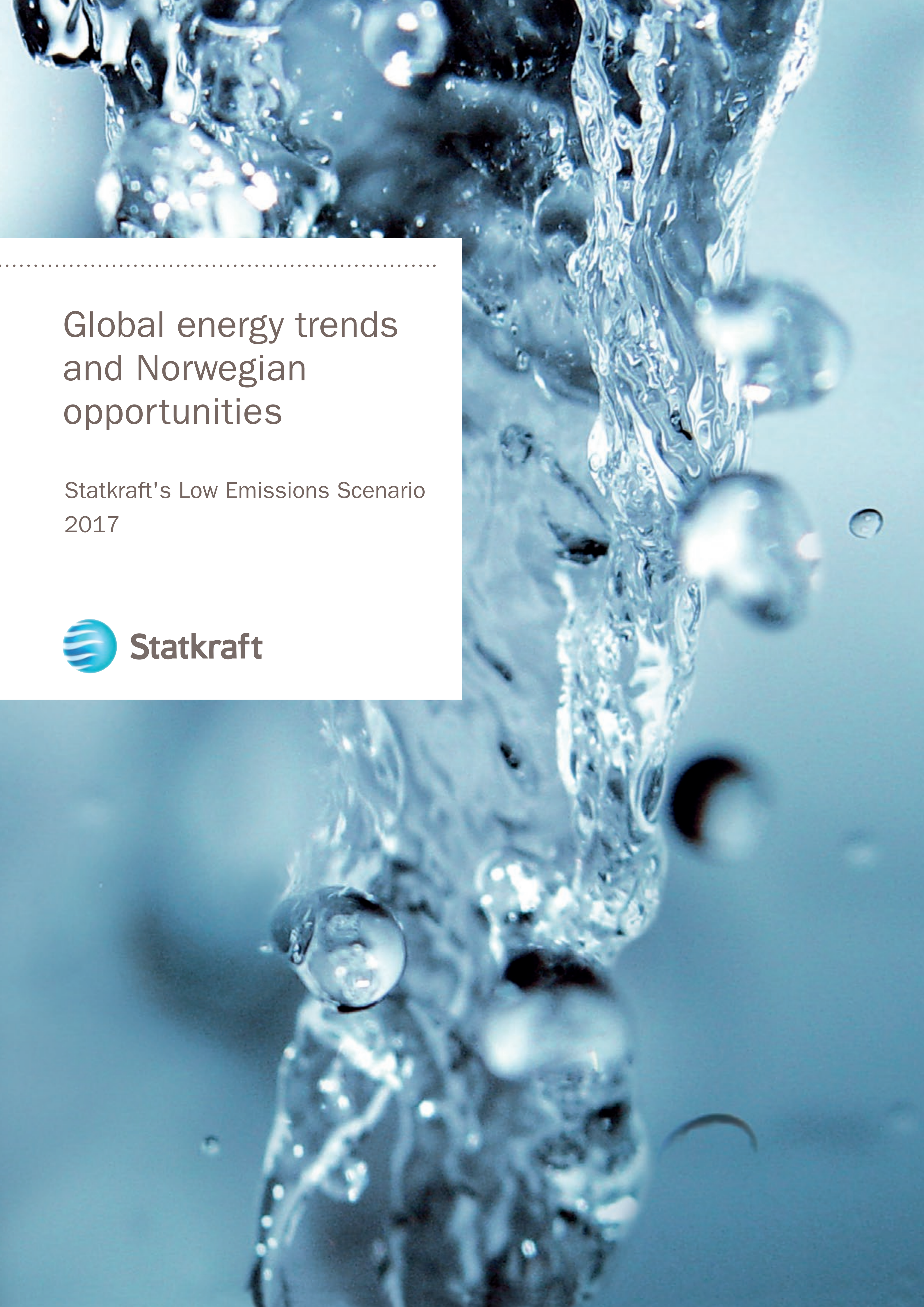
Global energy trends and Norwegian opportunities

Statkraft's Low Emissions Scenario
2017



Global energy trends
– Statkraft's Low Emissions Scenario 2017

The world's energy systems are undergoing rapid and fundamental changes. We are moving from a world based on fossil fuels to a world with a large share of renewable energy.

The changes are driven by technological developments, market dynamics and government policies. At the same time, the way in which energy systems work is also changing. We use energy more efficiently, technology costs are declining, processes are being electrified, energy systems are becoming more decentralised and more integrated. The demand for energy is growing in many parts of the world, while in the OECD countries it has levelled off in recent years.

These major transformations challenge business models and investment strategies: how do we ensure profitable investments in a world of continually changing technology and declining technology costs?

The changes also challenge energy policies: how do we ensure a stable energy supply in a world that is becoming increasingly reliant on variable technologies like wind and solar?

To better capture future uncertainties, Statkraft develops various scenarios where we analyse global and regional drivers in the energy markets. In this report we present one of these scenarios. We have called it a "Low Emissions Scenario." It shows a development in which today's trends of growing renewable energy deployment and increased electrification continue towards 2040, which leads to a world with lower greenhouse gas emissions.

The Low Emissions Scenario is based on known technologies and builds on Statkraft's internal country analyses in conjunction with in-depth studies of numerous external sources. This scenario is one of several that informs Statkraft’s strategic decisions.

