2016 Dream Commitment: Clean Energy for Green Growth in Industry and Services

A report from Innovation Norway on the challenges and opportunities within Clean Energy
Dream Commitment: A voluntary initiative on innovation policy

In 2015, Innovation Norway and its partners arranged 84 open debates in Norway and abroad. The initiative attracted more than 3,500 people from industry and the community to debate the future of the country. We also received a great deal of written input.

Key issues were: How can Norway prepare for a time in which the importance of the oil and gas industry will decrease, with regard to both business activities and earnings?

All major challenges also represent an opportunity for business development, conquering new markets and new economic growth. How can Norwegian industry help solve major global and national challenges?

Six areas of opportunity were identified as part of the Dream Commitment. These are areas that cover industries and sectors where Norwegian expertise, technology and commodities meet global challenges and new market opportunities. The six areas are:

- Ocean Space
- Clean Energy
- Bioeconomy
- Healthcare and Welfare
- Smart Societies
- Creative Industries and Tourism

Can we replace lost export earnings by developing new, internationally competitive and knowledge-based industries? This report discusses the challenges and opportunities associated with Clean Energy, and provides recommendations for the development of this.

For more information about the Dream Commitment and other reports from the process, see www.drømmeløftet.no.
Summary and Recommendations

Climate change is one of the world's greatest challenges. In order to limit anthropogenic global warming to below two degrees, the consumption of fossil fuels must fall sharply. Replacing fossil fuels with clean, emission-free energy is the most important input factor for achieving global climate goals. The world is seeking solutions for energy production and use that are climate-friendly, stable and economically justifiable.

The world and Norway are also rapidly changing. We are experiencing an explosion in technology, related in particular to ICT (information and communication technology). The use of data and digitisation will permeate all goods and services we produce, as well as how we purchase and use them. This will involve radical changes in the opportunities for the streamlining, coordination and monitoring of communal services. We are moving towards a “smart” green future, where cars have no emissions and buildings are energy efficient and make active use of digital solutions. The energy sector has an important role to play in this, as access to adequate clean and stable power is a prerequisite for realising that Smart Society.

Norway is uniquely positioned to maintain and further develop itself as a renewable energy nation. We are the sixth largest hydropower country in the world and have a storage capacity of 85 TWh, which corresponds to approximately 2/3 of annual production. Norwegian Clean Energy is a valuable resource, providing a basis for wealth creation and jobs in the production and sale of power and system services. It is also an essential input factor in energy-intensive industries. In addition, it creates value from the supply of technology and equipment. Norway also has considerable potential for further energy efficiency, especially in buildings. In addition, we have the world's largest concentration of electric vehicles, which can function as a real-time laboratory. We are world leaders in technology development and the realisation of green maritime transport - green shipping.

Norway has several strong industrial clusters and knowledge communities that can contribute to the development of new solutions for production, integration and the use of Clean Energy. Enterprises within Clean Energy can ensure increased export revenues for Norway, while at the same time helping to solve the climate commitments faced by Norway and the world.

This report is based on Innovation Norway's Dream Commitment process, where we asked individuals, companies and institutions with an interest in innovation and restructuring to contribute ideas about what Norway can do to ensure growth at a time when oil and gas are less important for economic growth and employment. The report leverages the existing analyses of Clean Energy in Norway, input from other stakeholders and Innovation Norway's own work.

Based on the trends, opportunities and comparative advantages for Norwegian players within Clean Energy, some steps must be taken in order to realise the full potential. Innovation Norway’s innovation policy goals and recommendations can be summed up as follows - Norway must take a position based on our plentiful supply of renewable power - we must make use of the energy to create more jobs and increase economic growth.

Coordination across policy areas

An all too often occurrence today is that energy policy and industrial policy pull in different directions. Stakeholders in the market are looking for measures that make it possible to achieve efficient energy use in industrial development in Norway. There is a need for policies and measures for energy supply and economic development to be better coordinated, both at ministerial level and among the public funding agencies.

Innovation Norway recommends that the government assigns a single ministry the overall, coordinating role for implementing a national direction and associated goals and action plans in
order to ensure that we realise the potential in the electrified society. This corresponds with Innovation Norway's advice for the Smart Societies (see separate report 1).

It is important that the authorities have clear expectations for good coordination of the instruments in the Research Council, Innovation Norway and Enova and that they support the ongoing cooperation between the organisations.

**Attractiveness for energy intensive industries and service production**

The world needs an increased production of emission-free products - produced with Clean Energy. Thanks to our hydropower, Norway already has a world-leading industrial position with several industrial powerhouses. It is important that we keep these enterprises in Norway, and that we create the conditions for new energy-intensive manufacturing and service production. We must adopt Norwegian Clean Energy in order to keep and further develop energy intensive enterprises.

Innovation Norway recommends development in line with Norway's position as a preferred location for green establishments, in accordance with Invest in Norway's slogan *The Greenest Industrial Site in the World*2. This means attractive terms to retain existing actors and active efforts in order to create a brand that attracts foreign investors and industries to Norway.

It presupposes that the authorities ensure competitive conditions for international industry in Norway, including long-term contracts for competitive, Clean Energy, a competitive tax and levy system, and a good framework for skills development, the development of technology and investments in climate-friendly technology.

**The world as a domestic market for Norwegian technology and service providers**

The future will require the production of Clean Energy. Norway is currently a major player in hydropower, but we also have ancillary suppliers throughout the entire energy system supply chain. There is considerable expertise in Norway, although the picture of those involved is fragmented. The Norwegian domestic market for new energy solutions is too small, and therefore, suppliers must develop their solutions in cooperation with international partners - and regard the world as their domestic market.

Innovation Norway recommends that Norwegian technology and service providers within Clean Energy receive access to the necessary risk mitigation and market expertise so that they can compete internationally and develop the best and most cost effective solutions in the industry.

The authorities should

- Ensure financing for the development of technology as well as the demonstration and commercialisation of new technologies. The relevant financing schemes for the Research Council, Innovation Norway and Enova should also be used when solutions will be tested outside Norway.

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2 This is a slogan that Invest in Norway uses in the marketing of Norway as an industrial country - due to our plentiful supply of renewable power.
• **Ensure that Norwegian catapult (under SIVA)** ¹ includes **Clean Energy** for the testing of new solutions and the scaling of technology, and facilitates Norway being a test arena for solutions with international relevance.

• **Ensure a market for green solutions** that trigger new business models, innovation and economic growth. It should be profitable to choose green products, and we recommend a green tax shift favouring things we want to have more of and taxing more those that we want less of. ⁴ The authorities should make regulations and support schemes green and digital. A review of laws and regulations is needed, with the aim of identifying provisions that impede innovation and the development of digital solutions. ⁵

• **Public procurement as an engine for innovation.** Innovation in industry can be promoted through public procurement. A national programme for challenge-driven innovation and the use of the public procurement power to drive innovation should be developed.

**Decarbonisation**

There is great need for the reduction of greenhouse gas emissions throughout industry, but transport is clearly one of the biggest sources of emissions, both nationally and globally. The decarbonisation of transport is necessary if we are to reach our climate goals.

Norway is already far ahead with a high density of electric vehicles and we are world leaders, with a large domestic market, in green maritime transport. We should see this in the context of the electrification of society and facilitate the **testing of new business concepts** related to zero emission transportation. Hydrogen as an energy carrier is an important supplement to electric transport, not least for the maritime sector and heavy transport.

• **Norway should adopt a position as a laboratory for the testing of new business concepts related to zero emission transportation.** The authorities should put into effect measures that stimulate industrial and public transport to switch to low emission solutions. As the Government’s panel of experts on green competitiveness have pointed out, a CO₂ fund ⁶ - modelled on the NOX fund – could contribute to climate-friendly investments in the transport sector, both on land and offshore.

• The Norwegian maritime industry has already shown that it can deliver low- or zero-emission ships and ferries. In the short term, the most important market will be local routes, but the demand for clean transport across oceans will increase. **There is a need for long-term, dedicated investments in Norwegian maritime expertise and product development as well as clear requirements from the government through orders and regulations.**

**Furthermore,** the public policy of encouraging electric vehicles ought to be continued.

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¹ Programme for the testing, simulation and visualisation of new technologies https://siva.no/dokument/norsk-katapult-forslag-til-program/
⁴ Extract from the Strategy for Green competitiveness, p 26
⁵ Extract from the Roadmap-for-smart restructuring
⁶ Strategy for green competitiveness, page 53
• Beyond 2023\textsuperscript{7} only new cars with zero emissions should be allowed for sale in Norway. The
global market will increasingly demand complete solutions for the use and integration of
electric transportation in cities and regions. Here, Norwegian industry can contribute both
energy and systems expertise.

• Strong enterprises and research institutions in the field of electric mobility should unite and
establish a dynamic environment for the development of future electric solutions (in line
with the template for the Green Coastal Shipping Programme\textsuperscript{8} or the Cluster Programme).

\textbf{Increasing energy efficiency}

Saved energy provides energy that is more available. Increasing energy efficiency releases energy
resources for other uses.

In Norway, the construction sector stands out; it accounts for 35\% per cent of energy use in Norway.
The potential for more efficient and sustainable use of resources in buildings is huge in all aspects. This
includes the use of energy and resources in the manufacturing of materials, the construction or
renovation of buildings, and not least the consumption of energy in buildings, among other things.

\textbf{Innovation Norway recommends that the authorities establish defined standards and regulatory
frameworks that ensure the realisation of increasing energy efficiency. These will provide added
value and employment through the development of national actors that can offer energy services
internationally.}

The authorities should

• \textbf{Strengthen instruments for increasing energy efficiency} that provide incentives for the
establishment of new business models and the products that the market demands. An
example is the use of EPC (Energy Performance Contracting) where a provider identifies the
energy saving potential and implements efficiency measures, and receives revenues
equivalent to the saved energy in a given period.\textsuperscript{9} The financing of such contracts is currently
challenging.

• \textbf{Take the lead and set high environmental and climate requirements for publicly owned
buildings.} The public sector should use its purchasing power in this area to promote green
solutions and enter into innovative partnerships to develop new future-oriented solutions.
When the technology becomes available, it should set a new standard. For example, by 2017
all new public buildings ought to be zero-emission buildings.

• \textbf{Set requirements for building standards for new buildings that create openings for new ideas
and innovation,} i.e. regulations that focus on the results achieved and not technical solutions.

\textsuperscript{7} The National Transport Plan 2018-2029 proposes that new fossil-fuelled cars will not be sold from 2025. Most people
believe that in 2025, electric vehicles will be competitive with fossil cars. If Norway wants to adopt a position as a pioneer and
be a laboratory for new solutions, it must set a deadline earlier than 2025.

\textsuperscript{8} The Green Coastal Shipping Programme will aid the adoption of more environmentally friendly vessel solutions, through the
creation and implementation of pilots.

\textsuperscript{9} Strategy for green competitiveness, page 72
Part 1: Clean Energy - introduction and background to the report

Clean Energy is expected to be among the world’s most sought after input factors for economic growth in the years ahead. The transition to the low-emission society means that we are becoming increasingly dependent on a secure and stable energy supply, and that the energy is clean. The smart society of the future, which is driven forwards by digitisation, cannot be realised without access to Clean Energy.

Norway has an excellent starting point to create value from this. We are in a unique position as one of the world’s largest hydropower producers; we have an world-leading process industry refining the energy; we have a transport sector that already has a high electric vehicle density; we are world leaders in green, maritime transport and we have expertise in key areas such as materials and ICT.

In order to be able to exploit this for employment and wealth creation, we should have a clear strategy for how to achieve it. Innovation Norway has an important role in the development of this area of opportunity, and we have prepared this document to set a direction for our own work.

This report seeks to summarise the present situation and the opportunities, as well as to provide innovative policy recommendations based on this.

Innovation Norway and Clean Energy

The opportunities of Clean Energy are based on three societal needs:

- **Reliable energy supply**: Norway should maintain and further develop a reliable and cost effective power system with high security of supply. This includes operational efficiency, optimisation and the expansion of the power grid and power generation.

- **Help to fulfil Norway’s climate obligations**: We should replace fossil energy carriers with renewables in carbon-intensive sectors such as transport, industry and agriculture.

- **Maximise economic growth and employment based on Clean Energy**: We need to maximise the value of Norway’s clean energy through the production and export of energy-intensive goods and services, and service production based on an electrified society and a world-leading energy system.

The relationship between these three drivers is illustrated in the figure below. A well-functioning, cost effective and smart energy system is the foundation of industrial economic growth. Clean Energy is the most important input factor and solution for achieving Norway’s climate targets.
Clean Energy includes in this context the entire value chain of the power system: generation, transmission, distribution and use of energy. Each of these elements are drivers for technology improvement, innovation, disruptive technologies and advanced solutions.

Clean Energy has interactions and overlaps with several other possible opportunity areas in the Dream Commitment 2.0:

- **Ocean Space**: Globally there is a significant potential for extracting renewable energy from the ocean. Offshore wind represents opportunities for innovative maritime technology development. Furthermore, the focus on low carbon fuels and green shipping will fall within both areas of opportunity.

- **Smart Societies**: Realising the Smart Society requires access to a clean, safe and stable electricity supply. Electrification is closely linked to the societal challenges of more sustainable transport, housing, industry and other sectors covered by Smart Societies. The smart supply of electricity is also an overlapping area.

- **Bioeconomy**: The production and use of biogas, bioenergy and biofuel will fall in both areas.

**Background material for this report**

For our work on Clean Energy, Innovation Norway is building on the following recent reports:

- The Energy Report 2016
- Energi21 strategy
- The expert panel for green competitiveness, and several of the road maps that have been prepared during the process; such as for the processing industry, the property sector, the transport sector and smart restructuring

Each of these is briefly described below:
The Energy Report 2016

On 15 April 2016, the Government of Erna Solberg submitted The Energy Report 2016 - *Power to change*.\(^{10}\)

The main message in the report is that the security of supply, climate and economic development should be considered comprehensively in order to ensure an efficient and climate-friendly energy supply.

The Energy Report is an important part of the backdrop for the development of an innovation policy in this area and emphasises the following:

- **Security of supply as a premise for Norwegian industry, including**
  - Strengthening the transmission grid - better coordination of grids, consumption and production
  - Power and control capacity will be emphasised in the concession negotiations

- **Profitable production of renewable energy, including**
  - Phasing out of the electricity certificate scheme after 2021
  - Phasing out of the guarantee of origin schemes
  - Upgrading of existing hydropower plants
  - Further development of onshore wind
  - Offshore wind is considered unrealistic for Norway

- **More efficient and environmentally friendly use of energy, including**
  - Low-emission technologies in industry
  - The use of hydrogen instead of coal for energy storage and transportation
  - Use of electricity in transportation - also investing in shore power at ports
  - Reducing energy consumption in the construction sector by 10 TWh
  - Enova will play a key role

- **Economic development and economic growth, including**
  - Strengthening connections to the continent - also others than just Statnett should be able to own cable connections to Europe
  - Research and development
  - Ensure industrial owners have access to renewable power

Energy21's analyses and recommendations

Energi21\(^{11}\) is the national strategy for the research, development, demonstration and commercialisation of new energy technologies.

Energi21 concludes that Norway has comparative advantages in future energy markets due to its natural energy resources, technology and expertise base as well as industrial experience.

The strategy prioritises the six areas: hydropower, flexible energy systems, solar power, offshore wind power, energy efficiency and CO\(_2\) management, and specifically recommends the promotion of hydropower and flexible energy systems. The conclusions underpin Innovation Norway’s recommendations within Clean Energy.

