ESG Research

Disruption of energy markets has already started

The way that we consume and produce energy accounts for 72% of greenhouse gas (GHG) emissions and we believe it is more important than ever to address the impact of this behaviour. Coal demand is nearing its peak and oil seems to be next in line, followed by natural gas – and as wind and solar are now competing head-to-head with fossil fuels on production cost, the stage is set for a renewables boom, with the pace of change largely dictated by policymakers.

The forces behind the transition to renewables are strong

Disruptive forces such as technology, electrification and regulation are likely to have a profound impact on global energy markets. Electricity as an energy source is over time set to capture energy demand share from other energy sources such as oil. For example, in manufacturing, technologies like the electric arc furnace are significant for the shift to electricity, and in transport, uptake of electric vehicles will shift demand from oil to electricity. For electricity production, technology has enabled wind and solar to now compete head-to-head with fossil fuels on cost and they are thus set to capture market share. Regulations on carbon prices and the removal of fossil fuel subsidies will likely dictate the speed of the energy transition. Given the deteriorating climate change situation, policy makers cannot afford to do nothing.

The renewables boom is here

We expect the global energy transition to unfold with huge additions of renewable energy capacity during the coming decades. Solar PV and wind power are broadly expected in energy outlook reports to be the biggest winners in the coming renewables boom. Declining costs have transformed these technologies from being negligible niches in energy markets into booming industries, now competing head-to-head with fossil fuels on cost. Since 2010, solar PV and onshore wind production costs have dropped a whopping 73% and 26%, respectively. Including externalities such as pollution and natural disasters in the calculation, we argue that the cost analysis tilts inarguably in favour of renewables. The variable nature of wind and solar requires solutions such as energy storage systems (ESS) and demand-response systems (DRS). For a long time, there will be a significant reliance on hybrid systems that can combine different energy sources into one plant.

Oil and gas – short-term gain, long-term pain

The energy transition has already put downward pressure on coal. Oil is likely next in the long run – the pace largely boils down to policymakers. As the fossil fuel with the lowest carbon footprint, natural gas is well-positioned to bridge the energy transition, making the situation brighter for the offshore industry. Our model of a hypothetical offshore asset in the scenario forecast by DNV GL illustrates that a souring oil market would hurt valuation but that natural gas should offset some of the downside.

There are potential synergies between offshore oil and gas activities and offshore wind (eg capabilities for operating under harsh conditions and knowledge about the seabed). However, given the relatively low share captured by offshore renewables forecast in energy outlook reports, this will hardly compensate for limping oil markets.

Nordea Markets - Analysts

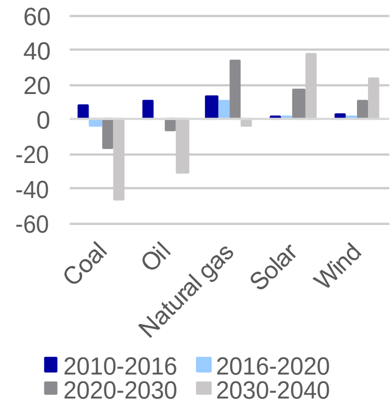
Hugo Fredriksson
hugo.fredriksson@nordea.com

Elias Porse
elias.porse@nordea.com

Adrian Bergem
adrian.bergen@nordea.com

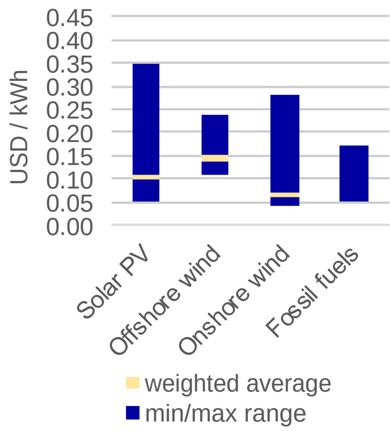
Ellen Benktander
ellen.benktander@nordea.com

CHANGES IN EXAJOULES OF SUPPLY



Source: DNV GL Energy Transition Outlook 2018

RENEWABLES NOW COMPETE HEAD TO HEAD ON COSTS



Source: IRENA

Disruptions in energy markets

To fully understand the reasons why the energy transition is taking place, we need to dig deeper into the dynamics of energy demand and supply. Recognised energy outlook reports claim that demand for energy will increase, but they also suggest that fossil fuels will lose ground in as early as 2020 due to rapid shifts in technology, electrification and regulations.

According to a recent report by the UN Intergovernmental Panel on Climate Change, climate warming will reach the crucial threshold of 1.5 degrees Celsius in as early as 2030, triggering extreme weather and other costly consequences. The report also states that to avoid global temperatures rising beyond 1.5 degrees, global net emissions would need to fall by 45% from 2010 levels by 2030, and to net zero by 2050.

Only 28% of greenhouse gas emissions are non-energy related. Thus, to reach any targets of combating climate change, we need to quickly cut energy demand and shift energy production to greener sources. In this section, we will look at:

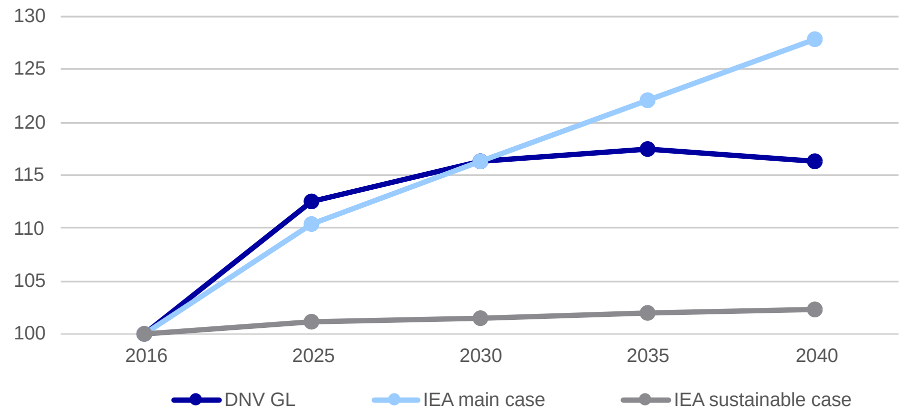
- **The outlook for future energy markets**
  Energy demand is forecast to increase, but fossil fuels are set to decline in importance in the energy mix in as early as 2020
- **Factors driving global energy demand**
  Population growth and economic growth lead to higher demand, whereas energy efficiency pulls in the other direction
- **Factors driving the energy transition**
  Incentives to switch production to renewables are likely to increase in the coming decades, driven by electrification, technology and regulations

The outlook of future energy markets

How demand for energy and the transition to a low-carbon society will play out largely depends on which forces one believes will be strongest. A myriad of different energy outlooks exists, all resting on different assumptions. We highlight a few of them in this report. Det Norske Veritas og Germanischer Lloyd (DNV GL) foresees a peak in global energy demand in the early 2030s, whereas the IEA's main case suggests that it will continue growing during the entire forecast period up until 2040. The IEA's sustainable case, based on the scenario necessary for us to reach the Paris Agreement targets, sees demand flattening out soon. The transition is broadly expected to change the energy mix, with coal losing ground first, followed by oil and finally natural gas.

Different assumptions behind population and economic growth, and energy efficiency lie behind the different forecasts of global energy demand

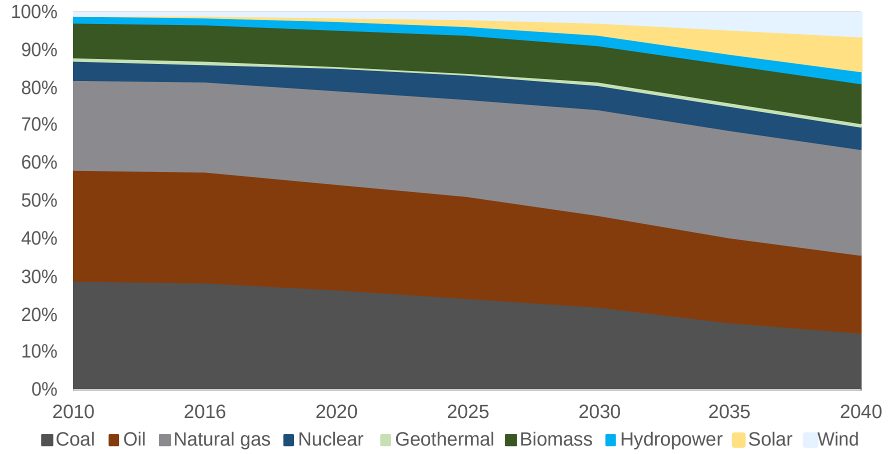
INDEXED ENERGY DEMAND SCENARIOS



Source: DNV GL Energy Transition Outlook 2018 and IEA World Energy Outlook 2017

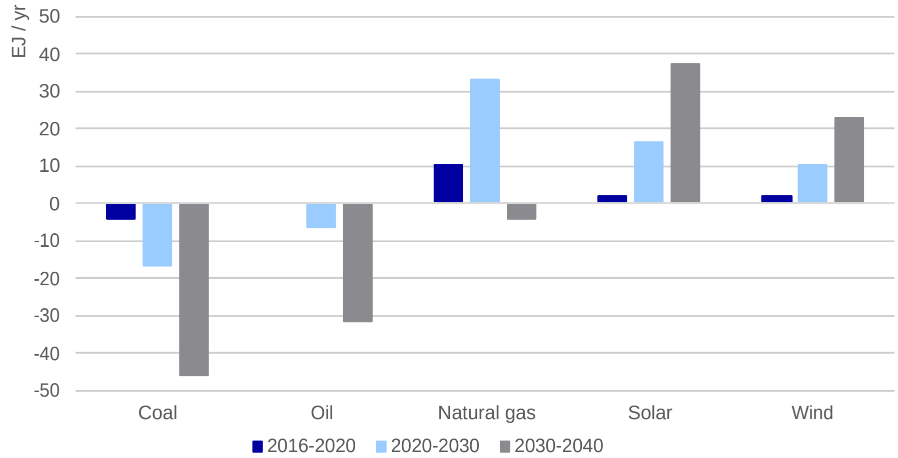
The DNV GL forecasts show coal declining steadily from today, oil to peak during the 2020s, substituted by natural gas and renewables

