A strategy for long-term EU GHG emissions reductions

WINDEUROPE RESPONSE TO THE EU PUBLIC CONSULTATION

OCTOBER 2018

WIND ENERGY TODAY AND TOMORROW

Wind energy is a reliable, affordable and clean form of power generation technology and plays a pivotal role in the decarbonisation of the European economy. With 173 GW of capacity installed today in the EU, wind energy already provides approximately 12% of the electricity demand. The IEA expects **wind to become the no. 1 source of power in Europe well before 2030. It could meet nearly 30% of EU's power demand by 2030**.

The EU has agreed a 32% renewable energy target to 2030, with an upward review clause in 2023. That equals around 55% of electricity coming from renewables in 2030. This means that wind will play an increasing role in Europe's energy mix and that Europe can stay at the forefront of global competitiveness in wind energy technology.

The benefits wind offers to the environment and society are manifold. Wind is zero-carbon electricity: it avoided 166m tons of CO_2 emissions in Europe in 2016. It reduces Europe's fossil fuel imports and exposure to volatile fossil prices. Wind is an increasingly stable and cheap form of power supply. New onshore wind farms now operate at up to 35% capacity and new offshore wind farms on average at nearly 50%. One single rotation of a large offshore wind turbine produces enough power to cover a household's power consumption for 29 hours. Integrating variable wind in the energy system is getting cheaper and easier with advances in technology.

Wind energy is also a key part of Europe's industrial base. The business of producing, installing and operating wind turbines supports over 260,000 quality high-skilled jobs and generates €60bn per annum turnover. Wind farms bring direct economic benefits to the places where they are located. They provide jobs and investments in local communities.

TOWARDS NET-ZERO EMISSIONS

COP21 produced a climate deal that was hailed as historic and ambitious. The Paris agreement has marked the start of a fundamental transition the global energy system. It sets ambitious long-term objectives to limit temperature rises, signalling an ultimate phase out of fossil fuels and giving investors a clear signal that high-carbon assets are not viable in the long run.

Nonetheless, the deal must be seen as a starting point. A turning point that will impact EU climate and energy policies and offers new opportunities for the wind energy industry both in and outside Europe. The key is implementation: measures and strategies that help to swiftly and fundamentally transform our energy systems and scale-up investments in renewable energy.

Taking into account the Paris Agreement and the recently released IPCC report warning on the risks of 1.5°C global warming, the European wind industry believes the EU should adopt a consistent strategy aiming at **reaching net-zero Greenhouse Gas Emissions (GHG) by 2050**.

The power sector is currently responsible for a significant part of the CO2 and other greenhouse gases emissions. **Decarbonizing electricity is crucial. But we need to go beyond the power sector**. Three other important sectors - industrial processes, transport and buildings – also need to reduce their energy-related emissions. Cross-sectoral renewables-based electrification is key to this process.

If EU policymakers make a clear choice for renewables-based electrification, Europe will hold the key to a **successful decarbonisation strategy while ensuring it retains its competitive edge in key climate mitigation technologies**. In the process, Europe will make its energy system more resilient, drastically cutting dependence on imported fossil fuels, improving Europeans' living standards by limiting air pollution and cutting the energy bills of citizens and businesses.

WindEurope in cooperation with DNV GL, who has been responsible for the modelling, has recently assessed that with the right policies it is **technically and economically possible to increase the share of electricity in the European energy use from 24% today to 62% in 2050, 78% of which would be coming from renewables**.[1] This wider use of renewables-based electricity beyond the power sector **would reduce related emissions by 90% by 2050**, helping to keep Europe on course to the achievement of net-zero emissions. **This scenario would ensure global temperature rises are well below 2 degrees but requires more ambitious policies than those currently in place or envisaged**.

This consultation response builds on this assessment and looks into renewable-based electrification as a key component of the 2050 decarbonization strategy of the European Union. It represents the European wind industry response to the public consultation on this topic. It lays out challenges, opportunities and solutions for a drastic reduction of GHG emissions in the final energy use in the power sector as well as transport, buildings and industrial processes as the way to move towards being a net-zero emissions society.