\(^{10}\) [https://www.regjeringen.no/no/aktuelt/stortingsmelding-om-energipolitikken-kraft-til-endring/id2484248/](https://www.regjeringen.no/no/aktuelt/stortingsmelding-om-energipolitikken-kraft-til-endring/id2484248/)

\(^{11}\) [http://energi21.no](http://energi21.no)
A broad focus is recommended based on good and predictable access to public research funding, strong market incentives, as well as commitment and strong participation from the private sector actors. Energy21 recommends a plan of escalating funding over four years, with an overall growth in public expenditure of NOK 1 billion.

**The expert panel for Green Competitiveness**

The Government's expert panel for Green Competitiveness was appointed by the government of Erna Solberg in the autumn of 2015 and submitted its recommendation in October 2016.

The panel recommended 10 principles for policymaking that will trigger innovation and willingness to invest:

1. Polluters must pay.
2. Emissions and other externalities must be priced.
3. What we want less of, must be taxed more. What we want more of, must be taxed less.
4. It must be made possible for the consumers to be able to make informed decisions.
5. Public procurement must be green.
6. Planning and investments must be based on the goal of becoming a low emissions society in 2050.
7. The life cycle perspective must form the basis of public investment and procurement.
8. New draft legislation must include an assessment of CO₂ effects where relevant.
9. Green competitiveness must be built on well-functioning markets.
10. It must report on what we want to achieve and what we want to avoid.

The panel, which consisted of Connie Hedegaard and Idar Kreutzer, conducted a broad mobilisation of the industrial community. As part of the process, a number of sector and industry specific roadmaps for increased employment and economic growth in the 2050 low-emission society were produced. Several of the roadmaps concern Clean Energy including, among others, the following:

**Roadmap for the processing industry**

The roadmap for the processing industry, which was published by The Federation of Norwegian Industries in May 2016, describes the industry’s vision that the Norwegian processing industry will significantly increase economic growth through increased production and the development of new processes and products, while greenhouse gas emissions will be reduced to zero.

In a low-emission society, there will be increased demand for products with a low carbon footprint, both in manufacturing and use. There will also be an increased need for new or improved products for the production and storage of renewable energy.

The Norwegian processing industry, with high energy efficiency and access to clean energy, is well positioned to deliver on this. The industry’s ability to deliver on its ambitions of increasing production and zero emissions of greenhouse gases, presupposes predictable framework conditions and continued access to renewable energy under competitive conditions.

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12 [https://www.norskindustri.no/siteassets/dokumenter/annet/veikart-for-prosessindustrien_web.pdf](https://www.norskindustri.no/siteassets/dokumenter/annet/veikart-for-prosessindustrien_web.pdf)
13 The carbon footprint of a product refers to the total amount of greenhouse gases that are directly or indirectly emitted during extraction, production, distribution and consumption of the product.
The roadmap for the property sector

The roadmap for the property sector\textsuperscript{14} was developed by the Green Building Alliance and the Norwegian Property Federation and published in June 2016.

The ambition of the roadmap is that the building sector will have reduced greenhouse gas emissions by 40 per cent in 2030. By 2050, the sector will have closed the product circle for materials and have zero emissions of pollutants. The roadmap contains 10 measures for building owners, including the removal of fossil fuel heating, and commissioning energy budgets for calculated energy consumption. It also contains 10 measures for the authorities, including introducing Enova support for energy management in buildings.

The Energy Report contains a target of a 10 TWh reduction in energy consumption in existing buildings compared to current levels.

Roadmap for zero emission transportation

The roadmap for industry transportation - with high mobility and zero emissions in 2050\textsuperscript{15}, was launched by 13 partner organisations in September 2016. The report shows that greenhouse gas emissions from industry transportation can be reduced by at least 45 to 60 per cent by 2030, and aims to achieve zero emissions in 2050.

The sector expects to double its economic growth by 2050. The most important requirement is the large-scale electrification of vans and buses, as well as a sufficient supply of sustainable biofuel and

\textsuperscript{14} http://byggalliansen.no/nyside/wp-content/uploads/2016/03/Eiendomssektorens-vei-kart-mot-2050-1-versjon-pr-120516.pdf

\textsuperscript{15} http://nho-transport.no/getfile.php/Filer/Brosjyrer%20og%20rapporter/Veikart%20for%20utslipp%20fra%20transport.pdf
biogas. In addition, they suggest a wide range of measures including a CO2 fund that will support measures to reduce CO2 emissions from mobile sources, which currently fall outside the support given by Enova.

**Roadmap for smart restructuring**

The roadmap for smart restructuring\(^\text{16}\) was prepared by Abelia, based on input from a number of enterprises.

The roadmap recommends three main priorities for enterprises: 1) A redistribution of the use of time and resources in daily operations, development and innovation, 2) Sustainable business modelling and 3) Increased intersectoral collaboration.

The main requirements of the roadmap are 1) Partnerships between private and public, 2) Incentives to promote innovation and green competitiveness in Norwegian businesses, 3) Innovation policy for a new era.

\(^{16}\) https://www.abelia.no/bransjer/klima/veikart-for-smart-gronn-vekst/
Part 2: The energy market is changing - the emergence of new markets within Clean Energy

Over the last 50 years, the population has doubled and the global economy grown six fold. It is expected that the middle class in emerging economies will have tripled by 2050. Growth since pre-industrial times has increased energy needs with a corresponding increase in global greenhouse gas emissions. Economic growth, digitisation and electrification make us increasingly dependent on a stable power system.

In this chapter, we will look at what trends are driving the development of the energy system, and look at Norway’s position for meeting these trends. This provides a good starting point for looking at comparative advantages and Norway’s opportunities in Part 3.

Trends within Clean Energy

In the coming years, it is expected that there will be enormous changes in technology and markets, both globally and in Norway. Many say that we are in the middle of an energy revolution, where renewable energy is replacing fossil fuels as a basis for economic growth and development.

The changes we are seeing include increased levels of distributed power generation, the smart control of consumption and production, cheaper and more types of energy storage technologies, interaction with other sectors such as construction and transport, as well as an increased focus on energy efficiency at all levels. This places considerable demands on the energy system, which in many countries requires a significant upgrade.

Currently the most important trends in the energy system are:

**Increasing climate and development policy ambitions.** Both COP21 and the UN’s resolution on sustainability goals point towards a rapidly growing demand for renewable energy production, and the electrification of society.

In the coming years this will have implications for national policy and drive the market for renewable energy. For example, the EU has set climate and energy targets that will make the Union the world leader in renewable energy in 2030:

- By 2030, emissions of greenhouse gases will be reduced by 40% compared with 1990 levels.
- Renewable energy will form at least 27% of energy consumption.
- At least a 27% increase in energy efficiency compared with a business-as-usual scenario.

**Increasing understanding for, and awareness of, carbon risk in the market:** Increased political and regulatory activities aimed at reducing greenhouse gas emissions have given rise to concerns about so-called stranded assets, and other financial risks arising from changes in the market for fossil energy carriers.

Mark Carney, Governor of the Bank of England, has been one of the most distinctive voices to raise these issues facing the financial sector. He believes the risk is of such a nature that it represents a significant danger to financial stability.

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17 The climate conference in Paris http://www.cop21paris.org/about/cop21
19 https://www.ft.com/content/622de3da-66e6-11e5-97d0-1456a776a4f5
Because of the increased understanding for, and awareness of, so-called carbon risk in the market, we see signs that more and more actors are arranging their operations in a way that reduces their exposure to this type of risk. This could be an increasingly strong trend in the coming years, with an increasing impact on the Norwegian economy and Norwegian companies.

**Falling price of renewable energy, particularly solar and wind**: The dramatic fall in the cost of renewable energy production has led to the LCOE\(^{20}\) for wind and solar now being competitive with new fossil power generation in many markets. Moreover, the cost of renewables is expected to fall further in the coming years.

**Increasing investments in renewable energy**: Investments in renewable energy, especially from wind and sun, have seen explosive growth in recent years despite low oil prices.\(^{21}\) More than twice as much (USD 286 billion) was invested in renewable energy production than in coal and gas-fired power stations (USD 130 billion) in 2015 globally\(^{22}\). These figures do not include investments in hydropower plants over 50 MW, which would have made the disparity even greater.

In previous years, investments in renewable energy have mainly been made in industrialising countries. In recent years, Latin America (Peru, Chile, Mexico), Morocco, India and the Arabian Peninsula have been important markets where major contracts have driven down the price of solar power.

The table below (extracted from REN21) shows that China leads as the largest investor in biofuels, power and heat, with the US as a close second.

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\(^{20}\) LCOE (levelised cost of energy) = comparable production price of energy


\(^{22}\) OECD 2016 Business and Financial Outlook
Decentralised energy production and a power shift in the energy system: The big energy companies (utilities) continue to dominate electricity production. However, a global trend is that both households and enterprises are increasingly choosing to produce their own electricity. The change in the competitiveness of renewable energy combined with the development of ICT and digitisation has led to new business development within decentralised energy production.

Smart control systems, product development and a price drop in battery technology combined with business models for decentralised energy production reinforce this trend. This has started a shift in power from the traditional power suppliers to a high degree of consumer power - liberalised power markets, domestic production and local energy storage, smart and consumer oriented energy services and solutions.

New digitised and smart product and service production: Digitalisation and the increased use of ICT enables goods to be produced and consumed in new ways. We are moving towards the "smart society", with strong growth in the sharing economy and an increased importance for service provision in national economic growth. Common to all use of ICT is a need for renewable, clean and stable power.

Urgent need for investment in networks: There is a significant need for investment in the power grid both in developing countries and in already industrialised countries. Many industrialised countries, including Norway, have a power grid that is well-developed, but significantly lagging behind in terms of investment. The EU has estimated the investment needs in the power grid by 2020 to be EUR 220 billion. Statnett is planning grid investments of NOK 50-75 billion in the period 2015-2025. For many developing countries, it is a major challenge to build new infrastructure that gives the population access to electricity. New investments in networks must be made in a way that takes into account the ongoing changes to electricity use and production.

For more information on international trends in the area of clean energy, see Appendix 1.

Norway's position for meeting the trends

The global trends mentioned above, are also valid for Norway. As with other countries, Norway must reduce greenhouse gas emissions. Currently, 38% of total energy consumption in Norway is based on fossil fuels, mainly used in transportation and the offshore sector. However, when it comes to

electricity production, Norwegian electricity production is 98% renewable, unlike most other countries.

Hydropower is still the mainstay of the Norwegian power system, and will remain so for the foreseeable future. Currently, we are Europe’s largest producer of hydroelectric power and the sixth largest worldwide. We are an integral part of a modern well-developed Nordic transmission grid, with transmission cables to the European power market.

Net exports of electricity in 2015 were 15 TWh (~10% of total production). The power surplus in the Nordic countries provides low electricity prices in Norway - a situation that is expected to continue during the next decade. 24

Innovation Norway’s offices abroad have put together an overview of the market potential for Norwegian suppliers of Clean Energy technology. As the figures below show, there is greater potential for wind and solar than for hydropower in several of these markets. There is considerable potential for smart energy systems in large parts of Europe and North America. Increasing energy efficiency in buildings is relevant throughout Europe. Hydrogen and CCS are of interest in North America, Japan and China. More information is shown in Appendix 2.

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### High potential, #### Moderate potential, ##### No potential

Analysis of market potential in selected countries by Innovation Norway’s offices abroad (cf. appendix 2)

Part 3: Great opportunities for Norway as an energy nation

Clean Energy has been crucial for the development of Norwegian industry and economic growth. The modern Norway was built and industrialised due to us succeeding in utilising rivers and waterfalls to generate power.

Based on Clean Energy, Norway has a number of comparative advantages and conditions for strengthening its position as a leading nation within the production of goods and services. Our access to sufficient, affordable, Clean Energy gives Norwegian industry great opportunities for innovation and economic growth based on the processing and development of new products and services, such as hydrogen, metals, chemicals, gigabytes, ready-to-use products, energy control and software.

In this chapter, we have grouped the most important comparative advantages and opportunities. For each of these opportunities, we will review the status and indicate how this area may represent an opportunity for economic growth.

Norway’s comparative advantage within Clean Energy

- **We have good access to clean, variable power.** Our hydropower capacity is (130 TWh) of annual production, and we have a storage capacity of 85TWh. Hydropower has a special position in renewable energy, as it contains both production and storage.

- **We have lower electricity prices:** Norwegian power prices are set by the balance between supply (production and imports) and demand (consumption and export), and they are expected to remain at the current low levels in the coming years due to the power surplus in the Nordic region.

- **We have one of the world’s most efficient power markets:** Norway was one of the first to deregulate the power market and introduce a power exchange for the trading of electricity - Nordpool Spot. The Norwegian power system model is currently a role model for energy reforms in Europe, Japan, India and South Africa.

- **Well-developed power grids, but lagging significantly behind in investment.** The Norwegian power system needs substantial upgrading and reinvestment\(^{25}\) in order to ensure continued stable, efficient and profitable production and distribution of power. It is the experience of county and municipal hydropower owners that the capital needs of the power companies are increasing at a time of falling and persistent low power prices. This stands in stark contrast to the exploitation phase over the last 20 years, where the companies have required little reinvestment and therefore awarded big dividends.

- **We have industrial powerhouses in the area of power refinement:** Companies such as Hydro, Elkem and Yara have shown a willingness to invest in energy-intensive industries in Norway in recent years. These industries give us access to knowledge centres for the development of new business, while at the same time also contributing to employment and national economic growth.

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\(^{25}\) In the following Energy Report, NVE estimates a reinvestment need for power generation of about NOK 110 billion over the next 40 years. Furthermore, Statnett is planning grid investments in the order of magnitude of NOK 50-70 billion during the period 2015-2025.
growth from our Clean Energy.

- **Norway is one of the most electrified economies**: We use electricity generally, both in goods and service production, in the household sector and also in the transportation sector. Norwegian investment in electric cars has given us the highest density of electric vehicles in the world.

- **We have a well-developed policy instrument system within Clean Energy**: The policy instrument system, with Enova in the lead, has the expertise and financial muscle to assist national and international companies with establishing new business and further developing existing business based on Norwegian Clean Energy.

- **We have a high level of specialist competence in the research sector**: Norway has several environments at both institutes and universities that have expertise in renewable energy, materials and digitisation. Sintef Energy and IFE are examples of institutes that are contributing to Norway asserting itself internationally and in the EU offer a good level of return on research funding. Earlier this year, eight new centres for environmentally friendly energy (FMEs) were established, securing core funding for eight years. See appendix 4.

Based on Norway's societal and natural comparative advantages and our access to renewable energy and modern energy systems, the greatest opportunities for Norway are related to the areas described in more detail below:

- The world as a domestic market for Norwegian technology and service providers
- Economic growth based on the Norwegian power system
- Decarbonisation of the transportation sector
- Increased energy efficiency in the construction sector
- Energy-intensive industries in Norway
- Exports of Clean Energy through cables

**The world as a domestic market for Norwegian technology and service providers**

Providers within Clean Energy production cover technology for the planning, production, installation and storage of renewable energy, and services related to this. Here, we will look at the opportunities associated with hydropower, wind, solar and energy storage. We also include carbon capture and storage (CCS) as it has been identified by the Norwegian Environment Agency as an area that must be developed if Norway is to succeed in achieving its climate goals.

According to the THEMA Analysis, the Norwegian renewable industry is currently made up of 1,700 enterprises with a combined GDP of NOK 70 billion of which about NOK 5 billion is in exports (2013). This is approximately 2.5% of Norway's GDP. The industry comprises 20,000 people.

The major anticipated investments, both in new power production globally and energy systems (both in Norway and globally) represent a huge market and opportunity. Good Norwegian technology and service suppliers can look at the world as the "domestic market" and participate in this market. Few

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26 "Economic growth in the Norwegian renewables industry,” THEMA Brief 2016-04
players in the renewable segment in Norway are significant international exporters, and the development is positive.