DNV GL'S FORECASTS FOR ENERGY SUPPLY SHARE BY SOURCE



Source: DNV GL Energy Transition Outlook 2018

DNV GL'S FORECAST FOR CHANGE IN ENERGY SUPPLY



Source: DNV GL Energy Transition Outlook 2018

Energy demand

Energy demand is driven by macroeconomic factors such as population growth, economic growth and energy intensity. We discuss them briefly in turn.

Population and economic growth to increase, albeit at a lower rate

The first obvious factor we see for total energy demand is population growth. The more people on the planet, the more energy we need. Population is closely connected to economic growth, as fertility rates tend to decline when a country becomes more prosperous. This means that as more economies become more advanced, we are likely to see a flattening trend in global population growth.

When developing countries become more prosperous, the population will likely require more energy for transport, heating, entertainment and so on. However, economic growth typically slows down as an economy becomes more services-driven. Global GDP should thus see the same pattern as for population growth, ie it will increase going forward, but at an increasingly slower pace.

Energy efficiency gains

Energy efficiency is significantly reducing energy demand

A force pulling in the opposite direction of energy demand is energy efficiency gains. As a country moves from an emerging economy to a developed one, economic growth and energy consumption tend to decouple. A great example of this has been China over the past five years, where the country has had formidable economic growth, while growth in energy demand has decelerated notably.

One of the main drivers for improved energy efficiency is simply replacing old assets with newer, more efficient ones. For example, a LED light bulb need about 6-7 W of electricity to produce the same amount of light as a 40 W traditional bulb. Extrapolate this across all products that consume energy and the savings become meaningful.

Another important driver is the massive electrification wave ahead that all energy outlook reports we have come across predict. Electrical devices are generally far more efficient than the ones running on fossil fuels. For example, electric vehicles (EVs) consume roughly one-fourth of the energy of internal combustion engine vehicle (ICEVs). Heat pumps can save up to 30% of energy compared with a gas furnace, and also offer air-conditioning too. Similar calculations can be made for equipment in cooking, motors in industry and so on.

We see that digitalisation, with its sharing economy, and automation will play a crucial role. For example, with autonomous cars in communal driving schemes, people would be sharing rides, thus decreasing the relative number of vehicles in the cities. Another potentially game-changing technology is the IoT. With sensors and remote control on literally every device, coupled with artificial intelligence, we would be capable of adjusting energy use far more efficiently. In manufacturing, 3D printing will decrease the reliance on transport and boost manufacturing efficiency remarkably.

Energy transition

The energy transition is a story about how the energy mix will change. This is driven by climate change, electrification, technology and regulation.

Climate change – probably the riskiest bet in human history

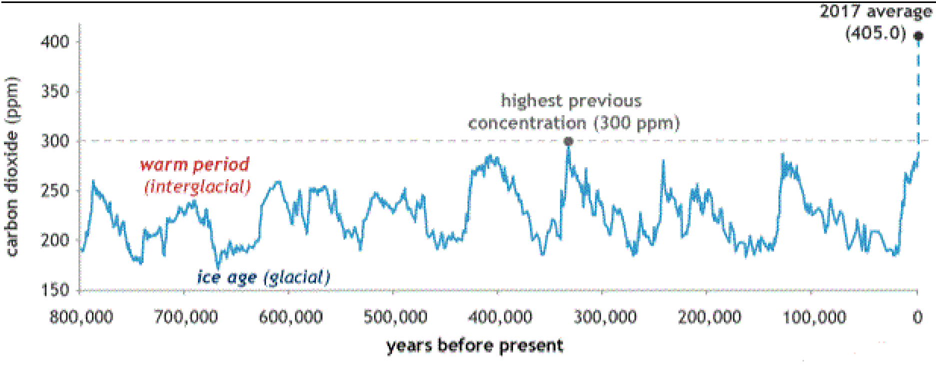
Global consequences from climate changes are becoming more and more visible – continuing down this path might be the biggest bet in human history

Climate change is becoming increasingly visible and costly. As this development progresses, it is likely to trigger greater awareness and actions to combat emissions, which we have seen mostly focusing on energy markets.

The average temperature has risen about 1°C since the pre-industrial period, and we are now witnessing rising sea levels and more extreme weather. With 40% of the world population living on the shoreline, rising sea levels and extreme weather require huge investments in eg installing pumps. For less wealthy countries, these investments are unaffordable. Natural disasters in the US in 2017 have cost the country USD 306bn.

Levels of CO_2 in the atmosphere have skyrocketed in recent decades, breaking an 800,000-year trend

CO_2 DURING ICE AGES AND WARM PERIODS, LAST 800,000 YEARS



Source: NOAA Climate.gov

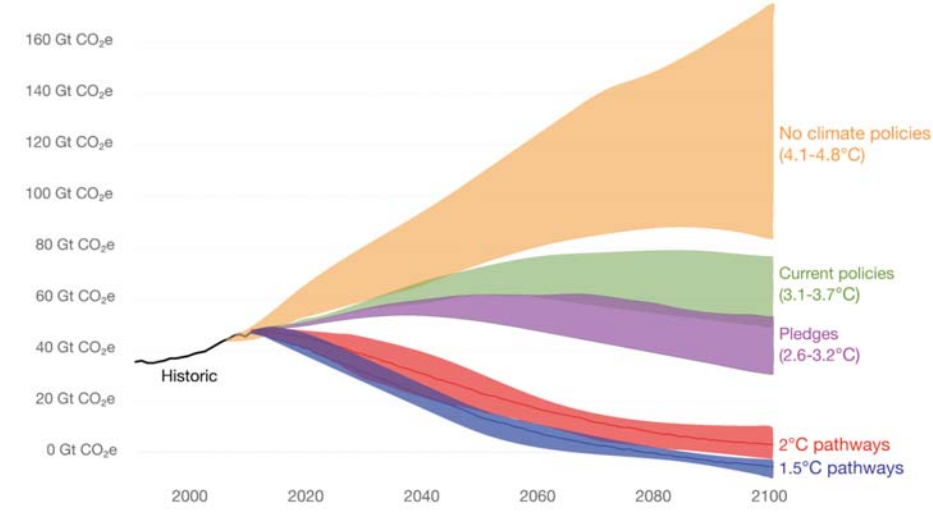
The Paris Agreement is the most promising attempt to stop climate change so far

The Paris Agreement represents the most serious attempt to curb climate change so far. It was signed on 12 December 2015. As of July 2018, 179 countries – representing 89% of global emissions – had ratified the agreement. Each country determines and reports its own contribution to mitigate global warming, with the main target of preventing the global average temperature from rising more than 2°C above the pre-industrial levels, while pursuing to cap it at 1.5°C.

In its latest report, the UN Intergovernmental Panel on Climate Change now claims that global warming will reach the crucial threshold of 1.5°C as early as 2030, triggering extreme weather and other costly consequences. The report also states that to avoid global temperature rising beyond 1.5°C, global net emission would need to fall by 45% from 2010 levels by 2030, and to net zero as early as 2050. The picture might therefore be even worse than what the chart below illustrates.

Given the current policy landscape, we are on a path towards a 3.1-3.7°C rise, which most climate research suggests will lead to catastrophic changes to the global climate

GLOBAL GHG EMISSIONS SCENARIOS

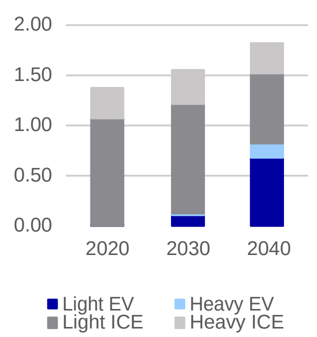


Source: Climate Action Tracker

The electrification wave to shift consumption away from fossil fuels

Electricity is essential to fuelling a modern economy. According to the IEA, global electricity demand doubled between 1990 and 2016. This trend is likely to continue given the rising population and economic growth described above. Today, 1.1 billion people still lack access to electricity.

