissions from the use of coal and coke as reducing agent in

metallurgical processes. It also involves more energy efficient methods of production of cement, minerals and fertilizers. Carbon capture and storage (CCS) is another relevant development path.

- **Production of bio-based chemicals**: By increasing investments in the biochemical industry, actively encourage full utilization of natural resources. Through new technology, ensure sustainable biological circulation from the oceans, forests and soil to produce food, medicines and chemicals.
- **The production of biofuels**: Several Norwegian companies are currently looking into sustainable production of bio-ethanol, based on industrial processing of forests. In addition, many are investigating the opportunities for industrial refining of biofuels from algae and seaweed.
- **Development of carbon capture and storage**: Commercialization of carbon capture and storage (CCS) is a key technology to reach global emissions targets, and participation by the Norwegian Petroleum business and industry will be crucial to the success of CCS. The Norwegian State will be responsible for realizing the transportation and storage of CO₂ in the North Sea, and data from monitoring and verifying these deposits will benefit future injection projects around the world.

- **Developing opportunities in renewable energy:** Norway already has significant expertise in hydro power and this expertise is exported for global benefit. Norwegian experience in offshore oil and gas is relevant and transferable to floating offshore wind installations. The Norwegian process industry has provided the basis for solar industry development. Renewable energy production requires sufficient net capacity and solutions for storage, an area for development that is highly relevant for Norway.
- **Smart grid and energy management within homes:** The buildings of the future will need energy efficient design,

including a system for production and storage of energy. Solar cells can be integrated in the construction elements of a smart house, for example, and novel building materials, building systems, technology for energy management and distributed energy production can increase energy efficiency.

- **Environmentally friendly shipping:** Low- and zero-emission technology, including associated infrastructure for sea transport, will yield significant emission reductions. Sufficient infrastructure is a prerequisite in order to operationalize the use of liquid fuels and electric charging of ferries and ships in port.

Reducing Risk

Early adoption of new technology gives faster emissions reductions, but includes risk, both technologically and commercially. Since the cost of implementation of climate measures in sectors such as transport, buildings, agriculture and waste to a large extent is covered by the individual customer, there is a need for incentives for market stimulation to encourage faster adoption.

- **Public procurement.** The largest customers in Norway are the public bodies who purchase goods and services worth over 400 billion NOK every year. This represents an opportunity to actively influence the development of

new technical solutions. The world's first electrical ferry, Ampere, was developed in close cooperation between the public buyer and the industry. The environmental specifications set by the buyer triggered a new mindset, and the result was better than anybody would have hoped for. There are budget risks associated with purchasing these kinds of innovation projects. The projects may fail, having economic consequences, but also harming the reputation of the procurement entity. Sometimes it is difficult to get acceptance based on life cycle cost. Publicly owned projects, by accepting this kind of risk, will act as frontrunners. In order to do so, however,

public agencies – such as regional purchasing departments – will need sufficient budgetary flexibility to select green solutions.

- **Taxation system:** The car and fuel tax regime must encourage the use of low- and zero-emission vehicles, including buses and short- and long-haul trucks and trailers. Norway is in the lead when it comes to electrical cars, and market incentives total 4 billion NOK annually. To ensure industry competitiveness, incentives must be long-term, information on phasing-out-periods should be well communicated, and financial instruments should not favor any specific technology.
- **Development of infrastructure for new energy carriers in the transport sector:** New energy carriers for the transport sector requires new or reinforced infrastructure such as charging stations and improved distribution of fuel (hydrogen, biofuels). Also, in order to speed up transition from oil to gas in

shipping and transport, it is important to make sure that LNG is a competitive alternative in the market.

- **Market mechanisms in the transport sector based on the design of the NOx fund².** The fund has been a successful instrument to achieve a shift in the maritime sector concerning NOx emissions, having reduced Norway's NOx emissions by 28 000 tonnes over the past 10 years. To encourage faster introduction of low- and zero-emission transport, creation of similar funds based on the model of the NOx-fund would have positive effect in global markets.

Summing up, it is clear that Norway needs a bundle of measures and incentives in order to succeed with a shift to a more sustainable economy. At the same time, many Norwegian businesses have developed climate friendly solutions available to international markets. Innovation Norway is ready to introduce these companies to the world!

²The NOx Fund was instigated in Norway as a means to reduce NOx emissions through a voluntary taxing system. By paying a yearly charge to the Fund, enterprises become Participants in the Fund. In return, the Participant enterprises may apply for financial support for NOx reducing measures.