Summary of Statkraft's Low Emissions Scenario 2017:

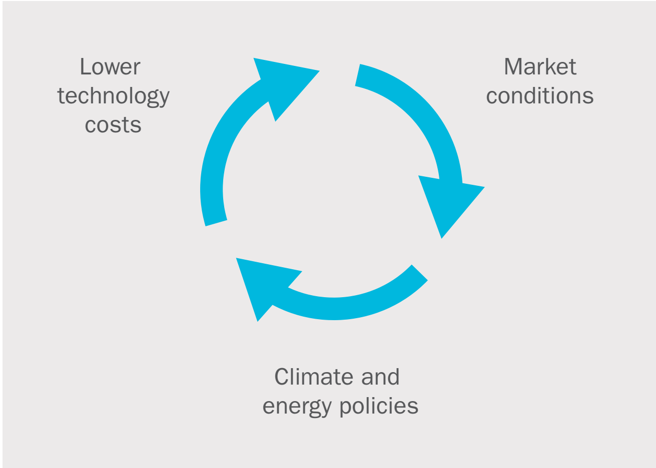
Low Emissions Scenario globally

- ➔ The restructuring of energy systems continues despite increased uncertainty around international climate policies. We are heading towards a world with more renewable energy and lower greenhouse gas emissions.
- ➔ Global energy-related greenhouse gas emissions may have peaked already. Emissions will level off before 2020 and by 2040 will be around 30 per cent lower than today. This is a major reduction, but not enough to put the world on track towards the two-degree target.
- ➔ Global power consumption increases by 86 per cent by 2040. The entire growth in power consumption is covered by renewable energy.
- ➔ The renewable share in the power sector globally will be 70 per cent in 2040, of which 50 per cent is variable solar and wind power. This will require major changes in energy policies and power market design.

The power system of the future: clean and reliable electricity

- ➔ Norway already has a power supply that is 100 per cent renewable through our flexible hydropower. There are only 10 countries in the world with a fully renewable power sector. In Norway the main climate policy priorities are to electrify transport and industry.
- ➔ The EU's energy and climate policies are increasingly setting the framework for the Norwegian energy system. Norway is in a different situation than most European countries. This should be reflected in how Norway implements European regulations.

Background: **Towards a world of lower emissions**



Statkraft presented its first Low Emissions Scenario in 2016. It was based on an assumption that the world in the coming years enters a positive spiral whereby the technological, market and political developments mutually reinforce each other.

In the past year, all of these parameters have changed. On 1 June 2017, U.S. President Donald Trump announced that he would withdraw the U.S. from the Paris Agreement. Although it will take around three years to formally complete the withdrawal, it is clear that the United States will not be a driving force in international climate efforts the next years. The few federal climate policies that exist in the U.S. are about to be repealled.

At the same time there has been a shift towards stronger climate policies elsewhere. As a response to President Trump's announcement, a number of U.S. governors, mayors and business leaders have declared that they will set their own climate targets for their cities, states and businesses in line with the Paris agreement. More than a thousand U.S. companies, institutions, cities and states have joined the movement "We Are Still In" [1].

More importantly, in the wake of the U.S. reducing its international leadership, other countries are increasing theirs. China, India, Germany, France and a number of other countries have declared that they will stick to the agreement. As an example, India has announced a new programme aiming at 100 per cent electric cars by 2030. At the same time India confirmed its Paris goal of a 40 per cent fossil-free share in the power sector by 2030. No country has so far followed the U.S. and withdrawn from the Paris Agreement.

The biggest changes, however, are still happening on the technology front and in the markets. The costs of solar and wind power continued to fall last year in line with – and even exceeding – our Low Emissions Scenario for 2016. Over the past year we have seen significant cost reductions and a high rate of installations. For solar this was especially true in China, the U.S. and Japan. In the Low Emissions Scenario 2017, which extends

Figure 1: The Low Emissions Scenario is based on an interaction between government policy, technology development and market forces. A host of new energy solutions and services will change the energy markets over the next decades.