FORECAST OF NUMBER OF VEHICLES WORLDWIDE, BN



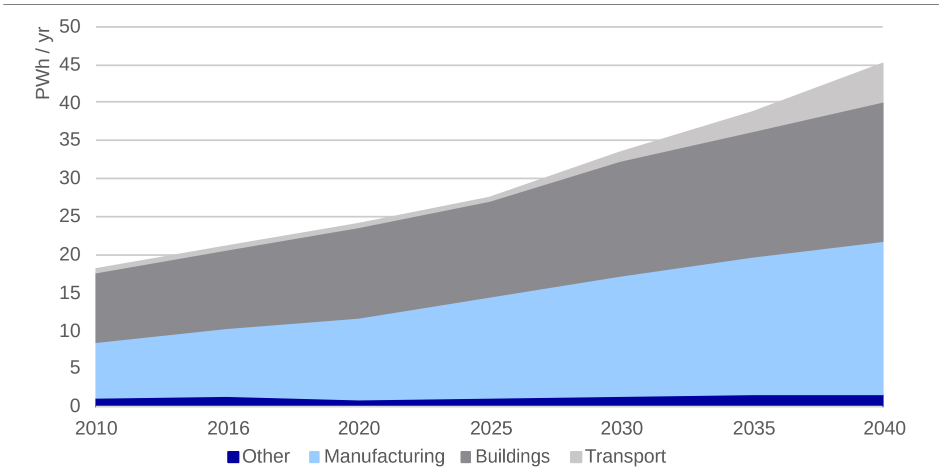
EV: Electric vehicle, ICE: internal combustion engine vehicle
Source: DNV GL Energy Transition Outlook 2018

Electrification will over time capture energy demand share from other energy sources such as coal, oil and biomass. Biomass such as wood used in buildings for heating and cooking will be replaced by electricity in many parts of the world. In manufacturing, technologies like the electric arc furnace are significant for the shift to electricity.

Transport accounts for 23% of emissions-related energy demand, and road transport accounts for almost 80% of that. According to McKinsey, consumers' three main hurdles for buying an EV today are charging limits, range limits and price. McKinsey claims that in advanced economies, high competition for charging infrastructure and battery technologies will alleviate the first two concerns by 2020. As for the price tag, the consultancy firm expects the price for a VW Golf EV to be the same as the price of a Golf with an internal combustion engine (ICE) in 2023. Overall, McKinsey expects 100% of new car sales worldwide to be electric by 2035. Current batteries are reliant on the relatively scarce cobalt, often sourced from the politically fragile Democratic Republic of Congo, but new technologies are being explored, such as lithium-titanate and lithium-iron-phosphate. The power sector accounts for nearly 40% of emissions worldwide, and the shift to electrification alone will not be enough to curb climate change. A rapid change to renewables and gas from coal is much needed as the former two are far more efficient than the latter and they generate lower emissions.

Electrification will meet more of global energy demand, driven in the short term by electrification of the manufacturing segment and boosted in the long term by the uptake of electric vehicles

ELECTRICITY DEMAND BY SECTOR



Source: DNV Energy Transition Outlook 2018

Cost learning curves – technology bringing cost parity

The renewable revolution is by and large enabled by impressive cost learning curves

To extend the productivity and efficiency trends of recent decades, we are reliant on technology. For energy production, the cost-learning curves play a key role. These are typically measured as the decrease in costs per doubling of installed capacity. For oil and gas, the shale revolution has disrupted the market, largely enabled by better learning curves. We expect the learning curve to continue improving at the same rates for some time, as the technology is still in its infancy. For conventional onshore oil, learning curves are flattening as the business is more mature. The same is true for offshore oil, which also suffers from less low-hanging fruit.

We consider cost learning curves to be one of the most important drivers for the energy transition. For wind and solar, learning curves have been phenomenal in recent years. Experts within the field expect these rates to continue. Looking at EVs, the success in market penetration is heavily dependent on the cost learning curves in batteries. Over the past six years, there has been a staggering 70% decline in the production price per kWh. When the first mass-market EVs were introduced in 2010, their batteries cost USD 1,000 per kWh, whereas in the Tesla Model 3 this has come down to USD 190 USD per kWh. Some experts claim that we might see figures below USD 100 before 2030.

Policies and regulation – the catalyst for change

New policies will be crucial to meet the 2°C target

Climate change is high up on the global agenda. Governments are working actively to implement their own Nationally Determined Contributions (NDCs), which outline the respective countries' own strategies to meeting the targets set out in the Paris Agreement. By the end of 2016, 176 countries had targets for renewable energy. However, the current and proposed policies will hardly be enough to meet the 2°C target. Growing awareness in the corporate landscape pushes for bolder sustainability targets and might be at least as important as the government initiatives. We will here discuss some of the most important topics related to policies and regulation.

Potential reduction of fossil fuel subsidies could drive energy transition

Fossil fuel subsidies still an important hurdle for capital shifting to renewable projects

Today there are still subsidies, tax breaks and other policies in favour of consumption and production of fossil fuel, with estimates of the total ranging from USD 370bn to USD 5,300bn, depending on the definition. This leads to artificially lower prices for fossil fuels either as a result of lower production costs or lower consumer prices, effectively causing an imbalance in the energy markets. This distortion of investments and consumption is counterproductive for decarbonisation policies.

Efforts to remove fossil fuel subsidies have remained mostly empty pledges. The most promising efforts yet are the World Trade Organization's Agreement on Subsidies and Countervailing Measures, which explicitly clarifies the definition of subsidies. Moreover, some countries are taking a leading role on this, such as those included in the Friends of Fossil Fuel Subsidy Reform, representing a slight momentum towards reforming these subsidies.

Along with increased public awareness, possibly fuelled by increasingly visible damage from climate change in addition to renewables gaining traction, we believe that fossil fuel subsidies will gradually be eliminated. When and how is yet to be seen.

Energy security – wind and sun are everywhere

Energy security concerns could drive faster investment in renewables in countries with no oil

Access to renewable energy sources is less concentrated than access to fossil fuels, as all countries have access to wind and the sun, to some extent. Diversifying and in time transitioning to renewable energy sources would therefore significantly enhance energy security for many countries and would constitute an important factor in the energy transition.

Political friction – fears of unemployment and loss of business

Uncertainty about the energy transition's effect on jobs and industries is working against its progress; however, more transparency and knowledge should quell the resistance

Progress on policies to accelerate the energy transition often meet objections in the discussion about employment, with the fear of many people losing their jobs. A prime example is the Trump administration's efforts to support coal power. According to the International Renewable Energy Agency (IRENA), in order to meet the Paris Agreement targets, 7.4 million jobs in the fossil fuels sector will be lost. This is more than offset by the agency's estimated creation of 18.5 million jobs in the renewable energy sector. However, as fossil fuel production is concentrated on some advantaged economies, there will likely be more resistance in these countries. The threat of winding down a business that has been enormously profitable will also inevitably impact policymakers.

Carbon pricing and carbon capture storage can drive adoption

Carbon pricing policies are an effective way of shifting producer and consumer preferences, but are still far away from the levels required to reach the 2°C target

The carbon pricing concept has been around for decades. It seeks to internalise the externalities of damage as a consequence of climate change by adding a price on carbon dioxide emissions. By imposing economic incentives on the market, the goal is to shift consumer preferences to more climate-friendly products and services. According to the World Bank, in 2018 the carbon pricing initiatives cover 11 $GtCO_2e$, which represents coverage of 20% of global GHG emissions. Prices vary greatly, with Sweden operating with the highest prices, followed by Lichtenstein and Switzerland, Finland and Norway. Three quarters of the emissions that are covered by a carbon price are still under USD 10/tCO_2. Thus, there is still a long way to go before we reach global price levels in line with the recommendations of the High-Level Commission on Carbon Prices, which claims that prices need to be a least USD 40-80/tCO_2 by 2020 and USD50-100/tCO_2 by 2030 to reach the two-degree target. However, the momentum is encouraging, from a coverage of 5% of global emissions in 2005 to 15% today (20% with scheduled initiatives).

Sufficient carbon pricing would work in favour of carbon storage and storage technology development and adoption

The carbon price is of high importance for one segment that might be significant for the development of CO_2 levels in the atmosphere going forward, namely carbon capture and storage (CCS). One of the CCS technologies seen so far transports CO_2 deep into the soil through pipes in onshore fossil fuel plants. Another is artificial trees made of a special plastic material, capable of absorbing up to 1 tonne of CO_2 per day. In theory, these two alternatives could be used together to limit or remove emissions. Development of these technologies and their implementation are, however, heavily reliant on an increased carbon price to be profitable.

The renewable boom is here

We expect the global energy transition to unfold with significant capacity additions in renewable energy during the coming decades. Cost learning curves have shifted renewables from being negligible niches in the energy market to booming industries now competing head-to-head with fossil fuels on costs.