Norwegian suppliers of equipment, technology and services generated sales of more than NOK 11 billion abroad in 2015, up from NOK 8 billion the previous year. These are foreign sales by Norwegian-owned companies and include more than simply exporting. This is primarily due to offshore wind and solar power, but hydropower can also point at a stronger result.

The chart below is taken from Export Credit Norway and shows an overview of the major exporters of renewable energy in Norway.

**Hydropower**

Hydropower accounts for the largest share of renewable energy with approximately 3,500 TWh globally. IEA predicts a near doubling of this amount to 5,500 TWh by 2025. Almost all this growth will be outside the OECD, primarily South America, Africa and Asia.

The average age of Norwegian hydropower plants is 45 years, and a large proportion of the production capital will be upgraded and improved over the next ten years. This also represents an opportunity and potential for the integration of new technology and solutions. In addition, this will involve increased economic growth due to better utilisation of energy resources.

The Norwegian power industry has considerable expertise in the hydropower field, and there are a substantial number of Norwegian suppliers of components such as turbines, transformers, and

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generators etc. We have a significant industry based on and knowledge of tunnel operations and dam construction. Likewise, we have internationally recognised communities in planning, mapping, weather forecasting and grid optimisation.

Wind power

Wind power is currently the largest source of renewable energy after hydropower. The prices for wind power have fallen considerably in recent years, making it a profitable source of renewable energy in an increasing number of markets. Norway has excellent conditions for wind power production, both onshore and offshore.

The potential for offshore wind power production is estimated to be approximately 100 times the Norwegian annual production of hydropower. However, there is poor profitability in projects with the current electricity prices and a lack of funding.

The market for offshore wind power is beyond our borders, and this will be the situation for a long time to come. This means that with the current market picture and funding, we cannot count on having a domestic market for offshore wind power. In time, however, the natural conditions may change this picture.

Some onshore wind production has been installed in Norway, but taking into consideration the power surplus for many years to come, this has also experienced difficulties in securing domestic investment. An expansion of just under 3,000 MW of onshore wind is anticipated nearer to 2021, when the system of green certification ceases. It is unclear what level of investment we will see after this.

There are currently a significant number of enterprises in Norway that supply technology and services to the offshore wind power market, originating from the oil and gas and maritime industries. Despite a small local market currently, Norwegian companies are seeing growth with ambitions for a significant export of technology and services targeted at the growing wind power markets, both in the North Sea, but also in Europe and globally.

Solar Power

Solar power is the fastest growing renewable energy production technology internationally (ref. global trends from the previous chapter). Norwegian technology in solar energy is based on our history of metallurgy and electro-chemical processes, realised by companies such as Elkem and REC. Over many decades, high levels of expertise have been built up within the materials and processing industries. After half a decade of the phasing out and dismantling of Norwegian industry in the field, there are now clear signs that the level of activity is picking up and that new businesses are being built on the existing expertise and resource base.
The production of high-purity silicon and the first parts of the silicon value chain are dependent on the availability of electrical power and cooling water. These are resources that are in ample supply in Norway, and according to power forecasts will continue to be readily available. Lower power prices can be expected in the years ahead. These are not labour-intensive processes. The correct level of automation could lead to profitability and economic growth. [3]

In 2005, 21 companies were classified as solar energy companies in Norway. In 2010, the figure doubled to 40, even when consultancy and research were excluded. Elkem has taken over REC and reopened their wafer fabrication facility at Hærøya[1]. Other significant Norwegian solar enterprises include Norsun, Scatec Solar and Norwegian Crystals.

The type of business is also changing in line with the market. While the Norwegian solar industry previously mainly consisted of actors who were in the module chain, (fabricated silicon, ingots, wafers and panels), there is currently a significant and growing industry cluster along the entire solar energy value chain. A change can be seen downstream where there are now new actors, such as Scatec Solar, which invests in and develops larger and smaller solar power installations based on solar cells. It is an emerging installation industry geared towards project development and construction.

With the increase in completed installations, a market will also grow for financing, servicing and operation. Otovo is a newly started Norwegian company delivering solutions for local solar energy production on roofs. The company offers leasing agreements for solar panels so that the investment cost for the individual homeowner is low.

Norway is well placed to develop future silicon-based solar energy technologies due to our leading position upstream in quality, innovation and energy efficient silicon processes. We should intensify our activity in several parts of the value chain; such as the establishment and operation of large-scale solar installations.

In order to support the potential for economic growth, we should strengthen our research environments so that they maintain their international relevance. As an example of a research cluster for solar energy, the Research Centre for Sustainable Solar Cell Technology is highlighted. For more information about FME, see appendix 4.

**Carbon Capture and Storage**

CO₂ sequestration (CO₂ capture, transport and storage) has been a focus area in Norway for many years and has contributed to Norwegian research and industry players becoming among the best in the world.

Carbon capture- and storage (CCS) is considered a necessary global instrument for achieving the 1.5-degree target.

Norway is a leader in CCS technology through our full-scale plants at Sleipner and Snøhvit, pilot plant at Mongstad and the overall Norwegian R&D activity. The Norwegian continental shelf has the potential for storing CO₂ from all over Northern Europe. These storage opportunities along with the opportunities for the use of CO₂ for enhanced oil recovery will represent a significant market opportunity for Norwegian players.

Norcem AS in Brevik, Yara in Porsgrunn and the Klemetsrud incinerator in Oslo have tested carbon capture with promising results. There are great opportunities for storing CO₂ on the Norwegian continental shelf. Here Norway has a comparative advantage. In addition, the Norwegian maritime industry cluster is heavily involved in the area of the transportation of liquefied natural gas (LNG). These are relevant skills for the transport by ship of CO₂ and hydrogen in the long term.

Through the strong Norwegian research and development efforts in the field, Norwegian industries have developed technology and expertise that make them well placed to deliver capture technology for both power generation and industrial processes to stakeholders throughout the world. Analyses undertaken in the NORDICCS project, published in the Nordic CCS roadmap, show that in 8 out of 10 Nordic CCS projects, the transportation of CO₂ by ship will cost less than transportation by pipeline. This provides opportunities for a new industry within the Norwegian maritime sector, which is well equipped to take up positions within the transportation of liquid CO₂.  

Moving forwards, a carbon tax could be envisaged which would reduce the future value of Norwegian gas reserves. Efforts to develop technology for the decarbonisation of Norwegian natural gas may help to ensure this value in new tax and tariff regimes.  

**Energy storage**

The increase in electricity production from solar and wind has led to a growing need for storage. In particular, the market for batteries has developed significantly in recent years, driven by increased demand and reduced prices due to the emergence of electric vehicles. BNEF estimates that storage capacity worldwide will have to increase from around 58GW in 2015 to 858GW in 2040. Large-scale storage adjacent to the power plants reached a record level in 2015 with 250MW, an increase from 160MW in 2014. Announced projects have reached 1.2GW.

Batteries can be used for many purposes and battery systems will in future become increasingly more specialised. It is difficult to estimate how big the market will become in future, but there is little doubt that it will be big. Some estimates suggest USD 50 billion by 2022. The market will consist of batteries for consumer goods, electric vehicles, and large-scale industrial storage and battery systems for niche markets.

The development of "battery packs" and related control systems within certain niches may be a potential market for Norway. There may, for example, be battery systems for the maritime sector, which companies such as Grenland Energy have started to develop products. Norway has a natural advantage for this type of battery business since we have a global maritime industry, are at the forefront of innovation and have access to clean energy, good industrial infrastructure and research that is world class in some niches.

**Economic growth based on the Norwegian power system**

There is huge growth potential in other parts of the energy system: planning, grid, distribution, management, storage, monitoring, energy efficiency and other services related to the energy sector. Norwegian innovation environments and companies have an excellent position and potential for further growth in this area.

Power systems of the future will be increasingly characterised by user-centric services rather than the traditional producer-centric paradigm. The combination of decentralised production, local energy

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28 Energy21 Strategy Document 2014
29 Energy21 Strategy Document 2014
storage and a greater degree of electrification in heating and transportation will place considerable demands on the balancing and operation of the power grid. Energy efficient buildings will be controlled with modern information technology. Production and consumption are regulated and controlled in smart grids. User-centric service production for energy production and use in smart energy systems offers great opportunities.

Since 1991, Norway has been at the forefront of the introduction and operation of national and international energy markets and the Nordic model has become the platform for the "standard model" in Europe and several other countries. The Norwegian power industry has over these 25 years gained significant expertise in power trading in deregulated power markets. Companies such as Statkraft have extensive experience from the deregulated European energy market and have built up expertise in market analysis, production optimisation of variable power plants and energy trading.

The considerable economic growth potential in smart energy solutions lies at the interface between the opportunity spaces of Clean Energy and Smart Society. Smart energy solutions for cities and society include increased access to renewable energy, reliable energy deliveries and efficient utilisation of energy and systems that provide users with the opportunity to manage and influence energy consumption.

Norway has knowledge clusters that we can build on for economic growth in this area. Examples of these are the NCE Smart Energy Markets in Halden. Energy is central to the cluster projects and this has given specific expertise and experience to research and development projects, both nationally and internationally. Key enterprises that have already established themselves internationally in this area are Powel and eSmart systems.

From our prominent position as one of the world's most electrified countries, with significant renewable power resources, the world's highest density of electric vehicles and broad expertise in smart grids, Norway can take a leadership position in realising solutions and services for an electrified low-emission society. The high electric vehicle density in particular puts us in a good position to develop solutions for electric traffic systems, battery solutions, charging systems, etc. Norwegian transportation companies are also running initiatives relating to the transition to electricity based means of transport.

**Decarbonisation**

Electrification of the Norwegian economy is both an important climate measure and a measure for the development of new industries, economic growth and employment.

Norway has committed itself to climate objectives for 2030 and 2050, which means that the use of fossil energy must be replaced by renewables. A major source of carbon emissions in Norway is the transportation sector, which had an energy consumption of 58 TWh in 2014, of which 56 TWh came from fossil sources. This represents 30% of Norwegian climate emissions, and the decarbonisation of the transportation sector will be crucial if Norway is to meet its international climate change obligations.

**Electric vehicles:** Norwegian policy led to 17.1% of all new cars sold in 2015 being electric cars. A complete transition of Norwegian vehicles to electric vehicles will account for 10.7 TWh per year - an increase of less than 8% of normal annual production. In connection with the Energy Report and consultation paper for the National Transport 2018, the government has launched as an objective that all new private cars should be emission-free from 2025.
Ferries: DNV GL concludes in a report commissioned by Energy Norway\(^{31}\) that Norway can cut CO\(_2\) emissions equivalent to 80,000 cars per year by replacing diesel-powered car ferries with battery vessels on 52 ferry routes. Seven out of ten ferry routes in the report can be electrified at a cost of under NOK 1,100 per ton, and therefore fall within the measures that the Government Klimakur Report has recommended to be implemented in order to achieve the climate targets in 2020.

The Norwegian shipyard and equipment industry has a unique opportunity to take a world leading position in the electrification of maritime transport - in the same way that Norway leads the way in LNG\(^{32}\) as a maritime fuel.

Hydrogen: Hydrogen has the potential to play an important role as an energy carrier in the electrification of the transportation sector, perhaps in particular on long distances and for buses and heavy transport.

The first hydrogen cars are on the market, but at present, there is a considerable amount of technological development remaining before hydrogen becomes a feasible alternative. Toyota is one of the few car manufacturers that have invested heavily in hydrogen as the basis for their emission-free products in the passenger car segment.

Several large-scale hydrogen projects are under consideration in Norway. Norway should be sufficiently capable of building an industry around all aspects of producing green hydrogen derived from renewable energy: production, storage, transportation, distribution and use. Hydrogen produced by water electrolysis using renewable energy can be a medium for the export of renewable energy from Norway to markets in Europe and Asia.

Increasing energy efficiency

In Norway, construction is responsible for nearly 40% of energy consumption. In other countries where electricity production is based on fossil energy, the reduction of energy consumption in houses represents a significant climate measure. This means that solutions for improved energy efficiency in buildings are becoming increasingly more important, both nationally and internationally.

Traditional measures such as insulation and higher energy requirements for new buildings are still important, but increasingly attention is being directed towards measures that make buildings smarter consumers and producers of energy. Smart buildings are about monitoring, management, control and intelligent functions in a building that will result in energy reduction, increased comfort and improved user experiences.

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\(^{32}\) Liquefied natural gas.
Increasing profitability in local energy production with the use of solar cells, technologies for storing energy, as well as services and systems for the control of energy production and use in relation to energy prices are key driving forces behind developments in smart buildings internationally. There is potential to develop profitable business models for goods and services production for smart buildings in Norway, but this has still not been given a large scope. Some actors, such as Otovo, have started to provide solutions for the local generation of electricity through solar cells on rooftops. In Norway, the driving force has so far mainly been a desire for energy efficiency.

Norwegian expertise in energy efficient buildings has significant intentional potential, not least in countries where cooling needs represent the greatest consumption of energy. Experiences from energy efficiency in office buildings and industry will also be relevant. An example of a knowledge centre with international potential is the Norwegian cooperative project Powerhouse. Powerhouse Kjørbo is the first project in the world to show that it is possible to convert an existing office building into a net producer of renewable energy throughout its lifetime.

Norway has committed to a 10 TWh reduction in energy consumption in existing buildings by 2030\(^3\). There are also business opportunities associated with this.

**Energy-intensive industries in Norway**

Energy-intensive industries have played a key role in Norway as an industrial nation, both in terms of jobs and export revenues.

Traditionally, these enterprises delivered semi-finished aluminium bars, ferro-alloys, silicon, magnesium, cardboard, paper and newsprint.

Production is through chemical processes at high temperature and with a large consumption of electricity. In the future data centres will constitute an important part in addition to the metallurgical and electrochemical industries. In all, energy-intensive industry is responsible for more than a third of Norway’s total electricity consumption.

An important prerequisite for the industry’s growth in Norway has been the availability of competitive power- and long-term power contracts. Over time, the industry has been exposed to competition from low cost countries. This has strengthened the need for innovation in the sector, which has also occurred, particularly in energy efficiency.

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\(^3\) Agreed by Parliament in connection with the processing of the Energy Report.
In addition to the supply of cheap and green power, Norway has other competitive advantages in this industry: a high degree of process control, high productivity, and motivated, stable and highly educated workers with special expertise in for example electrochemicals, plastics/polymers, wood processing and the metallurgical industry. Norway also has an already very well developed infrastructure for marine transport and utilities (electricity, cooling water, process water, gas).

Future commodity production will have a far higher degree of customisation, new materials, shorter and more frequent changes in production series and not least advanced production technology such as 3D printing and use of ICT.

Norway is in a strong position with our research environments and operating environments in Raufoss, Kongsberg and Hønefoss. Many Norwegian companies - such as Norsk Titanium, Raufoss Aluminium, and Ragasco etc. - are highly automated/roboticised and already world leaders. Altogether, this means that Norway has become better able to compete with traditional low-cost manufacturing countries such as China. One example of this is that Neuman Raufoss Technologies, what is probably Norway’s smartest energy business, is moving production from China to Raufoss. The upcoming industry report will focus on automation/robotisation (Industri 4.0).

International players regularly consider Norway for the establishment of new energy-intensive industries - and in recent years data centres, a power-intensive service industry that is growing rapidly. This presents major opportunities for Norway in the future. The largest data centres need large amounts of energy; from 100 to 300 MW or 0.8 -2.4 TWh.