[1] http://wearestillin.com

Evolution of utility-scale solar PV auction prices

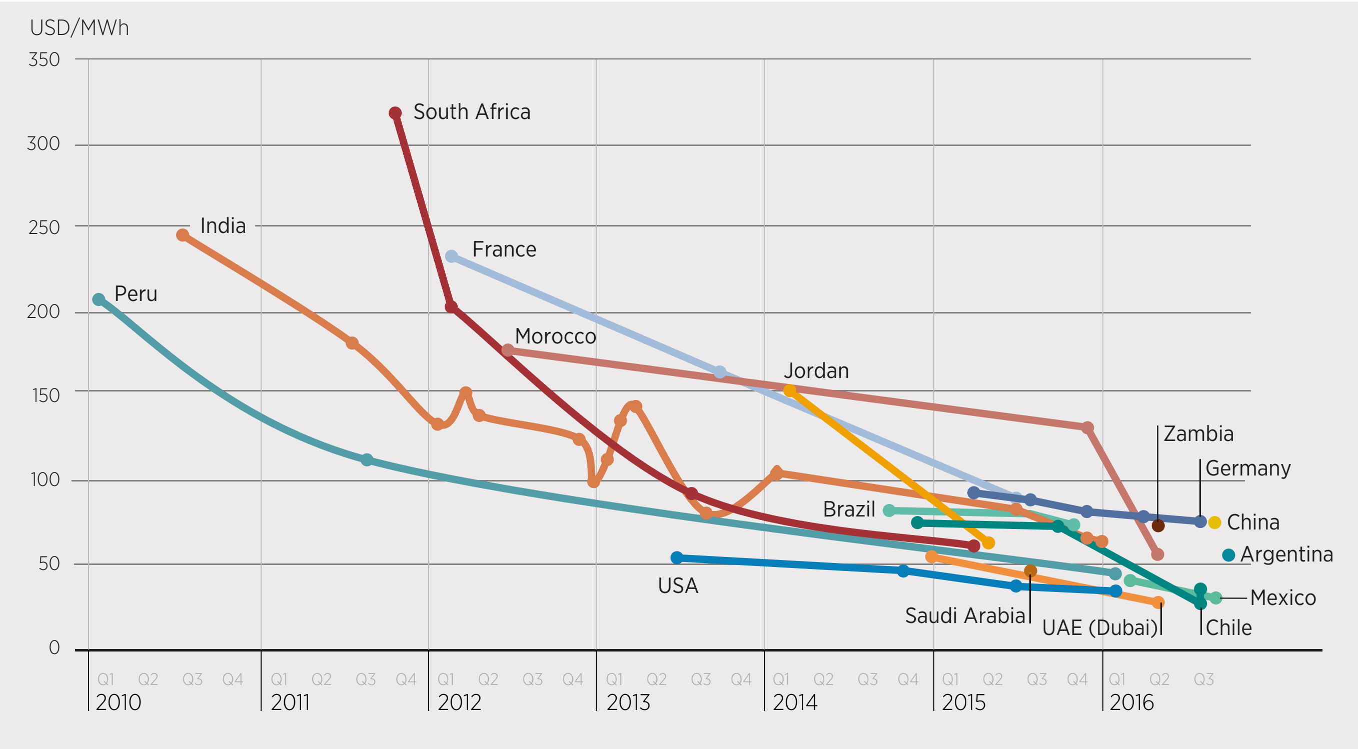


Figure 2: Competitive auctions contribute to price and cost reductions. Irena 2017

to 2040, we estimate that solar power will account for 25 per cent of the global electricity mix by 2040. This is higher than other comparable analyses.

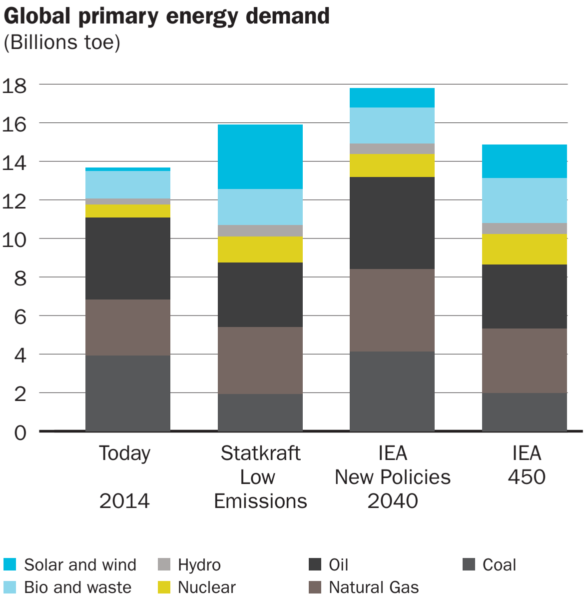
The biggest change from last year's analysis is the trend in battery costs. In the Low Emissions Scenario 2016 Statkraft assumed that passenger electric vehicles would become competitive with fossil-fuel vehicles around the mid-2020s. That was a more optimistic view than in many other analyses. Few if any serious analyses question *whether* this intersection will occur; the question today is *when* it will happen. All the major automakers are now developing strategies for a future after fossil-fuel vehicles. When the transport sector is more electrified, the electricity demand will increase. Demand for oil will decline, along with greenhouse gas emissions.

Much of this trend is market-driven. At the same time, this is part of the interaction between government policies, technological development and the market. We see that more countries, sectors and companies are taking climate risk into account in decisions and investments, and that their strategies incorporate a future, which require lower emissions. As an example, more and more companies are operating with internal CO_2 pricing, making carbon-intensive projects unprofitable already today. In the past year alone several major international investors have announced that they will no longer invest in coal. According to Greenpeace, 64 GW of coal power generation was shut down in 2015 and 2016, and since 2010, 63 per cent of planned coal power plants have been cancelled[2]. In March, Beijing closed its last coal power plant and became the first Chinese city to phase out coal power. When such market changes reach a critical mass, they quickly become self-reinforcing.

The last three years the world's energy-related CO_2 emissions have been stable, despite the fact that the world economy has grown by around three per cent annually. The decoupling of economic growth and emissions, which occurred in Norway during the last decade, is now taking place globally. In the Low Emissions Scenario 2017, Statkraft assumes that global energy-related greenhouse gas emissions will level off by 2020. Perhaps the peak has already passed.

The pace is still not sufficient to meet the two-degree target. But we are moving towards a world with lower emissions, and a transformed energy sector.

[2] Coalswardm/Sierra Club/Greenpeace: BoomBust2017 report, March 2017.



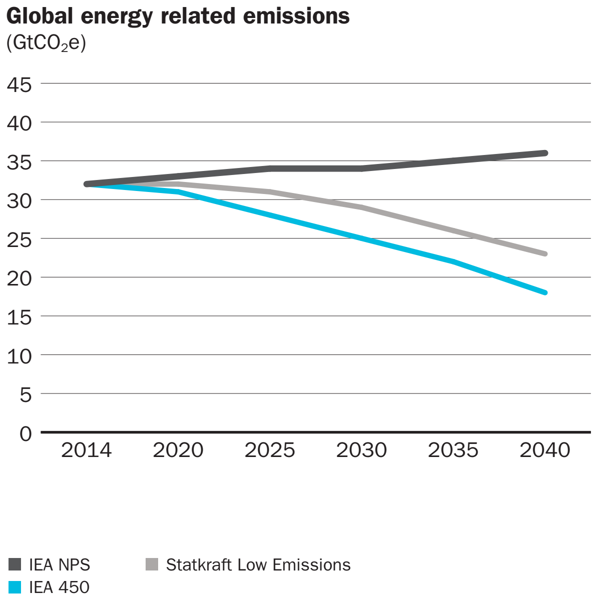


Figure 3: Statkraft's Low Emissions Scenario assumes significantly higher growth in the renewable share by 2040 than the International Energy Agency New Policies Scenario (IEA NPS)[3].

Global Low Emissions Scenario: **Strong growth in green technologies**

In the period up to 2040, our Low Emissions Scenario expects **the world's primary energy consumption to increase by 16 per cent**. The growth in energy consumption is mainly driven by population growth and an improved standard of living globally. The Low Emissions Scenario expects extensive improvements in energy efficiency, including significant electrification of transport, buildings and industry.