Wind and solar photovoltaics (PV) are set to experience strong market growth in the following decades

Renewable boom to benefit well-positioned companies

Wind and solar photovoltaics (PV) are set to experience strong market growth in the following decades, according to scenario forecasts from Det Norske Veritas og Germanischer Lloyd (DNV GL) and the IEA, led by:

- Decreasing costs allowing renewables to compete head-to-head with fossil fuels on levelised cost of electricity (LCOE)
- Expected increases in costs for carbon emissions, making renewable alternatives even more attractive
- A material electrification wave, first driven by the manufacturing segment and buildings, followed by transport

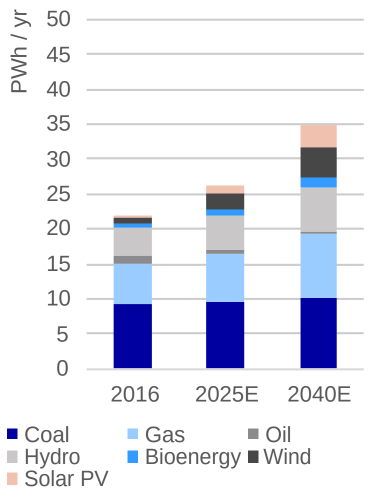
Costs and electrification to drive the renewables boom

In this section, we will look at how the overall renewable market is expected to develop in the long term, before taking a closer look at the most promising technologies at this point – solar PV and wind power.

Broad consensus on increased market for renewables going forward

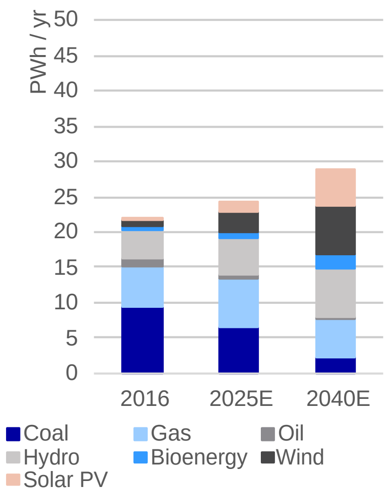
The charts below show how the IEA and DNV GL forecast global power generation by scenario. The main takeaway is that renewables will continue growing in all scenarios. In the more sustainable scenarios, renewables will account for roughly half of energy production by 2040.

IEA MAIN CASE



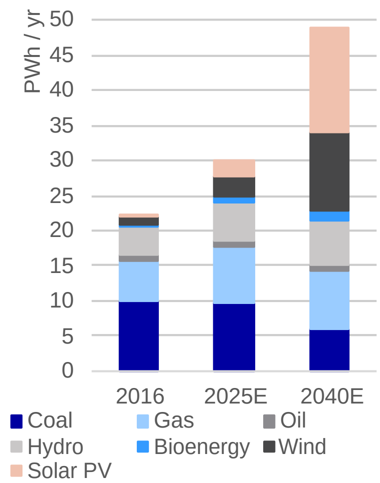
Source: IEA World Energy Outlook 2017

IEA SUSTAINABLE CASE



Source: IEA World Energy Outlook 2017

DNV GL CASE



Source: DNV GL Energy Transition Outlook 2018

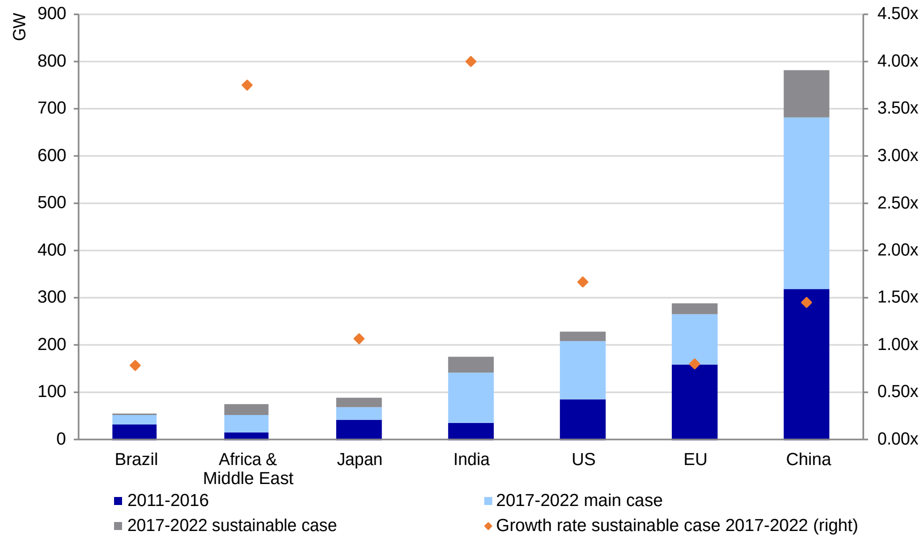
Significant renewables growth expected across the world

China has accounted for the majority of additions in installed capacity of renewable energy, followed by the EU. The IEA expects significant growth across the board with Africa and the Middle East, India and the US accounting for the largest growth rates in the next five years.

The IEA expects significant growth in renewables capacity for the coming years

India, Africa and the Middle East are expected to experience the highest growth rates, whereas China is expected to account for the majority in absolute GWs

IEA: RENEWABLE ENERGY CAPACITY ADDITIONS IN THE SHORT TERM



Source: IEA World Energy Outlook 2017

Renewables now compete head-to-head with fossil fuels on costs

The expected cost learning curves in wind and solar are only beaten by shale oil. Learning curves, however, measure how much costs fall each time capacity doubles – wind and solar are unparalleled winners in this regard.

Learning curves have enabled a drop in costs for renewables during recent years, now matching fossil fuels on LCOE

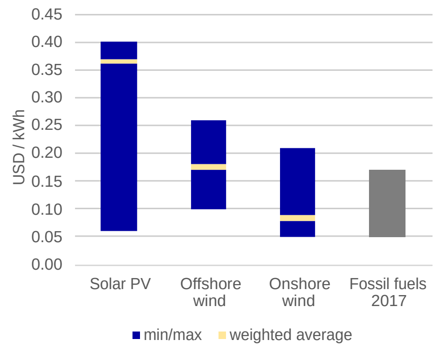
The costs for these technologies have now dropped to the extent that they are competing head-to-head with conventional power sources, and doing so without financial support. Levelised cost of electricity (LCOE) is a standardised method of calculating costs in electrical power generation, which can effectively be regarded as the break-even cost. Since 2010, LCOE has come down by 23% for onshore wind and 73% for solar PV. Costs vary from project to project, but according to the International Renewable Energy Agency (IRENA), renewable projects will be consistently cheaper than their fossil fuels counterparts by 2020.

The forces behind these figures are numbered. First, technology has played an important role in this. Larger wind turbines, new solar PV cell architectures that boost efficiency and data analytics capabilities reducing operation and maintenance costs are a few examples of advancements. Second, governments award contracts for new power plant developments increasingly on a competitive basis, forcing down tariffs. Third, the industry is subject to a high degree of globalisation, where a large base of experienced developers has emerged. Last, maturing businesses with proven track records now benefit from lower project risk, significantly reducing the cost of capital.

These LCOE calculations do not include any CO_2 pricing or account for the benefits of reducing externalities, such as the societal costs of air pollution and climate change. Therefore we argue that these cost analyses unambiguously favour renewables.

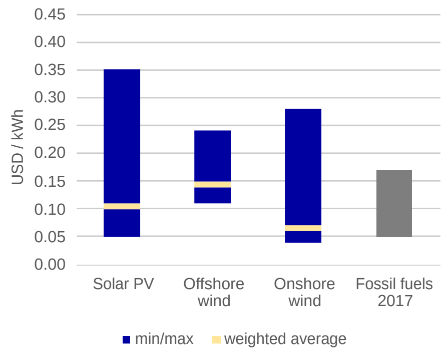
Break-even costs have dropped significantly since 2010 – here we show the range from the cheapest to the most expensive projects and the weighted average compared with fossil fuels in 2017

LEVELISED COST OF ELECTRICITY IN 2010



Source: International Renewable Energy Agency

LEVELISED COST OF ELECTRICITY IN 2017



Source: International Renewable Energy Agency

Solar photovoltaics

Solar photovoltaics is the energy source technology with the highest CAGR in installed capacity since 2010

The sun delivers more energy to the Earth in two hours than we consume during a year and thus offers an immense, clean source of energy. Photovoltaics, ie solar cells, have been around since the 1950s, but their use has been limited until the last decade. The total global installed capacity was 6.1 GW in 2006 – ten years later, we have now reached roughly 300 GW. In the beginning, Europe was the only driver behind these investments. Recently, Asia (especially China) has accounted for most of the expansion, more than compensating for lagging capacity additions in Europe. Overall, the CAGR of PV installations has been a whopping 24% between 2010 and 2017, a growth rate that is second to none in the global energy market.

