ENERGI 21

SUMMARY REPORT STRATEGY 2018

National strategy for research, development, demonstration and commercialisation of new, climate-friendly energy technology.

energi21

About the Energi21 strategy

The Energi21 strategy is the Norwegian national strategy for research, development and commercialisation of new, climate-friendly energy technology. The strategy is designed to promote coordinated, efficient and targeted efforts in research and technology for the energy sector. The development of the strategy has been led by the energy industry. The strategy provides the authorities and the business sector with recommendations on how to target activities relating to new technologies for the energy sector.

The Energi21 strategic body was established by the Ministry of Petroleum and Energy in 2008 and has a permanent board with representatives from energy companies, technology and service providers, research and educational institutions, and the authorities. Thematically, its mandate encompasses the entire stationary energy system as well as energy technologies for transport purposes.

The Energi21 strategy is an integral component of Norwegian energy policy. The mandate sets out three objectives which the strategic recommendations are intended to promote:

Objective 1
Increased value creation based on national energy resources and utilisation of energy.

Objective 2
Restructuring of the energy system through the development of new technology to reduce energy consumption and greenhouse gas emissions, and through efficient production of more environment-friendly energy.

Objective 3
Development of internationally competitive expertise and industrial activities in the energy sector.

The strategy gives priority to key areas that should be reflected in the activities of the public agencies in energy research and innovation. This is targeted towards instruments used by the Research Council of Norway, Gassnova, Enova, the Norwegian Water Resources and Energy Directorate (NVE) and Innovation Norway.

In keeping with the ongoing changes to society and the underlying framework conditions for energy policy, the strategy document is revised by the Energi21 board approximately every three years. The revised strategy document for 2018 is the result of a comprehensive revision process led by the industry and carried out in close collaboration with universities and research institutes. A draft of the strategy report was circulated widely for review, and over 300 individuals from all parts of the energy sector have been involved in the process. Thus, there is broad support throughout the energy industry for the recommendations presented in the Energi21 strategy.

Recommendations in the 2018 strategy

Energy systems will be undergoing radical changes in the years ahead. Rapid developments are taking place in a number of climate-friendly energy technologies.

Energy systems are becoming more digitalised, integrated and complex – and substantial restructuring is called for in order to meet national and international targets for sustainability and greenhouse gas reduction. At the same time, it is important to maintain security of supply and facilitate value creation in the Norwegian energy industry. This makes it crucial to maintain an integrated, strategic approach to addressing the knowledge and technology needs of tomorrow. Norway has a sound basis for future value creation based on its energy resources, power system and industrial experience. Solutions to future societal challenges will encompass both new and immature energy technologies. The scope and complexity of these solutions and challenges will require large-scale investments, as well as clear priorities, in the Norwegian research and innovation system.

In its fourth national research strategy, the Energi21 board therefore recommends a substantial increase in energy technology investment and priority efforts targeting the following key areas:

- Digitalised and integrated energy systems
- Climate-friendly energy technologies for maritime transport
- Solar power for an international market
- Offshore wind power for an international market
- Hydropower as the backbone of the Norwegian energy supply
- Climate-friendly and energy-efficient industry, including Carbon Capture and Storage (CCS)

The key area "Digitalised and integrated energy systems" is an overall priority area by virtue of its crucial role in the future security of supply, integration of climate-friendly energy technologies and value creation in society. All six of the key areas hold great potential for value creation in resource utilisation and further development of a supplier industry for national and international energy markets. The key areas and associated recommendations from the Energi21 board are discussed in greater detail in the main Energi21 report.

DIGITALISED AND INTEGRATED ENERGY SYSTEMS

It is essential to develop integrated, digitalised energy systems with a highly reliable energy supply, low emissions of greenhouse gases and effective integration of new technologies in energy production, consumption and

Hydropower with reservoir in Setesdal. *Photo: Agder Energi*

Steelworks at Celsa Armeringsstål AS - Mo Industrial Hub AS. *Photo: Celsa*

storage. The systems must also accommodate new business models, more active customers and efficient system operation and maintenance. Norwegian industrial actors and research groups have wide-ranging expertise in a variety of areas, including energy infrastructure for transport, power electronics and solutions for smart grids. Important research topics include integrated development of the energy system, ICT security and vulnerability, electrical power issues, dynamic system modelling, social science-based perspectives and more.

HYDROPOWER AS THE BACKBONE OF THE NORWEGIAN ENERGY SUPPLY

Hydropower is critical for Norway's ability to develop a virtually zero-emission energy system while maintaining its security of supply. National hydropower resources can play a vital role in the transformation to a low-emission society in Norway and internationally. Norwegian industrial actors and research groups possess some of the world's leading hydropower expertise, which provides an excellent basis for the export of Norwegian solutions and services. This expertise must be further developed. An effort should be made to increase the value of hydropower by better utilising the flexible storage facilities of reservoirs in the context of the Nordic and European power systems. Important research topics include flexibility and balancing, effects of precipitation, environment-friendly and cost-effective hydroelectric stations, effects of short- and long-term balancing power, the system perspective and more.