In the Low Emissions Scenario **global electricity consumption increases by 86 per cent up to 2040** (see Figure 4). Fossil engines in transport, and fuel-based boilers and furnaces in industry and buildings will be electrified on a large scale. Electrification is more effective than other forms of energy consumption. Our energy efficiency assumptions are thus somewhat above what the International Energy Agency assumes in its New Policies Scenario (IEA NPS). Increased energy efficiency is a major contributor to the expected decline in global greenhouse gas emissions.

Statkraft's Low Emissions Scenario differs from several other analyses by its belief in a **massive amount of solar and wind power entering energy systems globally over the next decades**. The renewable share in the power sector globally will grow from 23 per cent to 70 per cent in the Low Emissions Scenario, of which 50 per cent is variable solar and wind power.

A sharp increase in installed renewable power has significant consequences for **coal demand globally, which in this scenario falls by as much as 50 per cent by 2040**. Global demand for gas grows over the same period, but the rate of growth declines and is lower than we assumed last year. The flexibility of gas power combined with significantly lower emissions means that gas is expected to replace some of the global coal demand. Gas will have two roles in the power sector going forward. First, gas power will take over much of the running hours from coal power[4].

[3] IEA World Energy Outlook 2016. IEA presents several scenarios: IEA New Policies Scenario (NPS) is its main scenario, while in IEA's 450 scenario energy-related emissions line up with the two-degree target.

[4] In Europe, coal power is assumed to be regulated out of operation or made non-competitive through CO_2 pricing.

DATA CENTRES – THE NEW GLOBAL POWER-INTENSIVE INDUSTRY

Driven by digitalisation and an ever increasing need for storage and processing of large amounts of data, large data centres have become the new global power-intensive industry. Data centres are the world's fastest growing power-intensive industry, with power requirements of around 40 GW today, an increase of 60 per cent from 2010 [5]. Large centres today already use as much power as traditional smelters. Google, Facebook and Apple have already established data centres in Sweden, Finland and Denmark, with annual power requirements between 0.5 TWh and 1.5 TWh per facility. Energy accounts for between 30 and 50 per cent of the operating costs of a data centre and renewable power is increasingly demanded by major operators like Google, Apple and Facebook.

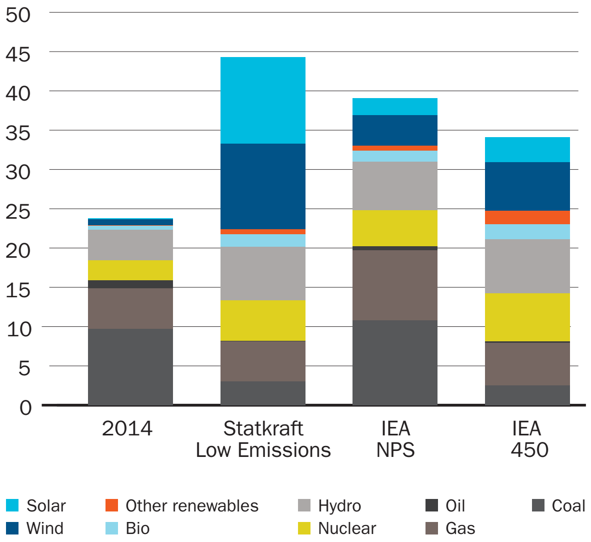


Figure 4: Power mix in electricity consumption (1 000 TWh) in 2040 compared to present (2014).

At the same time, an increasing share of the demand will be covered by renewable sources. In Europe the role of gas will go to peak-load generation to meet demand in those periods where renewable sources are insufficient.

In the Low Emissions Scenario, **global energy-related CO_2 emissions will peak already before 2020** and then decline from around 32 Gt per year today to 23 Gt by 2040. By comparison, the Low Emissions Scenario assumes over 36 per cent lower emissions by 2040 than IEA assumes in its New Policy Scenario. This is a significant reduction over the course of 20 years. But it is not enough to put the world on track towards the two-degree target.

The decline in solar and wind costs continues in the Low Emissions Scenario. Over the past few years we have observed that the costs of solar and wind power have declined faster than we and others expected. This is due to intense technology development, mass production and improved efficiency at every step in the value chain. Lower production costs provide a basis for increased volume, which in turn drives production costs further down.