Solar PV is a cheap and versatile technology with huge potential both on the utility scale and at the consumer level through rooftop panels

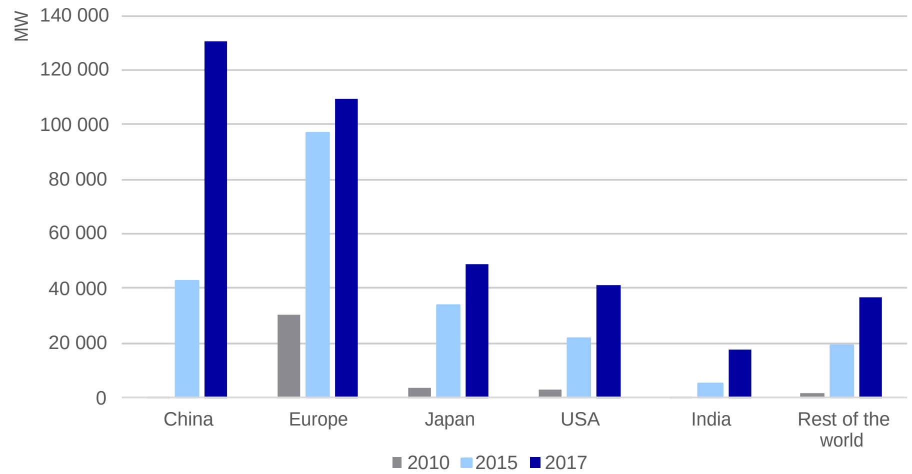
In addition to often being the cheapest source of electricity, solar PVs are extremely versatile in the way that they can be combined on a commercial scale or in smaller configurations for mini-grids or personal use. Solar PV-powered mini-grids are an excellent option for sunny, developing countries where grid infrastructure is not in place. Hybrid systems with solar panels accompanied by diesel generators are commonly used in rural areas or islands.

DNV GL expects the market to grow seven-fold by 2025 and account for 40% of electricity power production in 2050

Despite the tremendous growth of PVs during the last decade, this was coming from a decidedly low level – solar PVs only made up 0.2% of world energy supply in 2016. If the technology continues on the path seen lately, boosted by the electrification of the world's energy markets, DNV GL forecasts that PVs will account for 40% of the world's power and 16% of the energy supply in 2050. By 2025, DNV GL forecasts that solar PVs will account for 2,300 TWh of power production, ie seven times that of today.

Since 2010, solar PV capacity expansion was led by Europe at first, but China has been unmatched in the last few years

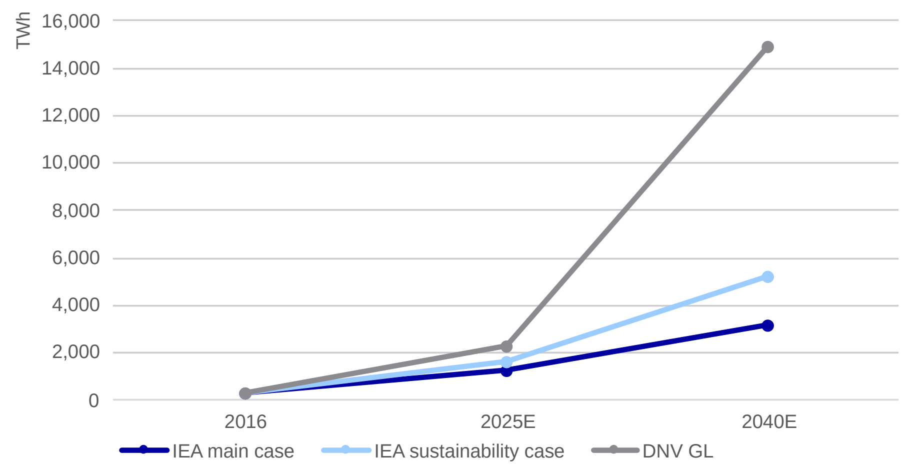
SOLAR PV INSTALLED CAPACITY HAS SKYROCKETED SINCE 2010



Source: International Renewable Energy Agency

All three cases forecast solar PV growth exploding in the next decades, with different assumptions yielding different exact outcomes

GLOBAL SOLAR PV ELECTRICITY GENERATION BY SCENARIO



Source: DNV GL Energy Transition Outlook 2018 and IEA World Energy Outlook 2017

Wind power

Wind power has experienced tremendous growth in installed capacity during recent years

Many parts of the world have strong winds, but the strongest are often found in remote places. The wind industry is also typically split into two segments, onshore and offshore. Onshore wind had almost 500 GW of installed capacity in 2017, dwarfing offshore installed capacity at roughly 19 GW. The CAGR for onshore and offshore has been a remarkable 11% and 20%, respectively from 2010 to 2017. Even though offshore wind has shown higher relative growth since 2010, onshore wind in absolute numbers has been and will likely continue to be the dominant segment. DNV GL expects offshore wind to gradually increase its share of total wind power production, but still only reach 20% by 2050. IRENA's sustainability case expects offshore wind to constitute less than 10% of installed wind capacity in 2050.

Onshore is (and will continue to be) a bigger market than offshore, but both segments will play important roles in the energy transition

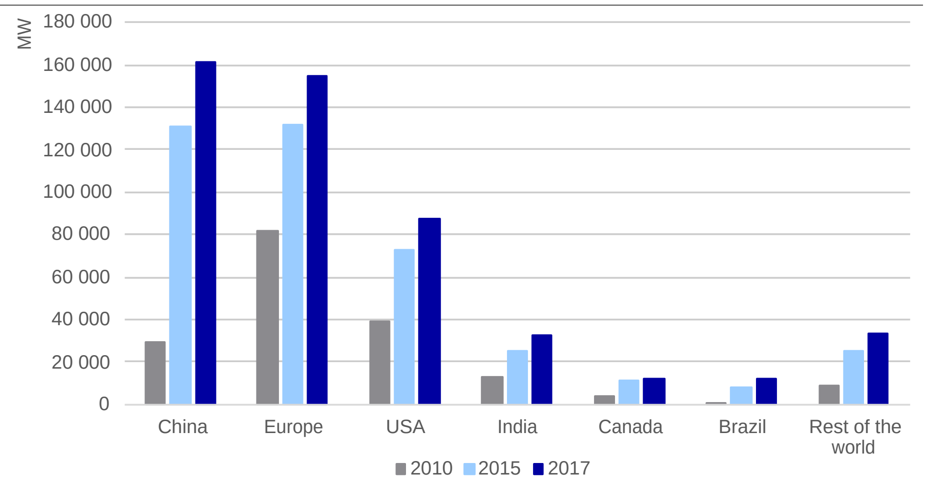
Europe and China are the most important drivers behind the installation of onshore wind capacity, with Europe currently far ahead of China on offshore. This sharp incline in capacity addition has offered significant cost improvements from learning curves, economies of scale and technology improvements. The rotor blade diameter is now up to 164 metres compared with the typical wind turbine in 1985 with an average rotor blade diameter of 15 metres.

China holds the lead position on onshore, whereas Europe is the king of offshore

Going forward, DNV GL forecasts wind will increase tenfold in the next 20 years and account for 12% of energy demand and 29% of electricity production in 2050. China is again by far the biggest driver, followed by India and the US, which DNV GL expects to ramp-up capacity additions in 2020.

Europe was first, but China has been on par since 2015 for installed onshore wind

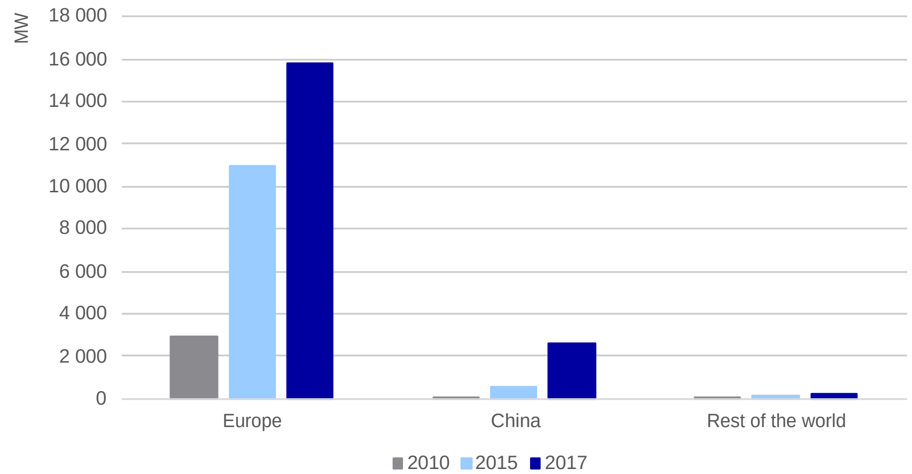
INSTALLED CAPACITY ONSHORE WIND



Source: International Renewable Energy Agency

Europe accounts for almost the entire offshore wind market

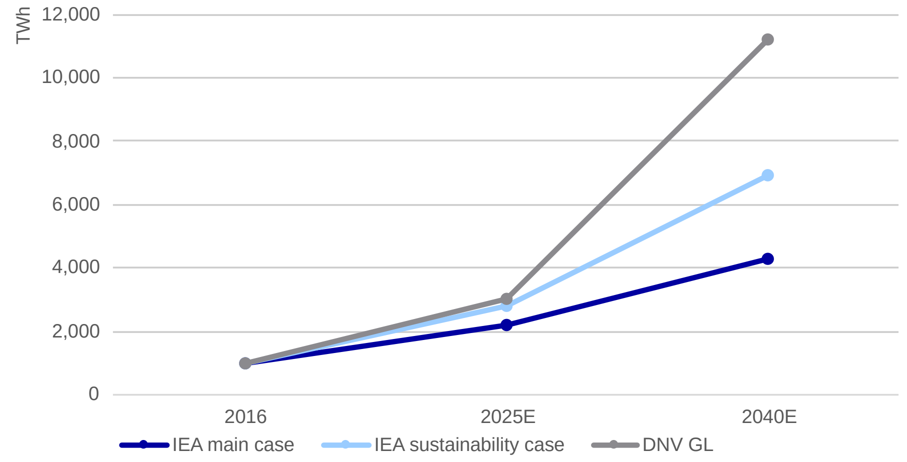
INSTALLED CAPACITY OFFSHORE WIND



Source: International Renewable Energy Agency

Similarly to solar PV, all three cases predict a boom in wind power, with different assumptions driving different exact outcomes

GLOBAL WIND ELECTRICITY GENERATION BY SCENARIO



Source: DNV GL Energy Transition Outlook 2018 and IEA World Energy Outlook 2017

Power flexibility solutions needed for renewables

The transition of power production to variable renewables like solar and wind will require additional flexibility in the grid, including energy storage, hybrid systems and demand-side response (DSR) solutions.