Foreign investment has a positive effect on Norwegian industry, in that

- Foreign ownership can increase market access and market knowledge
- Export-intensive companies that establish themselves here or Norwegian companies with new owners, take advantage of foreign networks, which in turn can lead to increased exports. The processing industry is well known for being highly export-intensive.

34 http://www.tu.no/artikler/dropper-kina-legger-fabrikk-for-bildeler-til-gjovik/346859
• New and better foreign technology leads to a general development of technology in the sector (positive spill-over effect)
• Increased access to capital leads to new investments, especially in sectors currently suffering from a lack of capital (e.g. forest industries and petrochemicals).
• New foreign companies that establish themselves, contribute to the strengthening of our leading industry clusters. This can lead to the optimisation of the value chain or the closing of an open niche.

More information on foreign investments in Norway appears in appendix 3.

Exports of clean renewable energy via power cables

Norwegian power prices have remained low for a while, which has had a negative impact on the bottom line of the power producers. In order to increase demand and prices, the Norwegian power producers have argued for the further development of power cables to the continent. In those markets there is a need for power capacity that can be phased in as a replacement for coal and nuclear power when renewable energy such as wind and sun is not produced, for example on windless or cloudy days.

There are several reports (Zero\textsuperscript{35}, Poyry\textsuperscript{36}, Thema\textsuperscript{37} etc.) that have reached conflicting conclusions on the size and value of these markets. Battery technology, demand response and off-grid solutions in our neighbouring countries will lead to the balance needs increasingly being solved locally when it comes to daily fluctuations in production and consumption.

For the long-term storage needs of green energy, Norwegian reservoirs are one of several options for Northern Europe. One challenge is the capacity - i.e. the ability to quickly adjust production up and down as well as to transfer energy over power cables. Total battery capacity ("charge/discharge" capacity) in Norway is estimated at 20GW. Viewed in the context of the total installed capacity of almost 300GW in our neighbouring markets (UK, Germany, Netherlands, Denmark), the Norwegian contribution will be relatively marginal. In Germany, alone the total solar and wind capacity is 80GW. However, it is not a given that Norway will act as "Europe's green battery" in the future.

In principle, we are also talking about the export of a valuable commodity where the value is created outside Norway. Apart from the capital income of Statnett, it is unlikely the cables will lead to much industrial growth. On the contrary, an increase in electricity exports will increase prices. Energy intensive industries are dependent on low power prices if they are to remain competitive. If the process industries move abroad, this will lead to a loss of important export revenues and knowledge centres in Norway.

\textsuperscript{35} "Possibilities for electricity exchange between Germany and Norway" - Zero 2012. paperroom.ipsa.org/papers/paper_18315.pdf
\textsuperscript{37} “Renewables and Interconnectors towards 2020” Thema - www.thema.no/renewables-and-interconnectors-towards-2020/
Part 4. We have many tools at our disposal

Norway already has several tools that can help us to realise economic growth and employment based on the business opportunities within Clean Energy. Below is an overview of the most important.

Public financing instruments

Norway has a well-developed support system that assists the private and public sectors in the transition to a low emission economy with strengthened economic growth and employment. The most important are Enova, Innovation Norway and the Research Council of Norway. In addition, GIEK and Eksportfinans have an important but more limited role.

The Research Council of Norway

The Research Council of Norway funds research activities from basic research in research institutions and universities to applied research in industry. Projects are financed through thematic programmes, and for the area of opportunity that is Clean Energy, these programmes are particularly relevant:

The SkatteFUNN scheme is a tax deduction scheme for the private sector's research and development costs. Through SkatteFUNN, small and medium sized enterprises (SMEs) receive 20 per cent of project costs as a tax deduction. Large enterprises are eligible for an 18 per cent deduction from the project costs.

The ENERGIX-programme supports research in renewable energy, efficient energy use, energy systems and energy policy. It is an important instrument in the implementation of the national R&D strategy Energi21 and other energy policy goals. EnergiX makes annual funding announcements and provides grants to enterprises and enterprise groupings.

BIA will contribute to optimal economic growth in Norwegian industry through research-based innovation in enterprises and collaborative R&D environments within the BIA programme's area of responsibility. BIA is aimed at businesses in Norway that are motivated to undertake intensive research and development projects in order to realise innovation. BIA is aimed at areas that do not have their own research programme.

Innovation Norway

The objective of Innovation Norway is to realise increased economic growth and lasting competitive advantages in Norwegian industry. Innovation Norway's financial instruments apply to all sectors, and the goal is to mitigate risk in order to trigger innovative and future-oriented solutions. The following instruments are particularly relevant to the area of opportunity that is Clean Energy:

The Environmental Technology Scheme is a subsidy scheme aimed at the demonstration and testing of new environmental technology in all sectors, including solutions that contribute to energy efficiency and renewable energy production. Solutions that bring down costs in these areas are also included. The scheme applies to all enterprises throughout the country.

The IFU/OFU Scheme awards grants for the research and development of new technologies in close cooperation between the supplier and the first user. The parties agree a contract that ensures the responsibilities and obligations between the parties. The scheme applies to SMEs throughout the country.

The Innovation Loan scheme is aimed at the development and commercialisation of new technologies in all sectors.
The Bioenergy Programme, including a programme for the financing of biogas pilots, is a grant scheme aimed at agriculture.

**Enova**
Enova SF was founded to contribute to the restructuring of energy and energy production in Norway. According to the Norwegian Parliament report, Enova’s role will be the continued reduction of greenhouse gas emissions and the strengthening of the security of energy supply, as well as the support of technological development that will also contribute to reducing greenhouse gas emissions in the long term.

Enova can recruit projects from all sectors. Projects for reducing greenhouse gas emissions are prioritised. This also includes technology projects that can reduce greenhouse gas emissions globally.

In recent years, Enova has supported a number of innovative projects related to energy efficiency in industry, including in copper production, aluminium production, biocoal production and new smelting technology.

**Siva**
Siva facilitates innovation by developing, owning and developing infrastructure for it. The national budget for 2017 of NOK 50 million was allocated to establish Norwegian catapult under the direction of Siva.

This scheme will stimulate more multi-purpose centres located close to industry for testing, simulation and visualisation. The goal is to build facilities that strengthen the competitiveness of Norwegian industry.

**GIEK and Export Credit Norway**
GIEK’s mission is to promote Norwegian exports, ensure economic growth and to be a strong financial partner and advisor for Norwegian exporters. GIEK issues guarantees for Norwegian exports on behalf of the Norwegian Government. The guarantees cover both political and commercial risks for all or parts of loans issued by private banks or Export Credit Norway.

Export Credit Norway offers competitive export financing to Norwegian industry. Export Credit Norway offers Norwegian and foreign companies loans (CIRR loans38 on competitive terms) when buying goods and services from Norwegian exporters. Exporters in shipping, oil and the offshore industry are among those who traditionally have used the export finance scheme the most. These are industries where Norwegian enterprises are strong internationally. In recent years, emerging industries such as renewable energy have also made use of the scheme.

**The EU’s Horizon 2020**
The EU framework programme for research and innovation, Horizon 2020, has allocated a total of Euro 80 billion for research and development related to the seven major societal challenges.

The EU is facing major energy challenges, and intends to develop a transition to a secure, sustainable and competitive energy system. To achieve this, Euro 1.3 billion has been allocated in 2016 and 2017 to projects in the energy sector. Norway is a full member, which means that Norwegian companies can access funding for their projects from the European fund.

38 Fixed-rate loans, so-called CIRR loans (Commercial Interest Reference Rate), are given according to the OECD-related agreement on publicly supported export credits. [http://www.eksportkreditt.no/no/RENTER/DAGENS-CIRR-RENTE/](http://www.eksportkreditt.no/no/RENTER/DAGENS-CIRR-RENTE/)
A comprehensive system has been established for strengthening Norwegian participation in the EU's Horizon 2020, among other things by linking Norwegian companies and clusters with relevant international business and research institutions, supporting the development of consortiums, and providing financial support and advice to Norwegian companies wanting to assert themselves in the EU framework programme for research and innovation.

**Policy instruments for solving specific societal challenges**

In close cooperation with industry players, the public sector can identify market opportunities that will come as a result of future needs or public sector requirements. PILOT-E is a financing offer for Norwegian industry, established by The Research Council of Norway, Innovation Norway and Enova.

The aim of the scheme is to develop and implement completely new products and services in environmentally friendly energy technologies in order to contribute to emission reductions both in Norway and internationally. Pilot E will speed up the development through greater predictability of funding, closer monitoring and stronger coordination between the public funding agencies.

Through Pilot E, the players will be monitored throughout the technological cycle - from idea to market. Applicants are given a single contact person to liaise with throughout the project, even if the entire policy instrument system is involved.

**Supplier Development Programme**

A supplier development programme can have multiple purposes.

The Supplier Development Programme was established in 2010 under the direction of NHO, DIFI and KS with the goal of increasing knowledge of and the implementation of innovative public procurement.

The goal of the supplier development programme for Statoil (LOOP) is to develop solutions that Statoil need in their business, and Innovation Norway provides funding through the IRD scheme to trigger good projects. The NCE Systems Engineering version of the supplier development programme will meet the needs of the member companies for competent subcontractors for their sophisticated systems.

A supplier development programme under the direction of the policy instrument system will provide methods and systems for large industrial companies that wish to take a role in the development of their subcontractors. Such a toolbox might consist of expertise, advice and financing for supplier development in Clean Energy.

**Clusters and Research Centres for Environmentally Friendly Energy**

**Clusters**

Norwegian Innovation Clusters are a state funded cluster programme that will contribute to economic growth through sustainable innovation. This will be achieved by promoting and improving collaborative development activities in the clusters, with a view to increasing the dynamics and attractiveness of the clusters, and increasing the innovativeness of individual companies.

The programme has the levels GCE, NCE and Arena, and is a collaboration between Innovation Norway, SIVA and the Research Council of Norway. The Norwegian Ministry of Trade, Industry and Fisheries and the Ministry of Local Government and Modernisation are funding the programme.

For more information on clusters that are relevant to Clean Energy, see appendix 3.
Research centres for environmentally friendly energy (FME)
The research centres for environmentally friendly energy (FME) are a concentrated and long-term commitment to research in renewable energy, energy efficiency, CO2 management and social sciences. The research will be conducted in close cooperation between research environments, industry and management. FME will develop expertise at a high international level.

In May 2016, eight new technologically oriented FMEs were established; these are further described in appendix 3.

International efforts through Team Norway

Norway is a small, open economy and Norwegian enterprises compete in an international arena. In order to strengthen the position of Norwegian companies internationally, Team Norway offers various services in the form of expertise, networks, meeting places, consultancy and connections.

Team Norway consists of

The Norwegian Ministry of Foreign Affairs, the embassies and the consulates general

The foreign service missions are the foreign service's premier resource when it comes to giving assistance to industry. The Norwegian Ministry of Foreign Affairs has more than 100 missions that can assist with networks, local information and advice on, among other things, security and social responsibility.

Innovation Norway is represented in numerous countries and it is an important partner for the diplomatic service. In several places, Innovation Norway is collocated with the foreign missions and formally part of these. In countries where Innovation Norway is not represented, the foreign missions will represent Innovation Norway in industry matters.

The Foreign Service also has close contact with industry organisations and other organisations that administer instruments for industry.

Innovation Norway's offices abroad

Innovation Norway's offices abroad assist enterprises with practical queries, provide market information, facilitate partner searches, organise study tours and events, and serve as a gateway into new markets.

Innovation Norway's export centre

The advisers in the Export Centre have knowledge of trade documents and labelling and can help companies in their export process. They assist with challenges relating to delivery requirements and payment requirements for international trade. The Exports Centre maintains the Export Handbook and offers courses in export-related subjects.

The international work of the Research Council of Norway

Norway has bilateral research agreements with many countries outside Europe, some of which are of particular political priority: USA, Canada, Japan, China, Russia, India, South Africa, Brazil, Argentina and Chile.

The Research Council of Norway itself points out that there is a huge potential to strengthen cooperation with these countries.
The Research Council of Norway works closely with the EU framework programme, and offers financing for the application process for the EU Framework Programme (Project Establishment Support PES). 39 The Research Council of Norway has technology representatives in several markets. In Asia, Africa and South America, these are co-financed and co-located with Innovation Norway.

**Invest in Norway**

Invest in Norway (department of Innovation Norway) markets Norway as an attractive country for foreign investment.
Invest in Norway works closely with foreign players in evaluating Norway as a country for establishing business, and connects the companies with relevant players in Norway.

**Intpow**

Intpow is a membership organisation for the renewables sector, and aims to create international market opportunities for its members.

Intpow organises various expertise and marketing initiatives, such as conferences, seminars, networking activities, B2B meetings, delegations and trade show participation etc. From 01/01/17 Intpow will be part of a larger organisation, ”Norwegian Energy Partners”, which is a merger of INTSOK and INTPOW.

**Norwegian Energy Centres**

The Norwegian Energy Centre (NEC) network deals with collaboration between Norwegian enterprises and research institutes with the leading technology universities in the relevant market. The goal is to make technology verification, market assessments and entry strategies in these markets available for Norwegian actors.

Innovation Norway in Singapore is about to launch a pilot of such a network in Clean Energy.

**Foreign investment in Norway**

Foreign capital, expertise and technology is crucial for Norway to maintain and develop industry. By the end of 2014, there was a total of about NOK 1,400 billion invested in Norway from abroad (so called FDI - foreign direct investment), of which approximately 45% of this can be linked to the oil industry.

With the current outlook in the oil industry, Norway can expect a fall in foreign investments, and we need to compensate this reduction with increased investments in other sectors. Increased investments in land-based industries is one way to proceed.

Invest in Norway is noticing interest from foreign investors to invest in Norwegian renewable production (primarily wind - especially from Germany), as well as from companies/investors who either want to expand their involvement in Norway or who want to start new production in Norway.

Invest in Norway considers that there are a number of important measures that must be implemented if we are to succeed in attracting FDI to Norway. It involves

- Close dialogue with the company in Norway and not least with their HQ abroad. This is to quickly access information about new investments and changes.

39 The Research Council of Norway’s strategy for international cooperation 2010-2020
• Regulation of land for industrial purposes.
• Investment prospecti with information about locations, access to energy, water and other infrastructure, prices and labour for relevant industrial areas in Norway.
• Easily accessible information on financial instruments in Norway.

The roadmap for the process industry draws up a number of requirements for the continued existence of the industry in Norway. Some of these are:

- A competitive tax and tariff level
- Good international trade agreements
- Good industrial infrastructure (transportation, etc.)
- Training in appropriate skills
- In order to avoid carbon leakage, there must be compensatory instruments for industries that are covered by the EU ETS\textsuperscript{40}.
- Long-term agreements on energy, at a competitive price
- A coordinated and dynamic support system

It is the experience of Invest in Norway that virtually all major companies that are considering investing or establishing themselves in Norway are asking for financial incentives. This is offered internationally on a significant scale. Both tax incentives and direct subsidies are given.

### Public sector demand for goods and services

The public sector in Norway is a major driver of demand for goods and services. In 2016, public procurement will probably exceed NOK 500 billion. What is purchased and the requirements it places on suppliers is of considerable significance to the emergence of a market for goods and services within Clean Energy.

In the transition to a low carbon economy, the state must take an active role in driving forward the demand for new technology and expertise. Construction and transportation have been and are important areas for national energy use and emissions where public procurement has been a driver. In the transportation sector, the most recent example is the battery ferry Ampere, which was realised after a public tender process that placed great emphasis on the environment and climate. This has now become the starting point for a possible new Norwegian export industry related to emission-free sea transport.