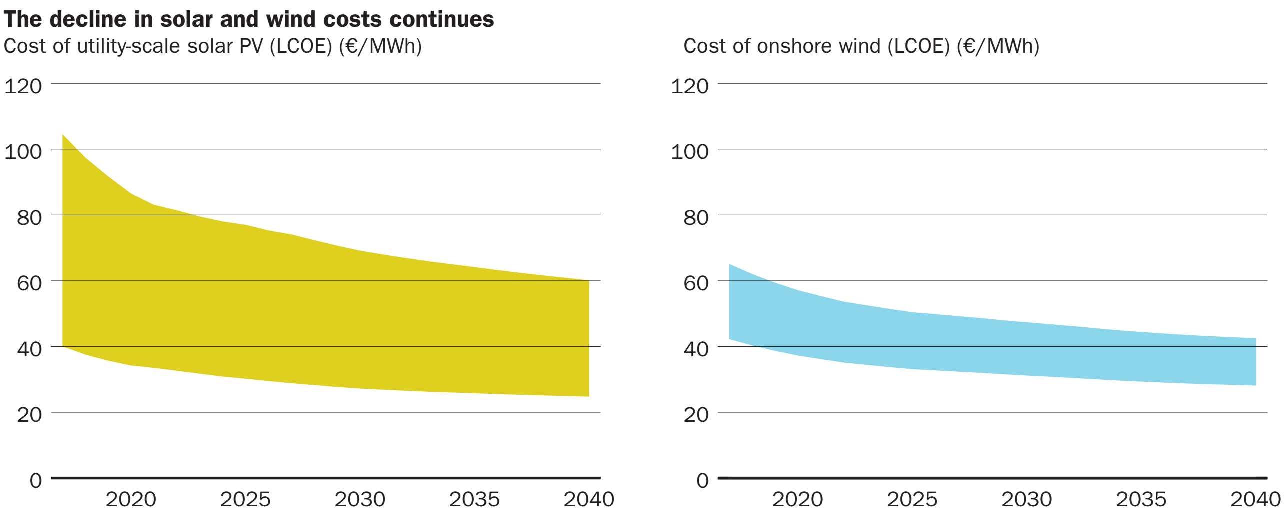


Figure 5: Expected trend in average costs for all countries from today until 2040. €/MWh (LCOE, WACC 4%)

5 DCD Intelligence 2014.

Productivity of solar and wind power is heavily dependent on the location of the resource. For example, a solar panel in Chile can produce around three times as much power as a similar panel in Norway. This makes the cost per kWh correspondingly higher in Norway than in Chile. Similarly, a wind farm in Germany will on average produce about half that of a corresponding wind farm located north in Brazil. The large spread in cost estimates in the graph in Figure 5 is mainly due to different solar and wind resources in different parts of the world.

In the Low Emissions Scenario, we expect that 55 per cent of new sales of passenger cars by 2040 will be electric cars. Battery technology is developing rapidly, we see economies of scale in production, and efficiency is continually improving in the supply chain. This has resulted in batteries with increased storage capacity and efficiency, and reduced costs. Tesla reports that their gigafactory, which will achieve full production capacity in 2018, will deliver battery packs at a cost that makes passenger electric vehicles competitive with petrol vehicles without any subsidies.

Figure 6 shows the expected trend in battery costs over the period. The cost of battery packs is expected to fall dramatically, while the uncertainty remains high. There seems to be a general concensus that electric vehicles will become competitive when battery packs approach a cost level below USD 150 / kWh.

Electric vehicles currently make up only around one per cent of new passenger vehicle sales globally, but this proportion is expected to increase dramatically in just a few years.

Expected decline in battery costs
USD / kWh storage capacity

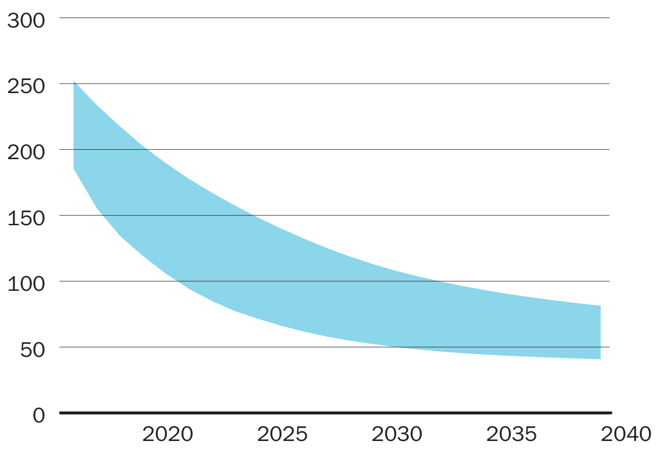


Figure 6: Battery pack cost developments.
The spread in the graph illustrates high uncertainty.

Most vehicle manufacturers now offer one or more fully electric or hybrid models. According to Bloomberg, more than 120 different electric vehicle models are expected by 2020. For example, Volkswagen has an ambition that 25 per cent of their passenger car sales in 2025 will be electric cars, while Volvo has announced that all car models launched from 2019 will be electric or hybrid. The driving range and charging infrastructure challenges have been significantly reduced in recent times. Recently major cities like Paris, Madrid, Athens and Oslo have announced various policy measures to limit the use of diesel vehicles to reduce local air pollution. At the same time, as already mentioned, India has announced a new programme of 100 per cent electric passenger cars by 2030.

We expect that portions of heavy transport will also be electrified. The trend in heavy transport is battery-electric where this is practically possible, such as for buses in city centres, for vans and lighter transport vehicles. Overall, in the Low Emissions Scenario we expect a global electricity consumption for transport of 5200 TWh, which corresponds to 12 per cent of global electricity consumption by 2040. This is several times higher than the 2.5 per cent assumed in the IEA New Policies Scenario.

Increased electrification of the transport sector, in addition to some use of biofuels and hydrogen, will reduce demand for fossil fuels beyond 2020. Demand for oil is expected to level off by 2020, then decline by more than 20 per cent compared with today.

The power system of the future: **Clean and reliable electricity**

Variable solar and wind power challenge the power markets
Costs have fallen so much in recent years that solar and wind power become a natural choice for new investments in power generation in many countries. This in itself creates enormous momentum for further growth. But it also brings new challenges. With a high share of variable, renewable electricity in a country's power system, stable power supply becomes challenging. Moreover, problems with cannibalisation and falling profitability for new investments are rapidly emerging[6]. These are some of the challenges that could curb the growth in renewable energy. In the Low Emissions Scenario, we assume that these challenges will be resolved although foresee that this transition can be demanding.

In a traditional power system, the production of power is adjusted up or down so that demand is met at all times. To achieve this, production must be flexible, i.e. it must be able to quickly ramp up and down in line with demand fluctuations. Power demand fluctuates greatly over the course of a day and a year. In Norway we have hydroelectric power that is highly flexible and in practice serves as a giant battery. In most other countries, thermal coal or gas power plants can adjust production so that power demand is always met.