The time variability of renewables requires solutions like hybrid power plants, demand-side response and energy storage

In addition to changing the architecture of energy transmission systems, grids need to support the intermittence of variable power generation. The peak-to-average transmission load for variable renewables is far higher than conventional generation. This can be partly handled by demand-side response, which evens out the demand for electricity by timing consumption in smarter way. Instead of having an extra power plant to meet peak demand, it is more efficient and economical to reschedule parts of the more flexible consumption. Smart devices and smart grids should enable this to happen automatically. In addition, DSR is implemented in many parts of the world already with traditional programmes that pay end users for reducing power consumption during peak hours. Measures are underway to develop this further.

TESLA'S POWERPACK PROJECT

Source: Electrek.co

Moreover, the variability of power production requires energy storage systems (ESS) that further narrow the timing mismatch between supply and demand. So far, the vast majority of ESS capacity is pumped-storage hydroelectricity (pumping water to a higher elevation in hydroelectricity power plants). There are various promising technologies for ESS, but lithium-ion (Li-ion) batteries are gaining the most traction at the moment due to their plummeting costs. These can be installed on a huge scale close to power plants and on a small scale in homes, eg to support roof solar panels. The largest big-scale project in the world for now is the famous Powerpack project in South Australia with 100 MW capacity. At the consumer level, the most well-known systems today are probably Tesla's Powerwall, ABB's react and IKEA's battery pack. Other large corporates like Panasonic, Nissan and LG Chem are now flocking to this market. ESS has gained more public attention lately as a means to increase grid stability and security, especially in the aftermath of the blackouts caused by Superstorm Sandy in 2012 and the hurricanes Harvey, Irma and Maria.

Costs related to current grid infrastructure and ESS, as discussed so far, only tell part of the story. If the grid were to be fuelled by variable renewables only, additional costs would be required to solve the timing mismatch. Hybrid systems could play an important role in this transition, with low-carbon fossil fuels like natural gas running power plants during off-peak hours.

Oil & gas: short-term gain, long-term pain

The energy transition has already put downward pressure on the coal industry, and oil is likely to be next; the pace of change largely boils down to policymakers. As the fossil fuel with lowest carbon footprint, natural gas is well-positioned to bridge the energy transition, making the situation brighter for the offshore industry. An increased focus on natural gas and renewables is thus likely for E&P companies going forward.

Based on carbon footprint, coal should go first, followed by oil and then natural gas

Policymakers largely dictate the speed of the phase-out

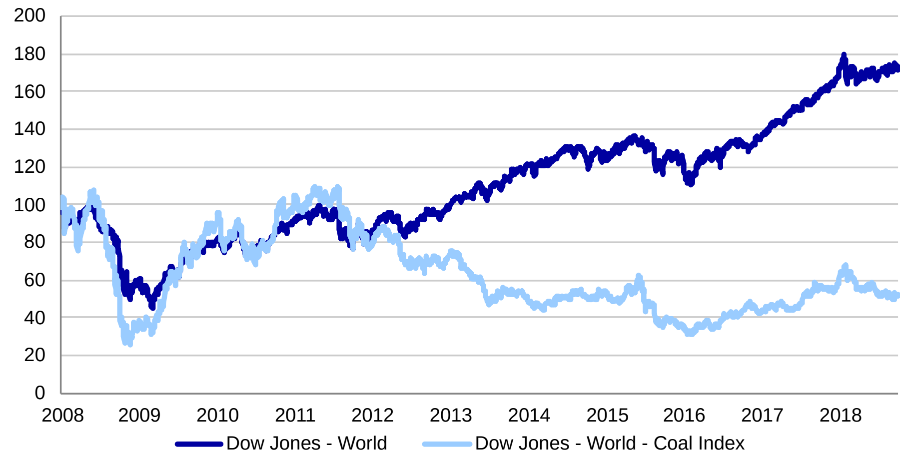
Short-term gain, long-term pain for oil – offshore saved by natural gas

Cutting the energy sources that emit the most first means that coal should be the first fuel to lose ground in the energy mix during the energy transition, followed by oil, and in the very long term, natural gas. However, even though segments of energy production will shift, growth in global energy demand is likely to stay strong for a while – unless policies drastically change course. The IEA's main case is growing demand for oil throughout its forecast period until 2040, whereas DNV GL sees a peak coming before 2030. Natural gas, on the other hand, is expected by both the IEA and DNV GL to capture shares of the energy mix, becoming the most important energy source for decades. It is often referred to as a bridge fuel for the energy transition, being the fossil fuel with the lowest carbon footprint.

We are in the early phase of a new up-cycle in the oil & gas industry, where we believe the offshore segment looks bright, with leading indicators pointing upwards. However, in a longer timeframe – looking at 2030 and onwards – there is a risk that oil will follow the same destiny as coal.

Coal's underperformance since 2012 shows how fast sentiment can hit valuations

COAL DROPPED SHARPLY WHEN NEGATIVE SENTIMENT KICKED IN, REBASED TO 100



Source: FactSet

Using a model for a hypothetical offshore asset, we find downside risk long-term, but limited thanks to bullish expectations for gas

Natural gas might alleviate the long-term risk for oil services

Oil services are more sensitive to cyclical up and downturns, as the industry relies heavily on spending from exploration and production (E&P) companies. In a scenario where investments deteriorate, the sentiment would likely turn negative quite fast, as happened in 2014. However, in a fair value model for a hypothetical offshore asset, cash flows beyond 2030 only account for a quarter of the value today, and the downside is limited thanks to bullish expectations for gas.

We used the DNV GL forecast to model how a relatively aggressive scenario for the pace of the energy transition would impact a hypothetical offshore asset operating from 2019 to 2040. To assess the impact, we used a DCF model with parameters listed in the table below. By linking the utilisation rate parameter in the model to the forecasted capacity additions for offshore oil and gas, we can estimate a rough theoretical impact on the fair value of the asset.

We base the original case on a long-term view on utilisation rates. In a scenario where offshore oil capacity additions are the only driver, the fair value would decrease by roughly 33%. In a scenario where offshore oil and gas capacity additions are equally important, the decrease was limited to 10% – highlighting the importance of the gas market going forward.

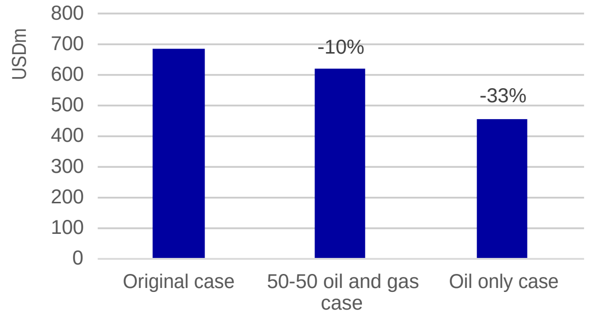
For some segments within oil services, such as supply and subsea, potential synergies with the offshore wind sector could compensate in the case of a tightening oil market.

PARAMETERS USED IN THE MODEL

Spot day rate (fixed)	USD 500 000
Opex days / month	90
Survey/upgrades/cap costs every 5 years	USD 50m
Downtime days every 5 years for maint.	40
Opex, % of spot rate	50%
Initial utilisation rate	90%
WACC	10%

Source: Nordea estimates

HYPOTHETICAL OFFSHORE ASSET MODEL



Source: Nordea estimates

E&P companies might use their balance sheets to gradually shift their focus to more gas and renewables...

E&P likely to increase focus on gas and renewables long-term

The same argument about natural gas providing support in the case of a souring oil market also holds for E&P companies. We are likely to see more focus on natural gas as a segment and we might see more activity such as Shell's acquisition of BG Group in April 2015.

Moreover, given the strong balance sheets, E&P companies generally have more flexibility to adapt towards greener alternatives when those projects surpass oil and gas on profitability. When the timing is right, existing capabilities in energy markets and offshore, coupled with cash reserves, give them the option to gradually make their portfolios greener.

However, given the expected market size of the greener alternatives (primarily offshore wind) compared to oil and gas, we believe it would be naive to think that they can fully compensate for any eventual losses in the oil market.