When the Norwegian power grid will be upgraded, it is essential that smart solutions are chosen that facilitate the ongoing development of the power market described in this report. By actively demanding a new smart service production for the power grid, the public sector can help drive forward a market for Norwegian businesses. By setting high requirements for the environment, energy use and emissions in public procurement, the actors in the market are challenged to innovate and re-think which in turn benefits the public sector through a better offering of goods and services.

New tendering rules for the public sector from 2017 allow for closer cooperation between the public sector buyers and private suppliers in order that they can jointly develop innovative solutions - called innovation partnerships. The purpose of the innovation partnership is to facilitate a close and flexible cooperation between the supplier and the client, throughout the entire development process. For the supplier the process involves less uncertainty in terms of commercialising what is developed.\textsuperscript{41}

\textsuperscript{40} The EU emissions trading system. For more information see the section Climate quotas and CO2 levy.

\textsuperscript{41} https://www.anskaffelser.no/prosess/innovasjonspartnerskap
Innovation partnerships can be used in connection with expansions where there is a limited challenge and where the current best solution does not meet the future need for sustainable solutions from a lifetime perspective.

**Carbon credits and the CO₂ levy**

Norway is connected to the EU carbon credit system. Enterprises in sectors subject to carbon credits are within wood processing, district heating, gas power generation, gas terminals, offshore fields, refineries, mineral production, steel production, chemicals, aluminium, ferro-alloys and some other industries.

Roughly half of Norwegian CO₂ emissions are from sectors subject to quotas and the price in 2015 was NOK 0.44 per ton of CO₂ emissions. New enterprises with emissions subject to carbon credits must apply to the EU's carbon credit reserve. There are still carbon credits available, but from 2015, the total number of carbon credits decreased by 1.74% annually and from 2020 the number will reduce by 2.2% annually. This will cause a reduction in available carbon credits and CO₂ carbon credit prices will increase. At some point, companies will have to make a decision about continued emissions or whether mitigation measures are more profitable.

The CO₂ tax is, in addition to the carbon credit system, one of Norway's most important instruments for reducing greenhouse gas emissions. Both schemes involve setting a price on CO₂ emissions. The level of the levy is determined by the Norwegian Parliament, while the price of the carbon credits is determined by the market.

Currently, over 80 per cent of Norway's total greenhouse gas emissions are covered by the CO₂ levy or the European carbon credit system. The price per ton of CO₂ varies for different products, and individual sectors or areas are exempt from the CO₂ levy (e.g. when natural gas is blended biogas). The emissions carbon credit scheme is seen in the context of the CO₂ levy, so enterprises will avoid paying twice for their emissions. A mineral product used in the carbon credit regulated onshore industry, is for example covered by a refund scheme for the CO₂ levy.

**Guarantees of origin cause trouble**

Guarantees of origin are the EU's labelling system for electricity, and aim to give the electricity customer a guarantee that the electricity they buy is produced with renewable power. Power producers that sell guarantees of origin receive an additional income from their renewable power generation.

Every year NVE publishes a national product declaration for electricity, and this is based on guarantees of origin sold in the market. As Europeans have purchased a substantial number of Norwegian guarantees of origin and Norwegian power suppliers have been paid for this, NVE's production declaration provides a picture of Norwegian electricity being exported to Europe with us in return receiving a European power mix. If NVE will however base its declaration on *actually exported power*, we can argue that the electricity used in Norway, is entirely based on Norwegian renewable power.

In May 2016, 10 Norwegian business organisations sent a letter to the Norwegian Parliament's Environment and Energy Committee, requesting "NVE's declaration is amended to reflect the physical..."
delivery of power. Norwegian businesses should derive benefit from the country's rich supply of renewable energy, to ensure economic growth and our climate-friendly restructuring and competitiveness should also be documented in a simple and accurate way with NVE's product declaration for power supplies".45

Innovation Norway supports the request by the aforementioned organisations to ensure that from 2016 NVE exclusively uses the national production statistics as a basis for the national product declaration, which are also indicated by the government in the energy report as an opportunity. In addition, it is desirable that the government works to remove the entire guarantees of origin scheme in the revision of the EU's Renewables Directive.


Part 5: Innovation policy recommendations

Norway has a unique opportunity. We can become the first completely electrified society in the world!

The world faces a number of challenges that require good and sustainable solutions. This applies not least to the climate. Climate change will have devastating consequences for the environment and society if we do not act soon to reduce greenhouse gas emissions. The obvious way to do that is to replace fossil energy with Clean Energy.

At the same time, Norway is facing a separate challenge. We have an economy that has performed well from the extraction of fossil fuels. The dramatic fall in oil prices in 2014 has, however, shown us how vulnerable this business structure is. Prices will probably also go up and down in the future, but the requirement of the climate crisis for reduced emissions combined with various clean forms of energy becoming more profitable, indicates that we must prepare ourselves for lower prices in the future. We will have a petroleum industry for the foreseeable future, but we must make the economy less dependent on oil and gas.

All this indicates that we must bring about a restructuring of the Norwegian economy, where new forms of export replace the revenues lost from the oil and gas industry.

Innovation Norway has argued that it makes sense to focus efforts on areas where Norwegian expertise meets world needs. Global challenges also represent market opportunities in an area where Norway is uniquely positioned.

A future based on green competitiveness

In its report, the expert panel for green competitiveness writes among other things about the potential in Clean Energy: 46

"Clean Energy will be among the world’s most sought after input factors in the years ahead. While many countries have started to make their power generation emission-free, Norway already has renewable electricity production. With access to variable renewable production, a well-developed energy system, an already high level of electrification in the household sector and the world’s highest density of electric vehicles, Norway has a unique opportunity to take a global leadership position as the first fully electrified society in the world.

This could make Norway a full-scale laboratory for technology development, new goods and services production and new business models. For this to provide economic growth and new jobs, Norway must exploit the opportunities the real-time laboratory offers within transportation, smart buildings, smart grids and other areas. This also requires the authorities to clearly communicate their aspirations in a credible way that motivates national and international industry, knowledge centres and investors to invest in facilitating R&D and new business activities in Norway."

As this report has shown, Norwegian industry and research environments possess highly relevant expertise in terms of energy production, energy distribution and energy systems – exactly the kind of expertise the world market will need in the transition to a society based on Clean Energy and with greater use of information and communication technology.

46 Green competitiveness report from the Norwegian Government’s expert panel for green competitiveness, 2016 http://www.gronnkonkurranssekraft.no/
Increased use of ICT in the production and consumption of goods and services will create new business models and change the structure of society. We need smart electrified transportation, smart energy-efficient buildings, smart healthcare etc. In the Dream Commitment report on smart communities, we also documented the potential that lies in the link between good access to Clean Energy and modern digital solutions in the development of towns and villages. 47

Increased digitisation of this kind will require a smart and adaptive power supply adapted to new consumption patterns. A future that will be more and more electrical provides great opportunities for economic growth in the form of new products and services, but this requires us to look across current sectors and pool resources for a joint effort.

We also have strong and innovative industrial companies that can exploit long-term access to Clean Energy in a sustainable manner. Access to clean and competitive electricity still makes it possible to invest in energy-intensive sectors, including the processing industry.

Being able to prove that the products they supply are produced in a way that takes into account the environment and society is in itself a competitive advantage in the current market. There is good reason to assume that this type of branding will become ever more important in coming years, for the enterprises, clusters and the country as a whole.

Just as Germany has been crucial in bringing solar energy and Denmark in bringing wind energy to the world, Norway can show that it is possible to be fully electrified. With a clear ambition and long-term, stable framework conditions, we can attract expertise and capital which in turn provides jobs and economic growth.

Will provide solutions in many industries and in various areas of society

In summary, we will be able to increase growth in several areas through the following efforts:

1. Increased production and sales of Clean Energy and energy technology.
2. Increased production in industries that use Clean Energy.
3. Increased sales of services for the production, transportation and use of Clean Energy.
4. Increased sales of transportation solutions based on Clean Energy (battery-powered ferries, etc.).
5. Increased sales of services for the design and implementation of complex smart digital solutions with the use of Clean Energy.
6. Increased sales as a result of Norwegian enterprises and clusters being perceived as "green" and environmentally friendly.

We see a great potential nationally and internationally

Since the growth can come in several different areas, it is not easy to estimate the possible effects of such investment in electrification and Clean Energy.

A recent survey by The Research Council of Norway 48 shows that there are already about 1,800 enterprises within green energy and Clean Energy technology in Norway, from hydropower and power distribution to wind and solar power. Many of these are small, but an analysis conducted by Multiconsult, shows that the Norwegian-based renewables industry employed approximately 20,000 full-time equivalents in 2013, which corresponds to approximately 20 per cent of the total number of employees in the oil and gas sector this year.

47 http://www.drømmeløftet.no/rapport-om-mulighetsrommet-smarte-samfunn/
48 Norwegian industry within environmentally friendly energy, The Research Council of Norway.
The processing industry employs 1.2 per cent of the Norwegian workforce and represents just over 1.7 per cent of GDP, according to *the Roadmap for the process industry*. The Federation of Norwegian Industries estimates that the processing industry accounts for about 9 per cent of the total procurement of all goods and services in Norway, suggesting that the demand employs an additional 210,000 people. 49

Norwegian industry traded goods and services for NOK 811 billion in 2015. Large sections of the industry receive their energy from Norwegian hydropower. These include metal production, chemical raw materials and plastics, rubber and mineral products. These are enterprises that had a combined revenue of NOK 140 billion in 2015. They compete for power and increased access to competitive renewable power can provide the basis for new investments in innovation and with that increased production. 50 An increase in the revenue in these industries of 10 per cent will provide NOK 14 billion in increased exports. Further developing existing industry is therefore very important for Norway.

However, it is in the development of new services and technologies where the long-term potential is probably the greatest. In McKinsey's global report on the so-called disruptive technologies, it is estimated that the world economy will grow by USD 30 billion in the coming decade, from about USD 70 billion in 2015, to about USD 100 billion in 2025. 51 Virtually all of this growth will come from society transforming technology-innovation, helped by a staggering number of simultaneous technological breakthroughs.

Common to almost all of this technology development is that it will be digitised in some way and this will require access to a robust and stable power supply. The effect of Norway taking an early position and being a pilot country for the development and testing of different services could therefore be very significant.

Furthermore, the cost savings for a high-cost country like Norway will be significant, both as a result of more efficient use of energy and from the productivity gains resulting from the digitisation.

**Innovation across industries, disciplines, technologies and policy areas.**

Note that the effects of the electrification of Norway will come in the interaction between different industries, different disciplines and, through the use of various technologies.

If we are to succeed, the relevant technology development must be viewed in relation to the needs of society and the demands of the market. Regulatory requirements, regulations and individual innovation processes will be involved in bringing forth innovation that helps Norwegian enterprises to occupy the forefront of developments.

Enterprises, clusters and research environments must develop sound expertise on the challenges and market opportunities at home and abroad. All development of technological solutions must occur in such a broader context. There will be a need for comprehensive design skills (i.e. the ability to see the entire innovation process as a whole on the basis of user needs) that embrace long value chains and the interaction between enterprises and enterprises, enterprises and knowledge institutions and enterprises and public sector actors.

The fact that the use of Clean Energy applies to all industries and all areas of society means that ministries and public funding agencies must coordinate policy measures across policy areas and institutional boundaries.

Based on the trends, opportunities and comparative advantages for Norwegian players within Clean Energy, there are some steps that must be taken in order to realise the full potential. A summary of Innovation Norway's innovation policy goals and recommendations is that Norway must take a position based on our plentiful supply of renewable power - we must make use of the energy to create more jobs and increase economic growth.

Coordination across policy areas

An all too often occurrence today is that energy policy and industrial policy pull in different directions. Stakeholders in the market are looking for measures that make it possible to achieve an efficient use of energy in industrial development in Norway. There is a need for policies and measures for energy supply and economic development to be better coordinated, both at ministerial level and among the public funding agencies.

Innovation Norway recommends that the government assigns a single ministry the overall, coordinating role to implement a national direction and associated goals and action plans to ensure that we realise the potential in the electrified society. This corresponds with Innovation Norway’s advice for the opportunity area that is Smart Society (see separate report52).

It is important that the authorities have clear expectations for good coordination of the instruments in the Research Council, Innovation Norway and Enova and that they support the ongoing cooperation between the organisations.

Attractiveness for energy intensive industries and service production

The world needs an increased production of emission-free products - produced with Clean Energy. Based on our hydropower, Norway already has a world-leading industrial position with several industrial powerhouses. It is important that we manage to keep these enterprises in Norway, and that we create the conditions for new energy-intensive manufacturing and service production. We must adopt Norwegian Clean Energy in order to keep and further develop energy intensive enterprises.

Innovation Norway recommends development in line with Norway’s position as a preferred location for green establishments, in accordance with Invest in Norway’s slogan The Greenest Industrial Site in the World53. This means attractive terms to retain existing actors and active efforts in order to create a brand that attracts foreign investors and industries to Norway.

It presupposes that the authorities ensure competitive conditions for international industry in Norway, including long-term contracts for competitive, Clean Energy, a competitive tax and levy system, and a good framework for skills development, the development of technology and investments in climate-friendly technology.

The world as a domestic market for Norwegian technology and service providers

The future will require the production of Clean Energy. Norway is currently a major actor in hydropower, but we also have ancillary suppliers within the entire energy system supply chain. There

53 This is a slogan that Invest in Norway uses in the marketing of Norway as an industrial country - due to our plentiful supply of renewable power.
is considerable expertise in Norway, although the picture of those involved is fragmented. The Norwegian domestic market for new energy solutions is too small, and therefore, suppliers must develop their solutions in cooperation with international partners - and regard the world as their domestic market.

Innovation Norway recommends that Norwegian technology and service providers within Clean Energy receive access to the necessary risk mitigation and market expertise so that they can compete internationally and develop the best and most cost effective solutions in the industry.

The authorities should

- **Ensure financing for the development of technology as well as the demonstration and commercialisation of new technologies.** The relevant financing schemes for the Research Council, Innovation Norway and Enova should also be used when solutions must be tested outside Norway.

- **Ensure that Norwegian catapult (under SIVA) 54 includes Clean Energy** for the testing of new solutions and the scaling of technology, and facilitates Norway being a test arena for solutions with international relevance.

- **Ensure a market for green solutions,** that trigger new business models, innovation and economic growth. It must pay off to choose green and a green tax shift must involve what we want to have more of being taxed less and what we want less of being taxed more. 55

The authorities should make regulations and support schemes green and digital. There is a need for a review of laws and regulations, with the aim of identifying provisions that impede innovation and the development of digital solutions. 56

- **Public procurement as an engine for innovation.** Through public procurement, innovation in industry can be promoted. A national programme for challenge-driven innovation and the use of the public procurement power to drive innovation should be developed.

**Decarbonisation**

There is great need to reduce greenhouse gas emissions throughout industry, but transport is clearly one of the biggest sources of emissions, both nationally and globally. The decarbonisation of transport is necessary if we are to achieve our climate goals.

Norway is already far ahead with a high density of electric vehicles and we are world leaders in green maritime transport with a large domestic market. We should see this in the context of the electrification of society and facilitate the testing of new business concepts related to zero emission transportation. Hydrogen as an energy carrier is an important supplement to electric transport, not least for the maritime sector and heavy transport.

- **Norway should adopt a position as a laboratory for the testing of new business concepts related to zero emission transportation.** The authorities must put into effect measures that stimulate industrial and public transport to switch to low emission solutions. As the Government’s panel of experts on green competitiveness have pointed out, a CO₂ fund 57 - modelled on the NOX fund – could contribute to climate-friendly investments in the transport sector, both on land and offshore.