However, solar and wind power production is largely dependent on weather, time of day and season, and therefore does not have the same type of flexibility. When the wind is not blowing and the sun is not shining, these technologies do not produce power. Large short-term variations mean that wind power is often poorly matched with power consumption over a day. Similarly, solar power has a profile that does not always match the demand, with highest production in summer and during daylight hours, lowest in winter and nothing at night.

Modern society, with its zero tolerance for power outages, must therefore rely on reserve capacity. The bulk of the reserve capacity globally is currently provided by coal and gas power plants. In our Low Emissions Scenario, we assume that efficient gas-fired power plants, which can be quickly adjusted up and down, will cover much of the need for reserve power over the next decades. This is the main reason why the demand for gas in our scenario does not follow the decline in oil and coal demand. The more coal-fired power plants that need to be kept alive to provide society with reserve power when renewables cannot deliver, the harder it becomes for society to reach its emissions targets.

[6] Cannibalisation means that the profitability of renewable, variable power will decrease as more similar power is added to the system.

Profitability in the power industry declines with more solar and wind
Solar and wind power require relatively large investments in solar cells and turbines respectively, while the costs of operation and maintenance are low. In other words, these technologies are capital intensive, but have a marginal cost (variable operating cost) almost equal to zero.

This means that in those hours where a solar or wind power plant supplies the "last" kWh demanded in the market, power prices will be almost zero. Power producers will not earn back their investments and the profitability in the entire power industry will be reduced. We get *cannibalisation* in the sense that the profitability of investments in solar and wind decline when more solar and wind capacity is installed respectively. For fossil power plants, a high proportion of solar and wind in the power system presents a double challenge. First, they produce less power when solar and wind cover an increasing proportion of total demand. Second, prices fall when there is a lot of solar and wind power in the system.

More solar and wind in the power system also means that demand for flexible production changes in the course of a day.

Expected change in demand for flexible production
MW

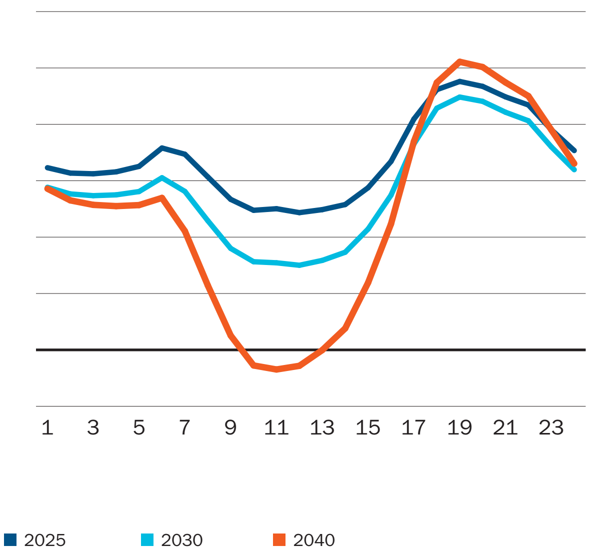


Figure 7: Expected change in demand for flexible production over a day with increasing renewables share. However, there will be large variations over a year and between countries and regions.

CORRECT PRICING OF EMISSIONS IN THE POWER SECTOR IN EUROPE THROUGH THE EU ETS

Strengthening the European emissions trading scheme EU ETS will help push through decarbonisation in the power sector. However, the joint political will to strengthen the EU ETS sufficiently seems to be lacking in the 28 countries today. The alternative to a strengthened CO_2 price, however, is that member states' continue with a patchwork of policy instruments that undermine each other and weaken both the emissions trading scheme and the power market. Continued subsidies to mature renewable technology will disturb both the power market and the emissions trading scheme by allowing new power generation even though there is no demand for more power. Overcapacity in the power market coupled with lower demand for CO_2 allowances push both power and CO_2 prices lower, thus weakening the profitability of the same renewable power generation that the policies were initially intended to support. This will in turn create the need for more support.

Together with the Nordic companies Fortum and Vattenfall, Statkraft has suggested a simple mechanism in the EU's regulatory framework to correct this problem.

The mechanism states that when a country introduces new national policy instruments in the ETS sector, the country must also estimate the amount of emissions the instruments will cut. Then the country reduces the ETS allowances accordingly. In this way new national instruments will no longer weaken but, on the contrary, strengthen the emissions trading scheme. The national policy instruments will then also have a real climate effect rather than just shift the emissions to other places or into the future. Such a mechanism thus gives more correct incentives to all actors. The different policy instruments will function in concert with each other. Implicitly, the overall European climate policy will be strengthened.

This can be illustrated by what is known as the "duck curve": during the day, solar power production is at its peak. Demand for flexible production then dips significantly, while in the evening it peaks. Figure 7 shows Statkraft's estimated "duck curve" for the German power market. Towards 2040 we expect that these fluctuations will gradually increase.

No single solution, but many partial solutions

Statkraft's analyses indicate that there is no single solution to these challenges. In order to cope with the transition to a renewable power sector, the world needs to use a whole range of partial solutions.

Firstly, improved weather forecasts and analyses of historic data over time will make it possible to predict solar and wind power generation more accurately than previously. This could somewhat reduce the need for reserve capacity in the system.

Hydropower with reservoir is one of the few renewable technologies that can contribute under such conditions. Norwegian reservoirs have 85 TWh of storage capacity, which accounts for 50 per cent of European reservoir capacity. Flexible Nordic hydroelectric power is, in essence, a large battery and is therefore an important partial solution for Europe.

In addition, more and steadily improving batteries (including in electric vehicles) will make power systems more flexible. However, batteries are expected to only be used for some hours of storage, they are not expected to meet the power needs of society for several days or weeks.

It is also technically possible to "store" power by producing hydrogen based on electrolysis when electricity prices are low, and then produce electricity in fuel cells when more power is required. This is a costly solution at the moment. Therefore, in our analyses, thermal power generation will continue to play a central role in the power systems for many years to come [7].