SOLAR POWER FOR AN INTERNATIONAL MARKET

Norway has an extensive technology and competency base in solar power, with large potential for further developing a competitive industry. Deliveries will mainly be to an international solar power market. The market is in rapid growth, and Norwegian actors are well equipped to strengthen their market positions through increased research and technology activity. The Norwegian solar power industry is built on world-leading expertise in material and process technology. Norwegian actors have also gained an international position in development and operation of large-scale solar power plants, and this know-how should be expanded. The Norwegian solar power cluster must be strengthened to enable it to gain ground in emerging markets and take a leading role in quality and innovation. New business models and solutions that combine solar power, smart control and digitalisation are needed. Important research topics include silicon-based solar cells of the future, floating solar power, building-integrated photovoltaics, reduced operational and maintenance costs, increased energy conversion ratios and more.

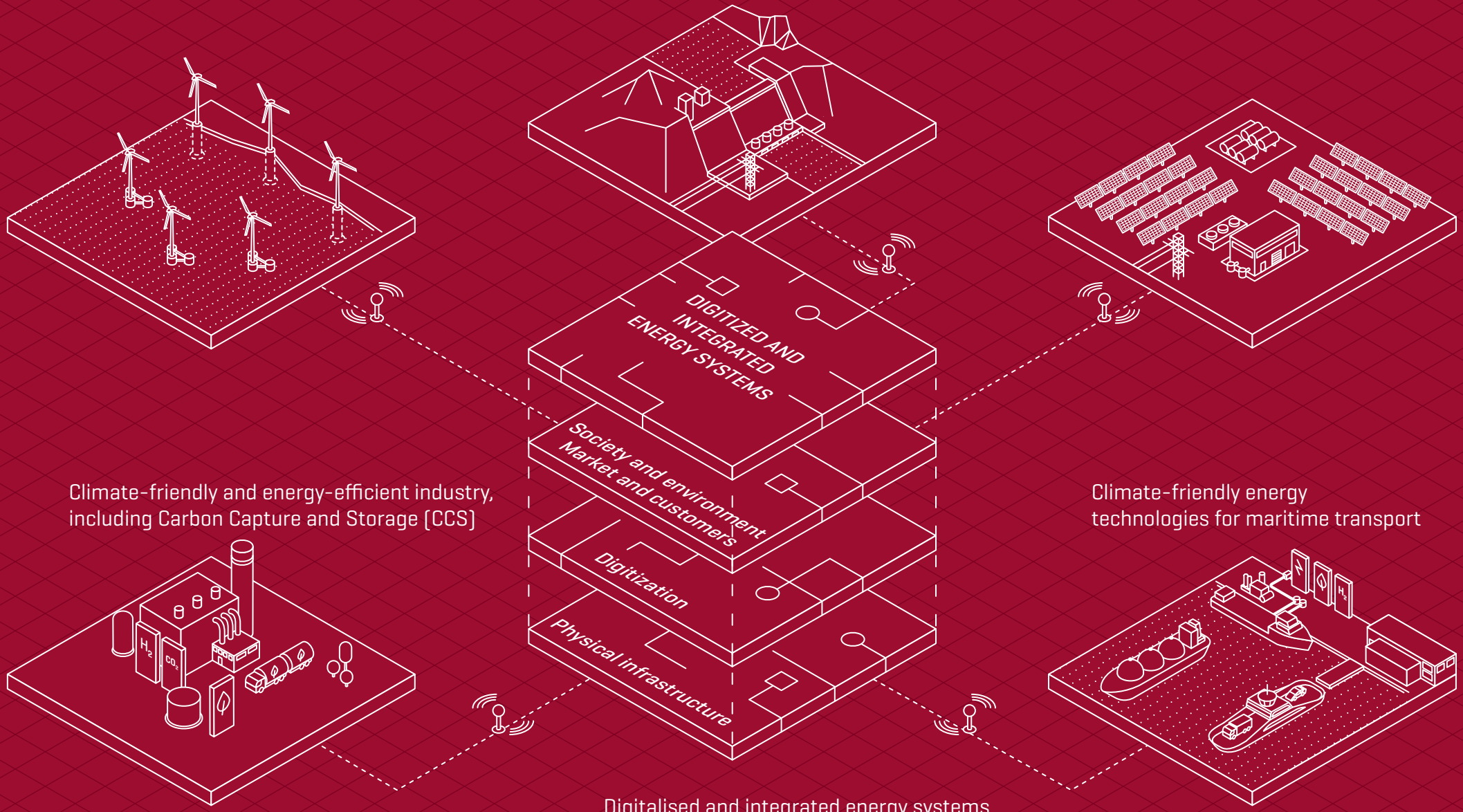
OFFSHORE WIND POWER FOR AN INTERNATIONAL MARKET

There is significant potential for further developing the internationally competitive Norwegian offshore wind power industry. This is already Norway's largest renewable export industry, and Norwegian actors are well positioned to strengthen their standing in a rapidly growing international market. Norwegian suppliers have ambitions to double their market share by 2030, and a concerted effort to develop new technology can help to achieve this. Actors in the Norwegian research and business sectors can capitalise on and further develop their world-leading expertise from the petroleum and maritime sectors and apply it to offshore wind power. In addition, Norway's early involvement in developing floating wind farms gives it a competitive advantage in further project development.