54 Programme for the testing, simulation and visualisation of new technologies https://siva.no/dokument/norsk-katapult-forslag-til-program/
55 Extract from the Strategy for Green competitiveness, p 26
56 Extract from the Roadmap-for-smart restructuring
57 Strategy for green competitiveness, page 53
• The Norwegian maritime industry has already shown that it can deliver low- or zero-emission ships and ferries. In the short term, the most important market will be local routes, but the demand for clean transport across oceans will increase. **There is a need for long-term, dedicated investments in Norwegian maritime expertise and product development as well as clear requirements from the government through orders and regulations.**

• **Furthermore, the public policy of encouraging electric vehicles ought to be continues.** Beyond 2023, only new cars with zero emissions should be allowed for sale in Norway. The global market will increasingly demand complete solutions for the use and integration of electric transportation in cities and regions. Here Norwegian industry can contribute both energy and systems expertise.

• **Strong enterprises and research institutions in the field of electric mobility should unite and establish a dynamic environment for the development of future electric solutions** (in line with the template for the Green Coastal Shipping Programme or the Cluster Programme).

**Increasing energy efficiency**

Saved energy provides more energy that is available. Increasing energy efficiency releases energy resources for other uses.

In Norway, the construction sector stands out; it accounts for 35% of energy use in Norway. The potential for more efficient and sustainable use of resources in buildings is huge in all aspects. This includes, among other things, the use of energy and resources in the manufacturing of materials, the construction or renovation of buildings, and not least the consumption of energy in buildings.

**Innovation Norway recommends that the authorities establish defined standards and regulatory frameworks that ensure the realisation of increasing energy efficiency. These will provide added value and employment through the development of national actors that can offer energy services internationally.**

The authorities should

• **Strengthen instruments for increasing energy efficiency** that provide incentives for the establishment of new business models and the products that the market demands. An example is the use of EPC (Energy Performance Contracting) where a provider identifies the energy saving potential and implements efficiency measures, and receives revenues equivalent to the saved energy in a given period. The financing of such contracts is currently challenging.

• **Take the lead and set high environmental and climate requirements for publicly owned buildings.** The public sector should use its purchasing power in this area to promote green solutions and enter into innovative partnerships to develop new future-oriented solutions. When the technology becomes available, it should set a new standard. For example, by 2017 all new public buildings ought to be zero-emission buildings.

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58 The National Transport Plan 2018-2029 proposes that new fossil-fuelled cars will not be sold from 2025. Most people believe that in 2025, electric vehicles will be competitive with fossil cars. If Norway wants to adopt a position as a pioneer and be a laboratory for new solutions, it must set a deadline earlier than 2025.

59 The Green Coastal Shipping Programme will aid the adoption of more environmentally friendly vessel solutions, through the creation and implementation of pilots.

60 Strategy for green competitiveness, page 72
• Set requirements for building standards for new buildings that create openings for new ideas and innovation, i.e. regulations that focus on the results achieved and not technical solutions.

For further description of Innovation Norway's strategy for the area of opportunity that is Clean Energy, see Appendix 5.
Appendix

Appendix 1: European market for Clean Energy

The EU has set climate and energy targets that will make the Union the world leader in renewable energy in 2030. By 2030:

- Emissions of greenhouse gases will be reduced by 40% compared with 1990 levels.
- Renewable energy will form at least 27% of energy consumption.
- There will be at least a 27% increase in energy efficiency compared with a business-as-usual scenario.

Achieving this transformation will require a fundamental change in Europe's electricity system: The electricity market must be redesigned, the energy markets of member states must be more closely integrated and there must be massive investment in the development and upgrading of infrastructure.

The EU expects the electricity market to undergo radical changes, and for it to look quite different in only five years. The proportion of renewable energy in electricity production is estimated to increase from 25 per cent today to 50 per cent in 2030. The increase in renewable energy in recent years has led to major challenges for the establishment as electricity prices have been negative and the power companies have lost huge sums.

The European Commission has estimated that the power grid will require an upgrade by 2020 amounting to around EUR 200 billion.

An expert group, commissioned by the French president to carry out analyses, believes that there is a need to invest in the high voltage grid, but even more so in the low voltage grid and that we are talking about many tens of billions of Euros annually in investments. In addition, there is a growing need to invest in smart meters. The expert group points out that this will require changes to the business model for electricity pricing and that this will become a hotbed for innovation.

The EU has, like many other countries, needed to redesign the electricity market so as to ensure a framework and incentives that promote an increase in renewable energy, while at the same time stabilising the electricity systems. The European Commission is working on producing an overview of how the new market design for electricity could appear in order for it to meet the future needs of consumers, to be able to take full advantage of new technology, facilitate increased production of renewable energy and ensure energy security for the member states.

The EU has set the goal that 10 per cent of the electricity will be cross-border by 2020 and that this will increase to 15 per cent by 2030. The aim is both to address the issue of areas in some EU countries that do not have access to electricity, but more importantly to facilitate the shift to low-carbon energy. These goals mean that each EU member state must have a cross border capacity that constitutes a tenth of the installed electricity production capacity. ENTSO-E has estimated that cross-border capacity must double on average by 2030.61

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61 ENTSO-E is the European Network of Transmission System Operators. The organisation represents 42 grid companies from 35 European countries. ENTSO-E will work to make sure that members develop appropriate responses to the challenges that the changes in the power system brings with them and ensure access to power. The organisation works to promote innovation, it is market-based, customer-focused and committed to security of supply and regional cooperation. https://www.entsoe.eu/Pages/default.aspx
In January 2016, the EU Commission decided to invest EUR 217 million in 15 trans-European infrastructure projects, mainly in Central and South-Eastern Europe. In the period 2014-2020, EUR 5.35 billion will be allocated for trans-European infrastructure projects.

This will require massive investments in the infrastructure and power grids in order to achieve connections across national grids. Furthermore, it will require changes in distribution, the development of "smart" solutions and probably additional development of micro grids as well.

The development and modernisation of Europe’s power grids will be crucial for energy security, more competitive electricity prices and sustainable societies as it is essential that the grid can cope with increasing quantities of renewable energy from solar and wind.

**Storage of renewable energy**

The increase in electricity from solar and wind has led to a growing need for storage. In particular, the market for batteries has evolved significantly in recent years due to the increased prevalence of electric cars, which has reduced battery costs.

The increased share of renewable energy in the power grid reinforces the need for storage and the development of improved technology to avoid fluctuations in the network, overloading and at worst black-outs. Storage connected to the electricity grid is important for several reasons:

- It makes it possible to increase the share of renewable energy in the power grid through control of the system.
- It allows for back-up in case of power failure, regulation and thereby stabilisation of the power grid.
- Distributed storage can reduce accumulation in the grid by "moving" the electricity to periods where there is lower demand on the grid and can thereby reduce the need to generate more electricity during peak consumption.
- By reducing the peaks in consumption and grid overloading, storage can lead to less wear and tear on the grid and a longer lifespan for existing infrastructure.

BNEF estimates that storage capacity worldwide will have to increase from around 58GW in 2015 to 858GW in 2040. Large-scale storage adjacent to the power plants reached a record level in 2015 with 250MW, an increase from 160MW in 2014. Announced projects have reached 1.2GW. 62

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62 Bloomberg New Energy Finance; UNEP; Frankfurt School: “Global trends in renewable energy investment 2016”
The storage of electricity outside the electricity grid is important as the energy generated from wind and solar gives access to electricity over a longer time period, and it will reduce the need for the use of polluting kerosene. A number of African countries are looking at the possibility of increasing the share of renewable through mini-grids powered by solar energy and distributed solar cell solutions in conjunction with batteries. Often batteries from electric vehicles are used. There are several projects of this kind underway in African villages.

**Developing markets**

About 1.2 billion of the world’s population (17 per cent) have no access to electricity. The majority live in Sub-Saharan Africa and Asia-Pacific.63

Bloomberg New Energy Finance (BNEF) refers to Africa as one of the most interesting markets for renewable energy over the next 10-20 years. The continent is experiencing strong population growth and requires rapid electricity development. The World Bank estimates that over 600 million people are without access to electricity in Sub-Saharan Africa. The extent of the black-and brownouts are considerable in areas where there is access to electricity. Lack of electricity and stable electricity hinders economic and social development. 64

South Africa and Morocco are thus far the largest markets for renewable energy. Kenya, Uganda and Ethiopia are about to increase development and investment.

In Latin America, three countries have passed the one billion dollar mark for investments: Mexico (USD 3.9 billion), Chile (USD 3.4 billion) and Uruguay (USD 1.1 billion). In Asia it is, Japan (USD 3.8 billion) and Thailand (USD 1 billion), that are in this league except for China, which is in class of its own.65

In several African countries there is about to be considerable activity in the development of small-scale, distributed PV systems. Kenya is among the pioneers in this as well. BNEF estimates that the market can be estimated at several billion dollars.

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63 REN21: Renewables 2016. Global status report
64 Bloomberg New Energy Finance; UNEP; Frankfurt School: “Global trends in renewable energy investment 2016”
65 Bloomberg New Energy Finance; UNEP; Frankfurt School: “Global trends in renewable energy investment 2016”
Technological advances, lower prices for renewable energy and batteries are leading to more countries and regions being able to become more self-sufficient in energy. It motivates the authorities to facilitate an increase in distributed systems for renewable energy.

The state of Hawaii has even gone so far as to decide that in 2045 it will be self-sufficient with renewable energy and not import any energy. It is a radical change for the island state which in 2010 imported 90 per cent of its energy and was dependent on oil for 75 per cent of electricity, with associated high electricity costs. By 2015, Hawaii was already generating 21 per cent of its electricity from renewables. The state has also agreed on a comprehensive development of battery storage capacity. Hawaii is an interesting "laboratory" for how a society can change an entire energy mix through proactive policy.

By the middle of 2015, around 44 million distributed PV plants were sold globally. These are plants that do not need to be connected to the electricity grid. This amounted to an annual market of USD 300 million. Around 70 countries in different parts of the world have either installed solar PV plants outside of the electricity grid or have established programmes to support this type of development. In parallel with the positive development of the markets and increasing investment, there is much innovation in business models. These include the use of payment systems via mobile, pay-as-you-go micro-financing schemes and the composition of products such as solar-powered lamps with radio and cell phone or TV. 66

Appendix 2: Clean Energy - Market potential globally

Innovation Norway's offices abroad have made an analysis of the market potential in selected countries. Below is an English summary of this analysis.

<table>
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<th>Country</th>
<th>Hydro</th>
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66 REN21: Renewables 2016. Global status report
### Canada

**Smart energy systems:** Good opportunity because of similar priorities, similar drivers to conserve and interest in diverse technology. Some work has been initiated and completed in this area, specifically smart grid and cybersecurity.

**Hydrogen:** Canada is one of the global pioneers of working with hydrogen and fuel cells. Hydrogen as an energy carrier and for specific initiatives such as port and warehouse technology/closed systems, as well as maritime vessels has been noted by the Canadian government as interesting.

**CCS:** High potential here, as Canada has implemented several globally leading commercial initiatives. Norway is already a trusted partner. Recently announced national carbon tax will further propel this sector. CO₂ pipeline, first of its kind globally, will be launched in 2017.

### USA

**Smart Energy Systems**

The US Dept. of Energy (DOE) is investing USD 4.5 billion to modernise the US's electric power grid. Under the largest programme, the Smart Grid Investment Grant (SGIG), DOE and the electricity industry have jointly invested USD 8 billion in numerous cost-shared projects involving more than 200 participating electric utilities to modernise the US electric grid, strengthen cybersecurity, improve interoperability, and collect an unprecedented level of data on smart grid operations.

**Hydrogen**

The US Department of Energy recently announced a notice of intent to invest USD 30 million to advance fuel cell and hydrogen technologies. Hydrogen and fuel cells continue to grow at an unprecedented rate, with more than 60,000 fuel cells, totalling roughly 300 megawatts (MW), shipped worldwide in 2015. The number of MW shipped in 2015 grew by more than 65% compared to 2014.

**Energy Efficiency in Buildings**

Buildings account for more than 40% of the US’s total energy demand and greenhouse emissions. This results in an annual energy bill of roughly USD 430 billion. On average, nearly a third of this energy is wasted. It is estimated that if the US reduced energy use in buildings by 20%, the nation could save nearly USD 80 billion annually. The Department of Energy announced in July that it is investing USD 19 million into advanced building technologies to improve the efficiency of US homes, offices, schools, hospitals, restaurants and stores.

**Carbon Capture Storage and Use**

Petro Nova, which was recently launched in Houston, will use ammonia-based scrubbers to extract CO₂ from their coal power plant for enhanced oil recovery. May encourage more “clean coal” transformation in the US, and will also increase necessary EOR on older fields. May also serve as an example of how to manage a project of this magnitude and with so many stakeholders in the US to prevent a situation like Kemper County Energy Facility in Mississippi.
**South America:**

**Wind:** Extremely favourable conditions for onshore generation with very high efficiency rates. Well-established supply chain.

**Solar:** Next best thing. Impressive growth rates and regions with perfect conditions for PV and solar-thermal. Local supply chain still in early stage.

**Smart Energy Systems:** Smart grids, smart houses (energy control systems), smart metering systems

**Energy Efficiency in Buildings:** Technology for refurbishing of all buildings and construction of new buildings. Smart control systems, thermal solar installations, heating and cooling systems, new construction materials.

**South Africa:**

**Wind and Solar:** Contributing to South Africa’s national grid and there are a number of projects that have been implemented. Scatec Solar have been particularly successful in South Africa. South Africa is very focused on manufacturing opportunities and developers should bear this in mind. South Africa has perfect conditions for these forms of energy.

**Smart Energy Solutions:** Energy efficiency is definitely a strong area of focus for South Africa and could include smart meters, fault line reporting on transmission lines and energy consumption management solutions. Off-grid solutions from Norway, whereby companies use waste to generate energy for plant operations, are also very interesting.

**Hydro:** We have small-scale hydro solutions typically 4MW in size and Norfund has contributed towards some of these projects. However, the size of these projects may be too small for Norwegian companies working in this area.

**Hydrogen:** The Department of Science & Technology has developed a research framework and strategy to develop and guide innovation along the value chain of hydrogen and fuel cell technologies. HySA has been established in collaboration with a Norwegian and there are three centres of competence in the country. The mining industry is interested in using fuel cells to take its platinum group metals refinery in Springs off the national grid. The Industrial Development Corporation has expressed interest in developing this industry.

**Energy Efficiency in Buildings:** Green building is forecast to double globally by 2018, according to new research, which showcased South Africa as one of the top performers worldwide, reporting the highest percentage of green building projects currently underway. Even more impressive is the fact that South Africa’s commitment to green building is not triggered by regulatory requirements, as is the case in many other jurisdictions, but by “doing the right thing”. There is an opportunity to engage with the Green Building Council of South Africa and introduce innovations such as building materials and architectural styles.

**Carbon Capture & Storage:** A great deal of work has been done to explore the potential for CCS deployment. This includes the release of and the endorsement of the CCS Road Map by Cabinet in 2012. The next milestone is the Pilot CO₂ Storage Project (PCSP), which aims to be a “proof of concept” for CO₂ storage in the South Africa with the first injection of CO₂ scheduled to happen after 2017. Two potential on-shore sites within UMkhanyakude and Cacadu District Municipalities respectively are being explored for the PCSP. Sasol has visited Norway a few times to learn about solutions in this area.
**East Africa:**

**Hydro:** Hydropower accounts for about 50% of the total electricity generated in East Africa. There is still huge potential of the untapped hydropower resources, especially small hydro (less than 10 MW capacities). There are government support schemes to promote hydropower, for instance an attractive feed-in-tariff that averages 0.1 USD per KWh.