Offshore wind to hardly compensate for limping oil markets

Even though natural gas is likely to serve as a great bridge fuel, this market will also eventually need to peak to combat climate change. Some of the largest corporates have already started to reshape their business models towards a lower-carbon strategy. DONG's divestment of its oil and gas business and renaming to Ørsted, as well as Statoil's renaming to Equinor are good examples. Shell's ambition is to halve the carbon footprint of the energy it sells by 2050, while investing USD 1-2bn each year in renewables and EVs is another example. The energy company Total has the ambition that low-carbon businesses will account for nearly 20% of the portfolio in 20 years' time.

For companies operating in the offshore segment, potential synergies with the offshore wind industry include project planning, manufacturing, installation and grid connection, operation, and maintenance.

In project planning, the knowledge about how to operate under harsh environments and about the seabed will be valuable. In manufacturing, capabilities in manufacturing support structures will come in handy, especially in deep water projects. For installation and grid connection, potential synergies relate to construction and decommissioning of turbine foundations, which are comparable to those of an oil and gas platform. Traditional oil and gas manufacturers such as Bladt, EEW, Smulders and Sif have completely moved to offshore wind. Other areas in the installation phase where oil and gas capabilities can be leveraged are array cables (especially low-tier cable components) and cable installation, substation structures and steelwork. Some oil and gas suppliers with solid cable installation experience have successfully diversified into offshore wind, such as Canyon Offshore, DeepOcean and Van Oord. However, companies such as SubOcean and Technip Offshore have exited the cable installation market for offshore wind after financial difficulties, as the market is already highly specialised and competitive.

...however, full compensation from offshore renewables is hardly achievable

With IRENA and DNV GL respectively predicting that offshore wind will respectively only capture a mere 10% and 20% of the total wind market by 2050, and given the low auction prices for wind projects compared to oil projects, offshore wind will hardly fully compensate in the case of a souring oil market in the future.

A closer look at oil and gas markets

In the remainder of this section, we will look more into the oil and gas scenarios and what drives them.

The long-term outlook for oil largely rests on policymakers

Up until 2030, both IEA's and Equinor's main cases support increased oil demand, whereas their sustainable cases along with DNV GL see a peak during the 2020s.

The shale oil revolution has disrupted the oil market, forcing all segments to boost efficiency and cut costs

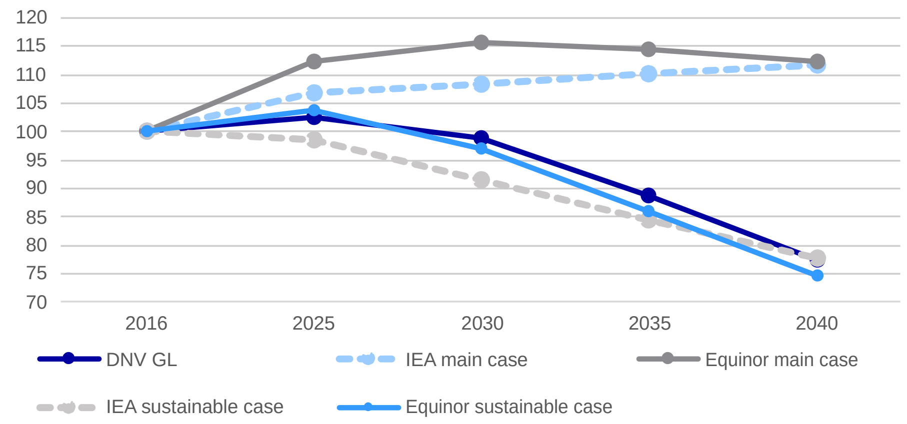
With the increasing threat from American shale oil, OPEC decided in 2014 to flood the market with oil in an attempt to starve out shale oil producers with low oil prices. The attempt failed, with the shale oil industry cementing its place in the market by innovating, cutting costs and boosting efficiency. By late September 2016, many OPEC nations had had enough, struck by serious government deficits, adopting a new strategy by cutting production and boosting oil prices. Since then, the shale segment has enjoyed significant cost learning curves and captured market shares in oil production. Moreover, it has benefited from a turbulent, risk-averse market with its flexibility and lower payback time.

The offshore industry has achieved substantially lower breakeven costs for deepwater projects following the massive cost cuts after the sharp oil price drop in 2014. These were achieved by a combination of commercial pressure on the supply chain, technology improvements, new ownership structures and greater standardisation. We are now going into a new up-cycle in the industry, and the short-term outlook looks brighter than it has for a long time. Almost all of the undeveloped offshore barrels have a breakeven below USD 65. Couple this with oil prices now trading at USD ~30 above cash breakeven after dividends for oil companies, as well as shrinking oil reserves due to underinvestment and low discovery rates, and the stage looks set for increased offshore activity. This is happening at a time when US shale may lose momentum owing to temporal issues and reservoir challenges. Moreover, oil prices have consistently stayed well above oil companies' budgeted oil price of USD 50 per barrel for over a year now, which we believe should leave plenty of room for upside surprises in offshore capital spending.

That said, if oil demand is hit at some point in the long term, the offshore industry is the oil segment that will likely suffer the most. This is due to the fact that the low-hanging fruit of offshore reserves are slowly depleting, and companies need to move to harsher, deeper fields, which are inherently more costly. Conventional onshore oil is operating at far lower breakeven costs, and unconventional onshore oil will most likely continue capturing market shares as the learning curves work their magic.

The sustainable cases of IEA and Equinor, and DNV GL's forecast, predict oil demand peaking within the next decade

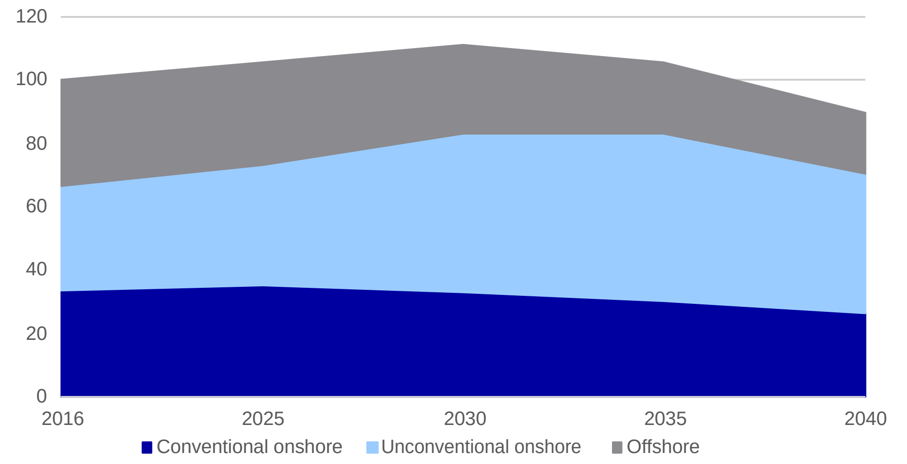
INDEXED GLOBAL OIL DEMAND BY SCENARIO



Source: DNV GL Energy Transition Outlook 2018, IEA World Energy Outlook 2017 and Equinor Energy Perspectives 2018

DNV GL expects global oil demand to peak by 2030 and unconventional onshore to capture market shares from especially offshore

INDEXED GLOBAL OIL PRODUCTION BY FIELD TYPE



Source: DNV GL Energy Transition Outlook 2018

Natural gas to bridge the energy transition

Being a cheap, cleaner source for power production in a time when massive electrification will shift the global energy demand mix, natural gas will be a more solid market for energy companies going forward

One of the stories of the shale revolution is the rapid substitution of natural gas for coal in the US. 2015 is marked as the year when natural gas overtook coal's position as the country's primary source of electric power generation. Natural gas has a far lower carbon footprint than other fossil fuels, with half the emissions of coal in power production and 20-25% lower CO_2 emissions than petrol for transport. As a cheap, cleaner source of power production at a time when massive electrification will shift the global energy demand mix, natural gas will be a more solid market for energy companies going forward. BP already has half of its portfolio in natural gas, and the development of new gas projects in Egypt, Oman and Azerbaijan are set to lift this to 60% by the end of the decade.

Hybrid solutions with gas as input factor will play an important role until an economical, emission-free solution for the timing mismatch of variable renewables is found

In power production, even though costs have come down markedly for renewables, capacity additions will not be enough to meet the demand from the electrification wave. Moreover, as mentioned previously, even though energy storage seems promising, alternative energy production is needed to further eliminate the mismatch between energy supply and demand. We expect that hybrid solutions like the ones offered by Wärtsilä will play an important part. Natural gas is a great option as a fuel in these systems. An example of this is the Kuraymat power plant, 160 kilometres south of Cairo, in Egypt. It is one of the new generations of power plants called Integrated Solar Combined Cycle (ISCC) plants. Using a combination of natural gas generators and solar energy, this plant supplies enough energy to power half a million homes 24 hours a day.