Offshore wind power for an international market

Hydropower as the backbone of the Norwegian energy supply

Solar power for an international market



Climate-friendly and energy-efficient industry, including Carbon Capture and Storage (CCS)

Climate-friendly energy technologies for maritime transport

Digitalised and integrated energy systems

In a longer-term perspective, increased focus on offshore wind power can promote use of Norway's considerable offshore wind resources and help to establish electricity production on the Norwegian continental shelf. Important research topics include turbine foundation design, composition and installation, reduced operational and maintenance costs, marine logistics, resource mapping and modelling, electric infrastructure, multi-use maritime platforms and more.

CLIMATE-FRIENDLY AND ENERGY-EFFICIENT INDUSTRY, INCLUDING CARBON CAPTURE AND STORAGE (CCS)

Norwegian industry is already energy-efficient with low greenhouse gas emissions, compared to similar industrial activity in many other countries. Nonetheless, industry still produces significant emissions and there is a need to develop new technologies and solutions to reduce them. Relevant measures include carbon capture and storage, and increased use of hydrogen and biomass. Specific efforts must be targeted towards technology development and breakthroughs that can reduce costs and boost efficiency. There is also potential for enhancing energy efficiency by utilising waste heat, e.g. by converting it to electricity. Norway has extensive expertise in process technology and heat pump systems, as well as a global leading role in CCS technology and solutions. Full-scale projects for testing and proof of CCS concepts are important for realising and commercialising the CCS value chain. Important research topics ahead include process improvement, conversion of waste heat, industrial use of hydrogen, utilisation of biomass, CCS related to industrial processes, long-term CO_2 storage and more.

CLIMATE-FRIENDLY ENERGY TECHNOLOGIES FOR MARITIME TRANSPORT

There is also great potential for cutting emissions in the maritime transport sector. Emissions reductions can be achieved by developing competitive, climate-friendly energy technologies as alternatives to current fossil fuel propulsion systems. Electricity, hydrogen and biofuels are relevant energy carriers in fuels of the future, as well as hybrids using combinations of energy carriers. Norwegian actors got an early start in developing battery and hydrogen-electric propulsion for maritime transport. As a shipping nation, Norway has a strong starting point with its advanced material and process know-how. In addition, there is a large domestic market with the entire value chain available for testing and proof of concept of technologies and solutions, and this should be taken advantage of. Examples of important future research topics include battery materials and systems, charging technology, electrolysers, hydrogen filling stations, biofuels, automation solutions, zero-emission hybrids and more.

Edda Fjord – offshore supply ship. *Photo: Norwegian Shipowner Association*

Following up the strategy

Following up the Energi21 strategy will require involvement and effort from the business sector, research and educational institutions, and the authorities.

Cooperation between these actors will be essential for achieving the Energi21 ambitions and ensuring that the necessary research activity is carried out. Consideration of long-term objectives combined with effective action in the shorter term will be critical in order to succeed in realising the ambitions. Business communities and industry must take part in knowledge and technology development by taking risks and investing time and capital in research and innovation activities. There will be a need for dynamic instruments and incentives that promote the efficient implementation of research activities, which in turn will provide rapid access to new knowledge, technology and solutions.

Participation in the EU research and innovation arena

The Energi21 strategy harmonises well with the EU research and innovation agenda for the energy sphere.

Active participation in the European Strategic Energy Technology Plan (SET-plan) is vital for ensuring Norwegian interests and priorities and paving the way for expanded research collaboration within Europe. The Energi21 strategy document recommends continued efforts to influence EU research and innovation programmes in the aim of ensuring that initiatives on the EU research agenda address topics of common interest for the EU and Norway. Norway's positioning in the EU in the field of energy must be strengthened. There is a need to establish multiple bridgeheads, as Norway is an energy nation but not an EU member. Norwegian participation in the EU research and innovation arena is of prime importance for gaining positions, raising the quality of research groups, contributing internationally recognised knowledge to the business sector, and enabling Norwegian research to be implemented in a European and international perspective. Internationally recognised expertise is a key to future competitive products, services and solutions.

Rooftop photovoltaic power station, ASKO. *Photo: The Norwegian Solar Energy Cluster*

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