**Wind:** Some parts of East Africa have proven wind energy potential of as high as 340 W/m² and average speeds of over 6 m/s. Wind measurement campaigns have been ongoing for the past few years, and soon viable sites will be allocated to the private sector for development. Kenya has a feed-in-tariff for wind (0.11 USD/KWh) while Tanzania and Uganda are preparing for the tendering process. Africa’s largest wind farm, with a capacity of 310 MW, is under construction in Kenya and Norfund has invested in the project.

**Solar:** The East Africa region receives an average daily insolation of 4-6kWh/m², and about 5-7 peak sunshine hours. The regions’ electricity access rate is below 30%, and solar power is considered a potential energy source to electrify larger parts of the community that are not connected to the grid – through off-grid systems. Pay-as-you go solar home systems have gained popularity, and the trend is expected to continue for some more years to come. There are also initiatives to develop grid-tie solar projects. Both Kenya (0.12 USD/KWh) and Uganda have attractive feed-in-tariffs for solar, while Tanzania have renewable energy procurement schemes.

**China:**

**CCS/CCUS** is one of the fields in which Norway has an advantage and experience. China has also implemented many projects. Both R&D and industry have great potential to cooperate.

**Energy Efficiency in Buildings** is emphasised by the Chinese government, because buildings amount to nearly 40% of the society’s total energy consumption in China. It is also concerned closely with smart city and urbanisation, which are critically important to China.

**Smart Energy System** is potential. The China State Grid, one of the largest companies in China, has a monopoly in this field. Normally, there will be some difficulty in cooperation practice. Hydrogen has high potential in R&D and pilot projects, but both sides are challenged by its commercialisation.

**Japan**

**Wind:** There is growing interest in offshore wind in Japan. Norway is far ahead in offshore wind, and has much to offer Japan.

**Hydrogen:** Norway and Japan complement each other in hydrogen technology. Fuel Cell Expo 2017 Tokyo has already attracted some interests from Norway.

**CCS:** Gassnova is eager to invite Japanese companies to their CCS projects. Many companies are engaged in CCS in Japan.

**South East Asia**

**Hydro:** Substantial potential for large-scale hydro projects in e.g. Philippines, Vietnam, Laos, Myanmar and to some extent Indonesia. SN Power has projects in Laos, Philippines and Myanmar, and has one ongoing project development in Sulawesi, Indonesia and is about to sign an MoU with PLN to develop another hydropower project in Kalimantan. MultiConsult, Jacobsen Elktro, Norconsult, Dynavec and Rainpower and others are engaged in several countries. Countries like Myanmar will experience major hydropower expansion over the next few decades.
Small-scale hydro has further unexplored opportunities in almost all energy hungry countries in the region. Opportunities are seen in upgrading/expanding existing hydropower plants as well as optimising reservoir operation to meet multipurpose uses of water.

**Solar**: Substantial growth in large-scale and small-scale plants and off grid/micro grid solutions in most countries. Elkem Solar is actively developing a range of opportunities, including floating solar (racks floating on reservoirs etc). Elkem/REC Solar have installed their solar panel in several projects in Indonesia (Central Bank, Bau airport etc) and have some potential projects in development in Indonesia.

There are opportunities in the production of solar PV, rooftop solar power, utilising solar energy for water desalinisation and water pumps.

**Smart Energy Systems**: Many countries have developed strategies and road maps for smart cities and smart energy systems but not yet in the implementation phase. Singapore is by far the most advanced in implementing their Smart Nation concept.

**Vietnam**

**Hydro**: Vietnam has enriched hydropower potential. 70% of this hydropower potential has been exploited. At present, more than 50% of Vietnam’s electricity demand is provided by hydropower. The first hydropower plant in Vietnam was built by a French company in 1945.

**Wind**: Vietnam’s wind power potential is first in the South East Asia region. The low Vietnam feed-in tariff for wind power (USCent 7.8/kWh for onshore wind farms and USCent 9.8/kWh for offshore wind farms) is the main barrier for greater development of wind power in Vietnam.

**Solar**: The Vietnam Ministry of Industry and Trade is going to submit the solar feed-in tariff to the government for approval, which is U$Cent 12/kWh for PV farm and U$Cent 14.5/kWh for rooftop solar.

**Energy Efficiency in Buildings**: Vietnam has huge potential for energy efficiency in industrial facilities, hotels and building. Opportunities are seen within green design, new technology for air-conditioners, water supply and construction material.

**Turkey**

**Hydro**: Turkey has the second highest potential in Europe after Norway. As of June 2016, installed capacity in hydro is 26250 MW. 6800 MW of this consists of run-of-river projects. Turkey recently focused on small and medium sized hydroelectric power plants (HEPP) instead of large-scale dams where Norwegian companies are highly competent.

**Solar**: As of June 2016, the installed capacity in solar energy is 535 MW. The target for 2023 is 5 GW, meaning that the installed capacity must increase tenfold. Turkey has the second highest potential in terms of annual sunlight in Europe after Spain.

**Wind**: Turkey’s technical wind energy potential is stated to be around 88 000 MW (Wind Energy Estimate System, 2003, 19). As of June 2016, the installed capacity in wind is 4900 MW. Investors and operators have increasingly shifted their attention towards operational efficiency and improving technical feasibility of projects.
The Middle East

**Solar:** There are many plans to implement solar parks throughout the Middle East in the years to come.

**Hydrogen:** The countries in the Middle East have extensive gas reserves. With the exception of Qatar and possibly Iran, these gas resources are currently not developed, but the reserves are huge. Hydrogen reforming from methane gas is the most energy efficient way to produce hydrogen and is currently used in the medical and petrochemical industries and not as an energy carrier. Technology and processes to produce hydrogen or a method to hybridise hydrogen production by means of solar energy are very much desired, but most of the technologies in this last category are at a lab scale level at best.

**Energy Efficiency in Buildings:** New building standards have been developed to reduce the energy footprint of buildings. Despite a desire to do so, there is a lack of expertise in the implementation of such standards and people rarely know the availability of new materials and solutions to construct buildings that are more efficient. The low cost of electricity, and the fact that the electric bills is paid by the tenants, does not create incentives for the implementation of energy efficient solutions. The use of building management software to reduce the electricity footprint is highly requested by tenants of large resorts and hospitals.

**Carbon Capture Storage and Use:** Technology related to CCS is highly relevant especially in the petroleum industry both in Saudi Arabia and the UAE, and mainly for Enhanced Oil Recovery.

Germany

**Smart Energy Systems:** Renewable energies have a share of more than 30% of the electricity production. In order to integrate these fluctuating energy resource in the energy system, Germany is working on network expansion, flexibility at the demand site, and storage solutions. Emissions-free solutions within transportation and principal demand have been the focal points for achieving the climate goals. Electro mobility infrastructure is developing. Different market players are targeting these segments, testing solutions and market acceptance.

**Energy Efficiency in Buildings:** Buildings use 40% of the total energy consumption. In order to achieve climate goals and to reduce emissions, we are expecting more public programmes that give incentives to modernise buildings and make them smarter.

Spain

**Wind:** Renewal of the existing equipment, distance monitoring systems, new materials, and wind forecast systems.

**Solar:** Renewal of the existing equipment, distance-monitoring systems, new materials.

**Smart Energy Systems:** Smart grids, smart houses (energy control systems), smart metering systems.

**Energy efficiency in Buildings:** Technology for refurnishing of all and construction of new buildings. Smart control systems, thermal solar installations, heating and cooling systems, new construction materials.

Italy

**Smart Energy Systems:** Italy is one of the most developed countries in Europe for the implementation of smart cities’ technologies. 36 million smart meters, which currently enable the real-time control of energy consumption and dispatching, have already been installed throughout the entire market. The
installation of “second generation” smart meters will start in 2017, which will also allow the connection, through the installed devices, to broadband data networks (internet) and the delivery of home automation services.

In addition, gas smart meter installation has already started. Electric mobility and car sharing systems are in sharp growth. There are opportunities in all the smart city technologies.

**Energy Efficiency in Buildings:** Government incentive programmes for energy efficiency in existing buildings (isolation systems, low consumption heating systems, etc.) started several years ago and are still running. Energy certification for new buildings is mandatory, which include a certified level of energy consumption and the self-production of a percentage of the energy needed by the building. There are opportunities within building materials, lighting systems, micro energy production systems (solar pv, solar thermal, and micro-wind), energy storage and home automation technologies.

**France**

**Hydro:** Hydro has little potential in France (and Europe in general) as most of the economically viable reservoirs are already exploited and there is little space left to build hydropower, except for hydro pumped storage on the seashores of France.

**Wind:** France has generally high wind potential and there is small penetration in this industry. France has the second largest wind power potential in Europe, but projects sometime meet administrative and legislative barriers.

**Solar:** Solar power has experienced strong development in recent years. Solar is in high demand, depending on the price. France has good remuneration for renewable power generators.

**Smart Energy Systems:** The Smart Energy System's market is saturated by governmental actors, such as EDF with the Linky smart meters (compulsory installation in France).

**Hydrogen:** France wants to become a “European champion” in hydrogen power technology, and estimates that the hydrogen market can generate an annual revenue of EUR 5 to 40 billion within approx. 10 years.

In May 2016, the government launched a new tender for “regional hydrogen” projects. Since 2014, the GRHYD project, led by GDF SUEZ and funded by the government, aims to investigate the technical and economic viability of combining green hydrogen and natural gas that can be distributed over existing natural gas networks, so that electricity produced from renewable energy sources outside of consumption periods can be transformed and stocked as hydrogen. Today, hydrogen is mostly used in industry, but the aim is for hydrogen to represent a larger proportion of France’s renewable energy mix, and be used to produce electricity and heat buildings.

**Energy Efficiency in Buildings:** Energy efficiency in buildings has very high potential. All newly built houses must comply with more and more stringent energy efficiency standards. France is currently lagging behind in this area; an old building park and cheap nuclear energy have led to high residential power consumption.

**Carbon capture and storage:** France supports R&D projects on CCS. Today, CCS is too expensive and an uneconomical option. With the current carbon price at the EU-ETS, it is cheaper to emit than to store carbon.
Poland

Energy efficiency in buildings – This topic has been high on the agenda for several years. The rules governing housing construction have become much more demanding. For several years, the Polish National Fund for Environment Protection has had programmes financing certain measures aimed at increasing energy savings in buildings.

Smart energy systems – Such solutions are implemented more and more widely in industry in Poland. I understand that smart grid solutions are also included in this area. There is currently a great deal of investment in implementing intelligent grid technologies.

Denmark

Wind: More than 40% of today’s Danish electricity consumption is produced by means of wind power, and the goal is to reach 50% by 2020. Offshore wind turbines are being moved further out to sea to ensure stronger and more stable wind resources, which could call for Norwegian offshore expertise.

Smart Energy Systems: Denmark holds a strong international position within smart grids and offers a unique opportunity of testing solutions in a nation-wide smart grid. Denmark is moving from 30% green power in the grid today to 100% by 2035 and has the most advanced value chain within smart grids.

The Baltics

Energy Efficiency in Buildings: A very neglected area during the Soviet era – so there is a great need for improvements and this is one of the most prioritised areas for the use of EU funds. In addition, there are National Smart Specialisation Strategies which focus on smart buildings and low energy buildings (R&D need and investments)

Smart Energy Systems: The installation of smart meters is ongoing in all three markets. In Estonia this will be ready in January 2016. An increasing share of RES results in a need of balancing the grid; the Baltic grids are building new and increased connections to Finland, Sweden and Poland. Smart Specialisation focuses on smart energy and smart systems, but there is also a lot of focus on ICT.

United Kingdom

Hydro: The UK has benefitted significantly from hydropower for well over a century and there is currently an installed capacity of 1676 MW, generating over 5885 GWh/year. In addition to this, there is around 2800 MW capacity of existing pumped storage. However, there does remain significant potential for further development, as independent surveys have identified a remaining practical potential for a further 2GW of capacity.

Wind: The UK generates more electricity from offshore wind than any other country. The sector meets around 5% of annual demand and this is expected to grow to 10% by 2020.

Solar: Solar Power has been slowly developing in Britain compared with some other European countries. Due to public subsidies and the falling of equipment costs, solar power is becoming a more attractive prospect for the region.

Smart Energy Systems: The UK’s energy sector is ready to deliver affordable, reliable and clean energy and to put the customers at the heart of future energy policy. The government is committed to ensuring that every home and small business in the country is offered a smart meter by the end of 2020.
Hydrogen: The first mass production of hydrogen cars has arrived on UK roads. A forecast by the government and industry estimates that there will be 65 hydrogen filling stations in the UK by 2020, concentrated in the busiest parts of the country. This will make long-distance travel possible on the busiest routes, though comprehensive coverage of the UK would require 1,000 filling stations.

Energy Efficiency in Buildings: The UK’s housing stock is amongst the least energy efficient in Europe, and is responsible for nearly a quarter of our annual carbon emissions. There are great opportunities in this field to make houses more cost-efficient.

Carbon capture and storage: This is a priority for the UK if it is to meet its 2050 climate goals. There is uncertainty around this as the UK government decided to scrap the GBP 1 billion carbon capture storage funds support.
Appendix 3: Economic growth from Clean Energy through energy-intensive industry and data centres

The processing industry accounts for a significant proportion of Norwegian export revenues, and the enterprises have in recent years worked to bring down their climate emissions. Energy intensive industries are important to rural Norway, many of which are the cornerstones of their home municipalities. The industry is formed mainly from parts of international groups, where the Norwegian unit functions as an R&D centre for the enterprise, testing new production methods with lower environmental emissions.

The Norwegian processing industry is a traditional industry with production sites all along the coastal strip from Halden to Finnsnes. The industry exported goods amounting to approx. NOK 180 billion in 2013, representing half of all exports from the mainland. The industry is also extremely important to national and local economic growth. An analysis of the industry cluster in Grenland by NHO showed, for example, that 1600 FTEs on “Herøya” triggered 9,500 FTEs with subcontractors through procurement of a magnitude of NOK 11.2 billion (source: Roadmap for the processing industry).

The process industry’s contribution to maintaining the value of Norwegian hydropower is considerable. Through its annual consumption of about 35 TWh, the industry contributes to substantial economic growth for owners at state, county and municipal level.

What growth opportunities are there in Norwegian energy intensive industries?

The roadmap for the process industry is based on extrapolations from the IEA’s Energy Technology Perspectives, 2015. It is clear that the world will also need industrial products in the low-emissions society, it could be said that the processing industry is an important contributor for getting there. Below are some examples:

- Car manufacturers are anticipated to increasingly use aluminium in order to reduce weight and thereby fuel consumption. The IEA considers that there will be a necessary production increase in aluminium of 150% by 2050. Norway is Europe’s largest producer (disregarding Russia) and could therefore have great opportunities for increased production.

- The prospects for silicon, for example, are also very good as the production of solar cells is expected to rise sharply. Elkem Solar is a Norwegian (Chinese-owned) player that is well positioned in this market. Elkem is also well positioned to deliver material for the batteries of the future, not least for vehicles.

- Within petrochemicals, the IEA considers that methanol production in the world will increase by 230%. The plant at Tjeldbergodden (Statoil) is said to be the world’s most energy-efficient, and should therefore have opportunities in this growing market.

- Yara is an international heavyweight within fertilisers. Fertilisers are seen as a necessary requirement in order to be able to feed the world’s growing population. The emissions from

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this type of production come mainly from ammonia. The IEA considers that there will be an increase in world production of about 60% by 2050.

- There is great potential in wood processing, among other things because the world is searching for organic products that can replace fossil fuels, i.e. from petroleum to biomass. It may be biofuels, biochemical products and biobased products that go into different process industries. Norway has considerable forest resources, and has two important industrial motors; Borregaard and Norske Skog.