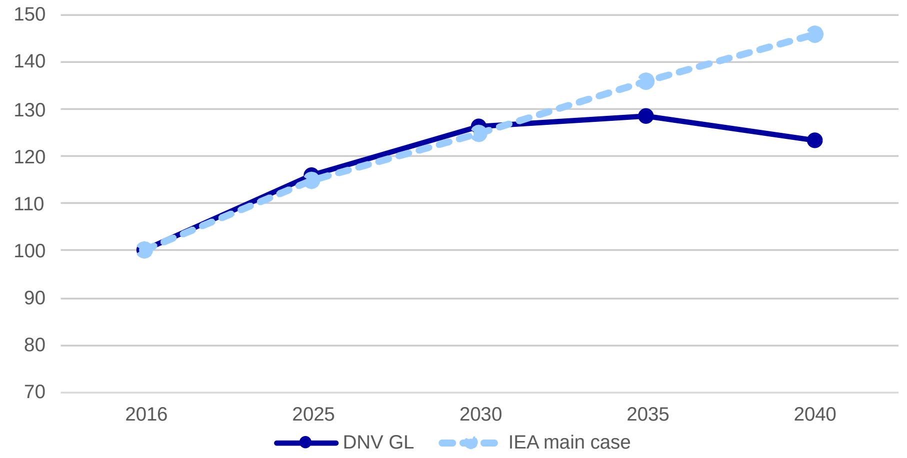
Unconventional gas extraction has some controversies though. There are concerns about the massive water usage that unconventional gas extraction requires, in addition to environmental threats such as fugitive methane emissions. Some countries have bans on this business, including France, Bulgaria, the Netherlands, parts of Australia and some US states. The debate is still ongoing, and other countries such as South Africa have decided that the pros outweigh the cons, and have lifted their bans on hydraulic fracturing. Moreover, technologies will likely make hydraulic fracturing more efficient, less toxic and less water-intensive. Such technologies consist of reusing water or using CO_2 or high-pressure nitrogen gas streams to boost production.

FLNG is a promising solution to freeing stranded offshore assets

Traditionally, offshore gas producers have faced significant challenges in that gas reserves are often far from the shore without access to export infrastructure. Gas has been inherently harder to transport, due to its low energy density. The emergence of the floating liquefied natural gas (FLNG) technology represents a way to mitigate this problem, unlocking potential in stranded offshore assets. By using LNG carriers, one can forego costly pipeline infrastructure to nearby shores.

With its low-carbon footprint and strong demand from countries such as China and India going forward, in addition to potentially significant cost learning curves on LNG technologies, we believe natural gas will play a fundamental role as a bridge fuel. In time, we are likely to see oil and gas companies focus even more on this industry.

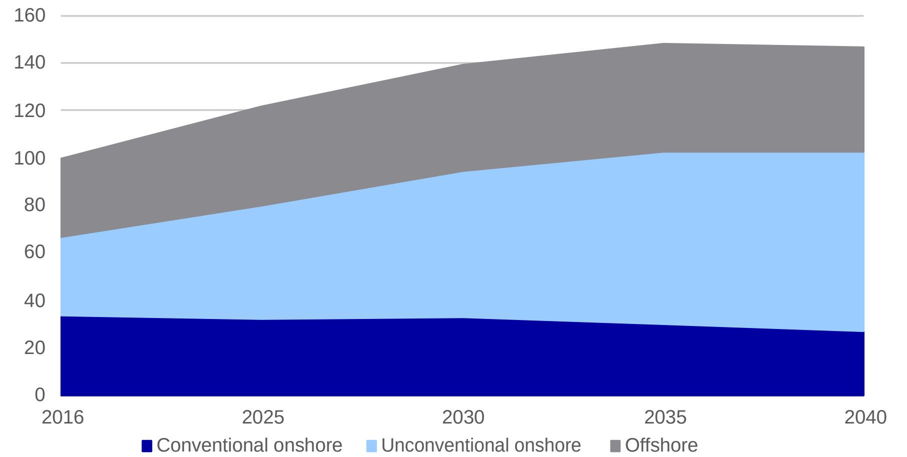
INDEXED GLOBAL NATURAL GAS DEMAND BY SCENARIO



Source: DNV GL Energy Transition Outlook 2018, IEA Outlook for Natural Gas 2017

INDEXED NATURAL GAS PRODUCTION BY FIELD TYPE

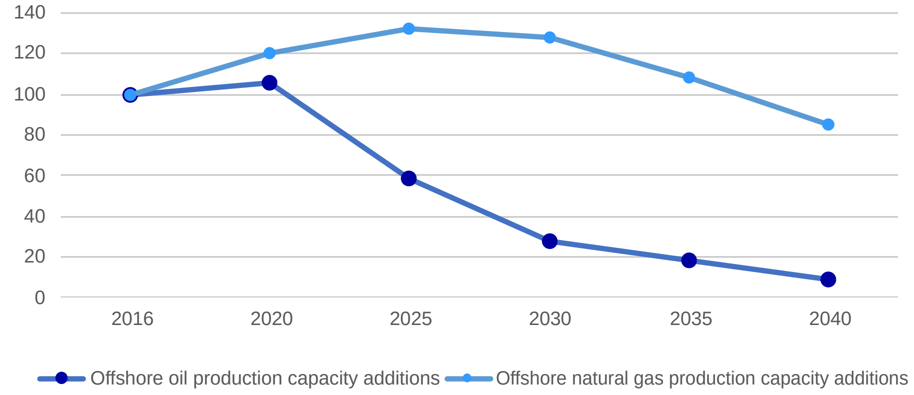
DNV GL expects the natural gas market to increase significantly during the next decades



Source: DNV GL Energy Transition Outlook 2018

Capacity additions set to drop for offshore oil during the 2020s, whereas offshore gas looks brighter according to DNV GL's forecast

INDEXED OFFSHORE OIL AND GAS CAPACITY ADDITIONS



Source: DNV GL Energy Transition Outlook 2018

Disclaimer and legal disclosures

Disclaimer
Nordea Markets is the name of the Markets departments of Nordea Bank Abp and its branches Nordea Danmark, Filial af Nordea Bank Abp, Finland, Nordea Bank Abp, filial i Norge and Nordea Bank Abp, filial i Sverige.

The information provided herein is intended for background information only and for the sole use of the intended recipient. The views and other information provided herein are the current views of Nordea Markets as of the date of this document and are subject to change without notice. This notice is not an exhaustive description of the described product or the risks related to it, and it should not be relied on as such, nor is it a substitute for the judgment of the recipient.

The information provided herein is not intended to constitute and does not constitute investment advice nor is the information intended as an offer or solicitation for the purchase or sale of any financial instrument. The information contained herein has no regard to the specific investment objectives, the financial situation or particular needs of any particular recipient. Relevant and specific professional advice should always be obtained before making any investment or credit decision. It is important to note that past performance is not indicative of future results.

This publication or report may be based on or contain information, such as opinions, recommendations, estimates, price targets and valuations which emanate from: Nordea Markets' analysts or representatives, publicly available information, information from other units of Nordea, or other named sources. To the extent this publication or report is based on or contain information emanating from other sources ("Other Sources") than Nordea Markets ("External Information"), Nordea Markets has deemed the Other Sources to be reliable but neither Nordea, others associated or affiliated with Nordea nor any other person, do guarantee the accuracy, adequacy or completeness of the External Information. Although Nordea Markets' information providers (Other Sources), including without limitation, MSCI ESG Research Inc. and its affiliates (the "ESG Parties"), obtain information from sources they consider reliable, none of the ESG Parties warrants or guarantees the originality, accuracy and/or completeness of any data herein. None of the ESG Parties makes any express or implied warranties of any kind, and the ESG Parties hereby expressly disclaim all warranties of merchantability and fitness for a particular purpose, with respect to any data herein. None of the ESG Parties shall have any liability for any errors or omissions in connection with any data herein. Further, without limiting any of the foregoing, in no event shall any of the ESG Parties have any liability for any direct, indirect, special, punitive, consequential or any other damages (including lost profits) even if notified of the possibility of such damages.

Nordea Markets is not and does not purport to be an adviser as to legal, taxation, accounting or regulatory matters in any jurisdiction.

Nordea Bank Abp, Satamaradankatu 5, FI-00020 NORDEA, Finland, domicile Helsinki, Business ID 2858394-9, VAT number FI28583949.

Completion date: 9 November 2018, 09:04 CET

Nordea Bank Abp

Nordea Markets Division, Research

Visiting address:
Aleksis Kiven katu 7, Helsinki
FI-00020 Nordea
Finland

Tel: +358 9 1651
Fax: +358 9 165 59710

Reg. no.: 2858394-9
Satamaradankatu 5
Helsinki

Nordea Bank Abp, filial i Sverige

Nordea Markets Division, Research

Visiting address:
Smålandsgatan 17
SE-105 71 Stockholm
Sweden

Tel: +46 8 614 7000
Fax: +46 8 534 911 60

Nordea Danmark, Filial af Nordea Bank Abp, Finland

Nordea Markets Division, Research

Visiting address:
Grønjordsvej 10
DK-2300 Copenhagen S
Denmark

Tel: +45 3333 3333
Fax: +45 3333 1520

Nordea Bank Abp, filial i Norge

Nordea Markets Division, Research

Visiting address:
Essendropsgate 7
N-0107 Oslo
Norway

Tel: +47 2248 5000
Fax: +47 2256 8650

Nordea