Furthermore, increased interconnection capacity and more integrated power markets across countries and regions will be important. Then you can export power in surplus periods and import during shortages. This is especially true of power systems with different characteristics, such as between the Nordic countries, the UK and the continental Europe.

Another important partial solution is digitalisation. This increases consumer flexibility so that consumption is more adaptable to variations in power generation. Smart power grids, smart houses and smart vehicles will enable more consumer flexibility.

Let the market drive the changes

In general, free price setting in the power market (so that scarcity of power is priced in) and pricing of CO_2 emissions will incentivise development of innovation and cost-efficient solutions. Free price setting means that supply and demand respond to scarcities in the market. This response will be important for integrating the high share of renewable power into the systems.

Overall, a power system with a fully market-based price setting mechanism, together with a price placed on CO_2 emissions,

[7] Preferably gas power due to lower emissions per kWh.

will provide the most cost effective transition to an emission-free power sector. A higher CO_2 price will improve the profitability of existing and new renewable production while reducing or removing the need for subsidies. An efficient power market depends on prices reflecting the marginal production costs at any time, including the cost of emissions. A higher CO_2 price will increase price variation and result in higher power prices during the hours when polluting power plants must operate to meet demand. The CO_2 price will thus help to shift from coal to gas power, as well as provide incentives for energy efficiency and flexibility in production and consumption during peak hours.

Around 2050, when we will likely have an almost 100 per cent renewable power sector, pricing of CO_2 emissions will be less relevant. But we have a long way to go. Even in Germany renewable power determined the price during only one per cent of all the hours in 2016. In other European countries, the percentage was almost zero. Actions taken the next 10 to 20 years will determine whether the world is able to move towards the Low Emissions Scenario, not to mention towards a two-degree path. In this transition phase, when changing the behaviour of actors is key, the correct pricing of power and CO_2 emissions is very important.

The consumer will become more important. A strong trend in Europe, which is also affecting Norway and the Nordic region, is that power consumers are changing from passive consumers to active customers. We see this through the building of smart houses, the rolling out of smart meters and the installation of solar panels on roofs and batteries in basements.

However, in our Low Emissions Scenario, we believe that these changes will have less impact for households in Norway than in most other countries. This is because in Norway we generally have small price variations, low power prices, and at the same time high power consumption in households.

Smarter management of energy consumption, and electricity prices that reflect actual supply and demand at any time, will help activate consumers. When prices in the underlying power market become more visible, this will act as a strong signal to change behaviour. Consumers will then have an incentive to adjust their consumption and production in line with the actual needs of the power system.

In several European countries the cost of subsidies for renewables has been added to electricity bills, together with other taxes (electricity tax and VAT in Norway). However, a household that has installed solar panels on the roof does not need to pay taxes and fees in many countries for the consumption covered by its own production. Still, these households will also benefit from being connected to the power grid, but will pay a disproportionately small share of the costs. This means that other customers (who may not be able to install solar panels) will have to cover not only the costs of maintaining the power grid, but also the costs of subsidising renewables. The more people who produce their own power, the more other customers will have to pay.

Denmark now wants to reduce this problem by removing the renewables tax on the end-user price. Denmark has also recently adopted a law that removes the exemption from power grid fees

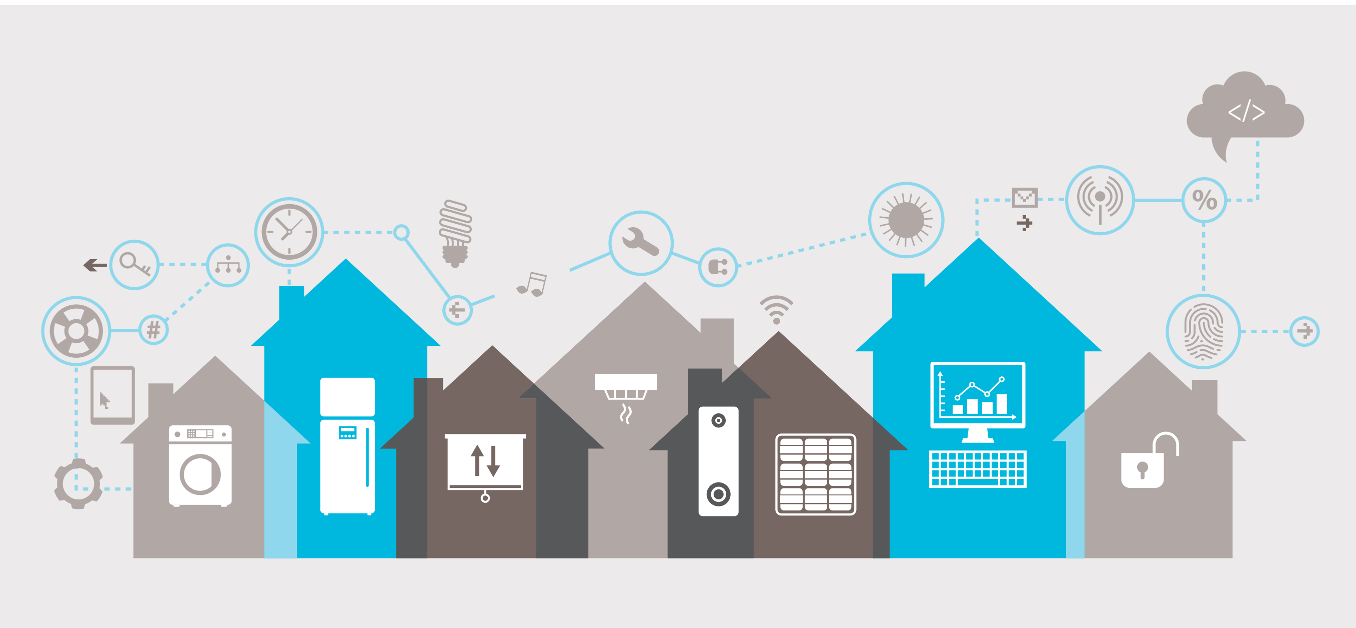


Figure 8: Power systems are becoming smarter and the consumer is playing a more important role.