- Norway is very well positioned to take part in the hydrogen revolution. Hydrogen is the main focus in Japan. Hydrogen requires a lot of energy (preferably green), a lot of space and not least good transportation routes. Norway meets these requirements.

- Strong growth is predicted in the construction of large, power-hungry data centres. This is a result of computer use, and therefore a requirement for storage is increasing sharply, particularly from smartphones. With our cool climate, an ample supply of cooling water, a lot of space and not least renewable energy, we are among the most attractive countries for locating such major facilities.

**Norway - the world's greenest industrialised country?**

Here are some examples that underpin Norway's position:

- From 1990 to 2014, greenhouse gas emissions from energy-intensive industries decreased by 40%, while production increased by 37%
- Hydro Aluminium has decided to build a pilot plant for the world's most energy-efficient aluminium production, and thus also the most climate friendly. The investment of NOK 4.3 billion is the largest single investment in Norwegian mainland industry in 15 years.
- The industry uses BAT Best Available Technology- and is therefore already well positioned in the low emissions society.
- The world’s most energy-efficient methanol producer, Statoil Tjeldbergodden, is located in Norway.
- By replacing coal with other input factors, Norcem's two factories have succeeded in reducing CO₂ emissions by 150,000 tons.
- Norway has the world’s most advanced test centre for CCS at Mongstad, and otherwise has several ongoing CCS/CCU projects.
- A high level of costs combined with stringent national regulations have forced forward automation, energy efficiency and a focus on side streams over a long period. Production in Norway counteracts resource waste.
- Norway has abundant natural resources, which means we have a number of short-travelled input factors.
- Norway has a lot of water and space, where industrial production does not compete for area with agriculture, for example.
- These are major export industries. Through our port structure and location of production sites, the requirement for land transportation is much lower than in many other countries.
But first and foremost, the Norwegian position as a green developer is bound to our access to clean and stable electric power.
Appendix 4: Clusters and research centres for environmentally friendly energy

In Clean Energy, there are many important industrial clusters and research environments that are important in the development of the opportunities that Norway faces.

Here is an overview of clusters that are of relevance to the area:

**GCE Node** is a world leading technology cluster related to the energy and maritime sectors. The cluster has relevance for the area of Clean Energy both in terms of industrial development and renewable energy. Node works with production technology, automation and robotics. The cluster also has research activities related to geothermal energy and offshore wind.

**NCE Maritime Cleantech (NCE MCT)** focuses on reducing environmental challenges and greenhouse gases related to the maritime sector. A main area is the transition from fossil fuels to batteries and hydrogen, and the implications this has for the energy system and infrastructure.

**The Eyde Cluster (NCE EYDE)** consists of processing industry enterprises that produce specialised materials and chemicals for the world market. These enterprises export approximately 90% of the production, and they annually carry out R&D activities worth approximately NOK 270 million. Among the owners of the core enterprises are some of the largest global corporations. NOK 9.4 billion has been invested in these enterprises over the last ten years. Knowledge providers have been able to join the cluster since 2015. The total annual revenue is about NOK 23 billion, with includes approximately 8,000 employees in all the enterprises.

**NCE Systems Engineering** represents a number of high-tech enterprises with leading market positions in many sectors. In order to further develop the cluster with new sustainable companies, NCESE has contributed to the country's widest industrial innovation initiative through Kongsberg Innovation. In this initiative, the enterprises help with relevant expertise, technology and networks in order to commercialise "green" renewable energy technologies and energy-efficient systems.

**NCE Raufoss** is the national centre of excellence for lightweight materials and automated production, with the ambition to become a Norwegian centre for all manufacturing industry. The network contains internationally leading expertise in materials and production technology.

**NCE Smart Energy Markets** is an important national innovation actor within SmartGrids and Smart cities. In the industry cluster there are a number of IT companies and academic environments that contain Norway's leading expertise in Big Data Analytics and digital technologies, which are now being used in smart energy.

**Electric Mobility Norway (EMN)** is a cluster (Arena Cluster from 2012 to 2015) of enterprises working together to achieve business opportunities within the area of electro-mobility. The enterprises develop and commercialise products and services that enable and improve electric travel. This gives electric cars and other electric vehicles a central position in the transport system of the future.

Here is a brief description of the eight research centres for environmentally friendly energy (FMEs) that were initiated in 2016:

**Norwegian CCS Research Centre** - Focuses on the development of technologies for CO₂ capture, also called CCS (CO₂ capture and storage). The aim is to facilitate a faster introduction of large-scale CO₂ sequestration. The centre will contribute to the reduction in existing barriers to the demonstration of technology for the capture, transport and storage of CO₂. The ambition is to become a world-leading centre for CO₂ sequestration.
Norwegian Research Centre for Hydropower Technology will prepare the Norwegian hydropower sector to meet new challenges and exploit future opportunities through innovative technological solutions. The ambition is to contribute to a doubling in economic growth in the Norwegian hydropower sector by 2050.

The centre will conduct research on hydropower plants, turbines, generators and develop solutions that address new markets and services, and balance environmental, societal and climatic considerations. Work will be carried out in collaboration with national and international industry and international research environments.

Norwegian Centre for Sustainable Bio-based Fuels and Energy will through interdisciplinary research develop technologies that can provide further breakthroughs for the production of second generation biofuels. One of the goals is to achieve a reduction of up to 30% in production costs compared to current levels. The centre will work with both chemical, thermal and biological processes.

Various alliances from the Norwegian and Nordic forest industry participate in the centre. The centre builds on research and cooperation in the CenBio FME and the research infrastructure NorBioLab.

Centre for intelligent electricity distribution – CINELDI - will contribute to the digitisation and modernisation of the distribution grid in a cost-effective, flexible and robust manner. The aim is for the grid to manage interaction with smart customers, electricity transport, solar cell systems and other forms of renewable energy.

The centre will develop a knowledge base for grid companies and authorities and a roadmap for the introduction of smart grids in Norway. The centre will collaborate with leading national and international industrial companies and international research environments.

Centre for an Energy Efficient and Competitive Industry for the Future - HighEFF - will develop technologies that will make it possible to reduce the industry's specific energy consumption by 20-30% and reduce greenhouse gas emissions by 10%. The centre will work on energy efficiency on a number of different levels, from components for processes, individual enterprises, groups of enterprises and regions.

The centre will collaborate closely with leading national and international industrial enterprises and international research environments. Among the industrial partners are all the major sectors of Norwegian industry; metal production, oil and gas, the chemical industry and the food industry.

Research Centre for Sustainable Solar Cell Technology will contribute to growth, the development of new industry and new jobs in the Norwegian solar industry. The main focus of the centre is the production of silicon-based solar cells and materials for these. The centre will also work on issues related to the use of solar cells, and the centre will thereby contribute to sustainable and cost efficient growth in the use of solar cells in Norway.

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The centre has 15 user partners with industry players involved along the entire value chain, from the manufacturing of silicon, silicon blocks (ingots) and wafers, to the use and installation of solar panels.
**Mobility Zero Emission Energy Systems – MoZEES** - will develop materials, components and technology for the use of batteries and hydrogen for transportation purposes by road, rail and sea. The centre will increase the scientific, technological and techno-economic expertise related to zero-emission transport. There will be a special focus on innovations for the maritime sector.

The user partners are broadly composed of actors from among the maritime industry, processing industry, power electronics, public transportation and transportation agencies.

**The Research Centre on Zero Energy Neighbourhoods in Smart Cities – ZEN Centre** - will contribute to the transition to a low emissions society by creating solutions for sustainable zero-emission areas in smart cities. The centre will develop tools to plan, design and operate areas that do not contribute to greenhouse gas emissions.

The centre will also help establish energy flexible market mechanisms by creating appropriate business models and services. The solutions will be implemented and tested in selected “living labs” at area scale.
Appendix 5: Innovation Norway's activities within Clean Energy

Innovation Norway's total funding commitment (grants and loans) in 2015 amounted to NOK 6.9 billion. For projects within energy and the environment, including the bioenergy programme, NOK 537.5 billion was spent, or 8% of the overall funding commitment in a total of 515 projects. This is on a par with previous years.

More successful entrepreneurs

Innovation Norway will stimulate entrepreneurial and start-up companies to exploit their opportunity for growth. In 2015, there was a clear increase in the number of funding commitments and amounts to entrepreneurs within energy and the environment in relation to previous years, see the table below. 2/3 of the projects were within services while 1/3 were within goods/production. The high percentage of services can be explained by the Clean Energy service projects being easier to finance with private seed and venture capital because the time from idea to market is often short, which investors prefer.

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of commitments</td>
<td>119</td>
<td>117</td>
<td>107</td>
<td>163</td>
</tr>
<tr>
<td>Amount granted</td>
<td>92.1</td>
<td>129.8</td>
<td>79.3</td>
<td>175.2</td>
</tr>
</tbody>
</table>

For entrepreneurs 11% of the total funding commitment to this target group is in energy and the environment, which is almost twice as much as for enterprises.

More enterprises with capacity for growth

Innovation Norway will assist both innovative companies with international ambitions and the breadth of Norwegian industry that is working to ensure its competitiveness and profitability. The figures below show the development in recent years. As the table shows, there has been a decline since 2012 and 2013, which may be due to Enova having received new tasks and increased allocations to this target group.

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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</thead>
<tbody>
<tr>
<td>Number of commitments</td>
<td>211</td>
<td>178</td>
<td>151</td>
<td>178</td>
</tr>
<tr>
<td>Amount granted</td>
<td>318.2</td>
<td>321.0</td>
<td>188.6</td>
<td>282.7</td>
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</tbody>
</table>

Clusters

Innovation Norway will stimulate enterprises, knowledge environments and public sector actors to interact in order to strengthen the ability to innovate and adapt. Of a total of 39 Arena, NCE and GCE clusters in 2016, there are only two within energy and the environment. These are the Solar Energy cluster at Kjeller and NCE Eyde in Southern Norway.


**Innovation Norway's financing services within Clean Energy**

Below is an overview of the financing services used for innovation in Clean Energy.

<table>
<thead>
<tr>
<th>Service/instrument</th>
<th>Commitment amount</th>
<th>% Of total funding commitments within the service</th>
</tr>
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<tbody>
<tr>
<td>Total for all services</td>
<td>537.5 MNOK</td>
<td>8%</td>
</tr>
<tr>
<td>Start-up grant</td>
<td>22.5 MNOK</td>
<td>8%</td>
</tr>
<tr>
<td>The environmental technology scheme</td>
<td>183.6 MNOK</td>
<td>54%</td>
</tr>
<tr>
<td>IFU/OFU</td>
<td>43.8 MNOK</td>
<td>12%</td>
</tr>
<tr>
<td>Low-risk loans</td>
<td>20.0 MNOK</td>
<td>1%</td>
</tr>
<tr>
<td>Innovation loans/risk loans</td>
<td>115.4 MNOK</td>
<td>15%</td>
</tr>
<tr>
<td>Contribution to regional development</td>
<td>48.5 MNOK</td>
<td>7%</td>
</tr>
<tr>
<td>Bioenergy programme</td>
<td>65.6 MNOK</td>
<td>100%</td>
</tr>
<tr>
<td>Other grant schemes</td>
<td>38.1 MNOK</td>
<td>17%</td>
</tr>
</tbody>
</table>

All of these services with the exception of the bioenergy programme are sector neutral. This means it is the economic growth potential of the project that decides the funding commitment.

**Expert services**

Companies that focus on environmental technology - in all sectors - are offered services through the Environmental technology mission of Innovation Norway. This applies to:

- Mentor services that provide enterprises with 100 hours of strategic consulting for developing the business.
- Up to 100 hours of free advice from Innovation Norway's offices abroad, as a boost into new markets.
- Management course (25 participants) and basic course in commerce (15 participants).
- FRAM Market that gives participating enterprises a base for input and growth in a foreign market.

**Internationalisation Services**

Innovation Norway's consultants in over 30 countries offer their expertise and their local networks to Norwegian enterprise with international ambitions. They know the local business culture and can help "open doors". The aim is that companies exploit international market opportunities, realise their growth potential and achieve faster commercial results.

Industry delegations, fairs, Norwegian joint stands and targeted events abroad are also important measures supported by Innovation Norway.

**EEA and Norway Grants**

EEA and Norway Grants 2009-2014 have provided financial support to enterprises in 16 EU countries in Central and Southern Europe and in the Baltic States. Innovation Norway has held various roles in the management of the EEA funds. Total Innovation Norway has managed NOK 650 for 110 projects in
Romania, Bulgaria and Poland before the Green Industrial Innovation programme, and for 75 of these projects, Innovation Norway has recruited unique Norwegian partners.

Among the projects in the six countries where Innovation Norway is the programme partner, there are 60 projects with Norwegian partners, which represent approximately 25% of all projects. In the Spanish Renewable Energy and Climate Programme, 50 out of 174 projects have Norwegian partners. EEA and Norway Grants offer considerable internationalisation potential to Norwegian businesses, and Innovation Norway wishes to strengthen this further in the next programme period that is starting now.

**Invest in Norway**

Invest in Norway is an instrument and a feature that should encourage more foreign companies to invest in Norway. Invest in Norway has seen great interest in investments based on Norwegian Clean Energy, either in renewable energy production or the use of Clean Energy for the production of goods or for data storage.

**In the area of Clean Energy, Innovation Norway wants to**

- **Strengthen Invest in Norway with resources and specify the assignment** so that they, together with the embassies and Innovation Norway’s offices abroad, actively promote and facilitate foreign investment and ownership in Norwegian power-intensive manufacturing and service industry.

  Strengthen cooperation between Invest in Norway and the clusters.

- **Promote Norwegian expertise and technology** related to Clean Energy, energy efficiency and Norwegian design/architecture.

  Increase the focus on internationalisation and host attractiveness in this area. This involves a strengthening of Team Norway and the placement of expertise in priority foreign offices, including a personalised training programme. One measure is to establish "Norwegian Energy Centres" (a network) in conjunction with leading international technical environment. The aim is to spread knowledge of Norwegian academic environments and technological solutions for universities in the most promising markets for Clean Energy.

- **Increase access to internationalisation loans.** Establishing abroad costs resources, and Innovation Norway will allocate a portion of their risk loans to international projects that bring economic growth back to Norway

- **Strengthen clusters**, through the development of existing clusters and cooperation across clusters. The clusters will be strengthened as an "adaptation engine." One instrument is turning parts of the innovation framework to Clean Energy in order to bring increased innovation and transfer of expertise.

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68 The innovation framework consists of grants that will encourage clusters to test out new ideas and concepts.
• **Strengthen the focus on supplier development.** Together with the end customer help more Norwegian suppliers become more competitive in delivering relevant knowledge, and together with others deliver overall solutions to large private and public sector construction projects.

• **Take the initiative to unite** strong enterprises and knowledge environments with the goal of establishing a dynamic environment for the development of future electricity solutions with the template for the Green Coastal Shipping Programme\(^69\) or the Cluster Programme).

• **Promoting business development and technology** related to the electrification and new energy carriers like hydrogen, both onshore and offshore. We will conduct targeted mobilisation, announcements, or other actions to businesses that invest in innovation for future markets - in line with models from Pilot-E\(^70\) or Climate and environmentally friendly shipping\(^71\).

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\(^69\) The Green Coastal Shipping Programme will aid the adoption of more environmentally friendly vessel solutions, through the creation and implementation of pilots.

\(^70\) See chapter 5 - Public financing instruments

\(^71\) Climate and environmentally friendly shipping measures in the revised national budget 2016 for enterprises that implement projects aimed more climate and environmentally friendly shipping travel.