NORWAY HAS A DIFFERENT STARTING POINT THAN OTHER EUROPEAN COUNTRIES

Renewable, *flexible* hydropower is the basis for the Norwegian power system [9]. The ability to store large amounts of water allows hydropower plants to be switched on and off as needed. No other type of renewable power generation has such flexible characteristics. Solar and wind power, on the other hand, are characterised by a production that varies over time and cannot be planned. In Norway, typically cold winter days with high consumption, low wind, low inflow to reservoirs and low solar intensity will determine the need for reserve capacity in the system.

Historically, the Nordic integrated power market has created significant value by exchanging power optimally across national borders. Norwegian flexible hydropower has made it possible to exchange power day-by-day with surrounding thermal systems, as well as to import power in years with low precipitation and export it in years with high precipitation. However, we now see a tendency for non-optimal cross-border flows between neighbouring countries due to e.g. local bottleneck problems. For example, only 11 per cent of the capacity between Denmark (Jutland) and Germany was utilised in 2016. This leads to sub-optimal solutions, reduced flexibility, and a more expensive transition to the low-emissions society. To ensure optimal use of the interconnector capacities between countries, clear frameworks and agreements are needed between the major grid operators in Europe.

for self-produced solar power. The authorities have estimated that this could amount to DKK 4.9 billion. Another policy measure which provides more correct incentives is to link the power grid fee to the maximum consumption of the household (effect). Thereby, everyone has to pay for the security that access to the grid provides. In this way, energy policies will provide more correct incentives and contribute to more equal competition between the different actors.

Power systems are changing – what about Norway?
Energy markets in the EU are gradually becoming more integrated. With the EU Energy Union launch in 2015, the EU Commission started a major effort towards more harmonised energy policies and more integrated energy markets in Europe. This has been followed up through a large number of proposals for new and revised regulations. The last and largest package from the Commission was presented in November 2016 and consists of eight proposals for regulatory acts ("the Clean Energy Package") [8]. The Clean Energy Package will lay the foundation for meeting the EU's 2030 climate and energy targets.

In practice, this means that the EU is setting more and more of the framework for climate and energy policy instruments in Norway, both through the EEA and through more tightly integrated physical markets. In general, more harmonised, integrated and well-functioning energy markets in Europe will be positive for Norway.

At the same time, Norway is in a completely different situation than most other countries in terms of energy mix and security of supply. Due to our hydropower we have a renewable and flexible power sector. There are only 10 countries in the world that enjoy such a position, and Norway has almost as much power production as all of the others combined. Moreover, we expect an increasing Nordic power surplus towards 2040. Norway's unique situation also means that our climate and energy priorities and challenges differ somewhat from the rest of Europe. This means that some policy measures that are reasonable in the rest of Europe do not necessarily have the same effect here.

In Norway climate policy is not focused on decarbonising the already decarbonised power sector but rather on using our renewable power to decarbonise the other sectors of the economy. The keyword is electrification, and the two most important sectors are transport and industry. In the report Low Emissions Scenario 2016, we wrote that a realistic estimate of reduced emissions from the electrification of the transport sector would be around 7 $MtCO_2$. This corresponds to around 15 per cent of total Norwegian emissions and will require around 9 TWh of power. This is power we already have today. Furthermore, we assumed a potential for new industry of 6 TWh, which could contribute to 3 $MtCO_2$ in lower emissions globally. We have the power needed for electrification and to reduce emissions. It is renewable, flexible and adjustable. Government policies should facilitate an even better use of it.

[8] The EU countries (Council and Parliament) are now negotiating the eight proposals and are attempting to reach agreement before new elections to the European Parliament in 2019. Then an EEA negotiation process could begin. https://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition.

[9] Norway has over 1 500 hydropower plants with a mean annual production of 133 TWh (billion kilowatt hours) and 1 200 reservoirs.

Sectors	Statkraft Low Emissions Scenario (2017)	IEA New Policies Scenario (2016)	Statoil Reform Scenario (2017)	Greenpeace Energy Revolution Scenario (2015)	IHS CERA Rivalry (2016)
Average annual growth in primary energy demand 2014 – 40	0.6%	1.0%	0.6% (to 2050)	-0.1%	1.1%
Transport sector					
Oil share (final, Mtoe, 2040)	67%	85%		49%	84%
% Electric vehicle (EV+PHEV) share of new vehicle sales	55% by 2040	15% by 2040	~70% by 2040		42%
Power sector (annual avg. growth, TWh, 2014-40):					
Demand	2.4%	1.9%	1.3%	2.3%	2.3%
Wind power	11%	6.7%	6.6%	11.6%	7.2%
Solar power	17%	9.8%	9.6%	16.5%	10.8%
Hydropower	2.2%	1.8%	1%	0.9%	1.3%
Fossil fuel share in power sector (TWh, 2040)	18%	52%		21%	58%
Oil consumption: annual average growth 2014 – 40	-0.9%	0.4%	0.3% (to 2050)	-3.1%	0.7%
Gas consumption: annual average growth 2014 – 40	0.7%	1.5%	0.8% (to 2050)	-0.7%	1.8%
Coal consumption: annual average growth 2014 – 40	-2.7%	0.2%	-0.5% (to 2050)	-3.5%	0.3%
Global energy-related CO_2 emissions ($GtCO_2$) in 2040	22.9	36.3	~31 (2050)	12.0	39.3

Table 1: The assumptions in the Statkraft scenario compared to IEA, Statoil, IHS Cera and Greenpeace

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