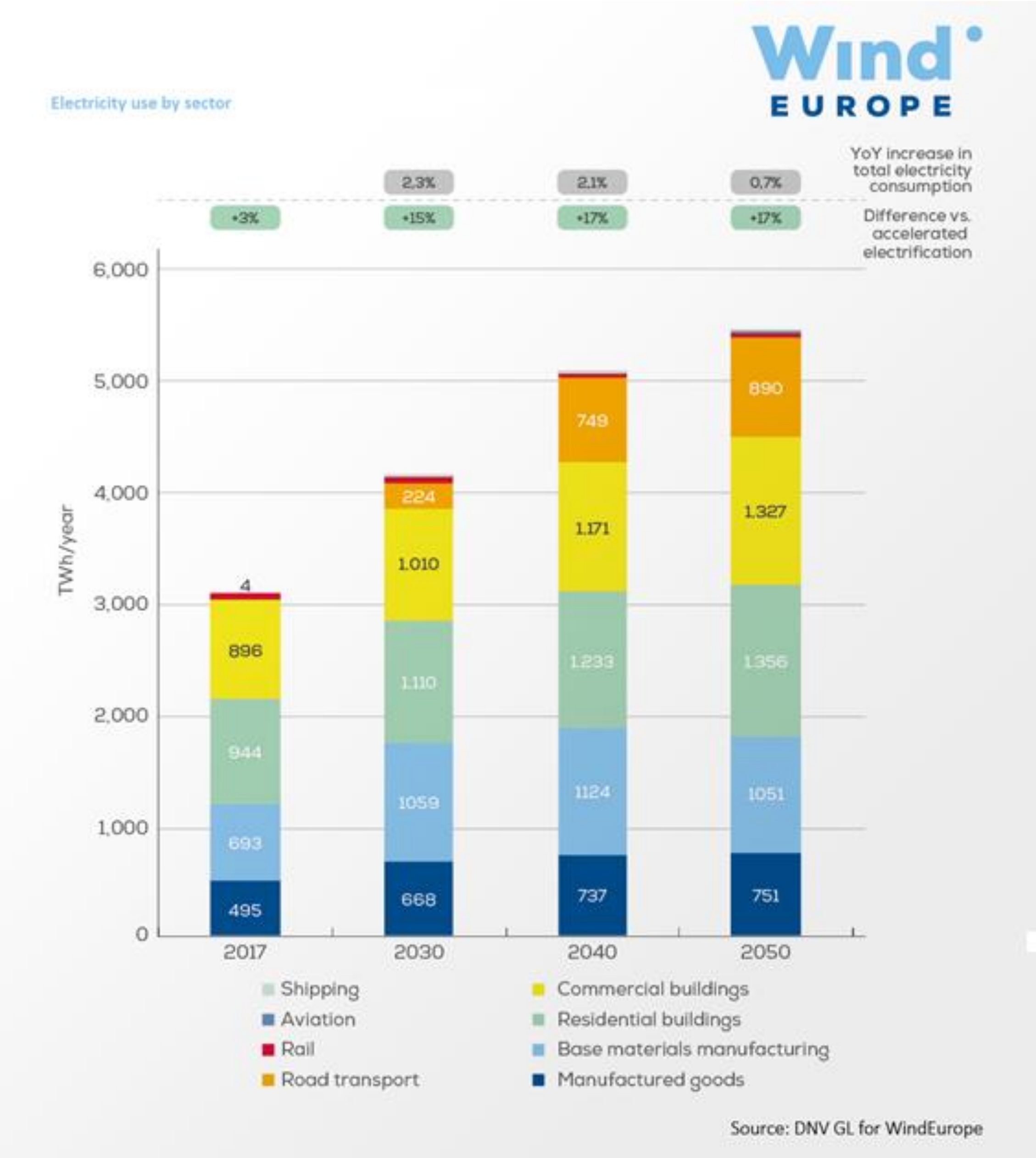
DECARBONIZING EUROPE'S ECONOMY

The decarbonisation of Europe's electricity sector has been one of the most transformative changes in the economy over the last two decades. Renewables have played a central role in this transformation, with 298 GW added to the power sector since 1995. Wind energy has been the largest single contributor, with 173 GW of capacity installed in the EU as of the end of June 2018. Wind energy now accounts for 12% of the EU's electricity and renewables in total account for 30%.

However, electricity is only about 24% of Europe's energy consumption. The vast majority of Europe's energy remains fossil fuel-based. Transport, heating and cooling (H&C) use most of these fossil fuels. Transport accounts for 32% of Europe's final energy demand, and 94% of it is covered by oil products. Heating and cooling account for almost half (46%) of the final energy demand, and 80% of it comes from fossil fuels. Today renewables makes up only 18% of the supply in heating and a mere 8% in transport.

[1] *Breaking New Grounds*, WindEurope with DNV GL, September 2018. Full report available at https://windeurope.org/wp-content/uploads/files/about-wind/reports/WindEurope-breaking-new-ground.pdf

Considering Europe's success already in renewables and its remarkable potential for future growth, a rapid electrification of the most carbon-intensive energy uses is the best and most efficient way to **simultaneously decarbonise and grow Europe's economy**. Integrating the power sector in heating, cooling and transport is the next big transformation in Europe's economy. Coupled with advances in digitalisation, machine learning and artificial intelligence, a renewables based energy system could become an engine of growth and technological leadership.



BENEFITS OF RENEWABLES-BASED ELECTRIFICATION

Environmental considerations and climate change mitigation are important to the rationale for the electrification of Europe's energy system. Nevertheless, reducing fossil fuel import dependence, increasing energy efficiency, hedging future energy bills for consumers and quality of life for Europe's citizens are equally important.

Health-related economic costs of air pollution in the EU are between €330bn and €940bn annually, equivalent to 3-9% of the EU's GDP.[2] In 2017, 130 cities in 23 Member States have infringed European air quality rules and nine Member States have requested European Commission exemptions to exceed their emissions caps. Displacing fossil fuels through higher use of electricity would reduce the exposure of large parts of the European population to dangerous pollutants such as SO2, NOx and other particles.

20% of all of the EU's imports are energy-related. The EU imports 90% of its crude oil, 66% of its natural gas, 42% of its coal and 40% of its uranium and other nuclear fuels. That accounts for 54% of all the energy it consumes, and costs EU citizens more than €1bn per day. Heating and cooling commercial buildings, households and industrial processes is 80% fossil fuel-based, mostly with natural gas. Furthermore, 94% of transport is dependent on crude oil, whose import bill is around €187bn a year. Replacing fossil fuels with domestic renewable electricity would significantly improve the EU's security of energy supply and would translate into imports cost savings for consumers.

Savings would become even greater as the efficiency of the power system and of electrical end-use appliances increases. A renewables-based electrification of the economy would help to reduce final energy demand as the production of renewable electricity has no conversion losses and it can deliver equivalent services with less energy input. In addition, electrical devices are becoming more efficient than fuel-based combustion, even when accounting for power transformation losses. For instance, battery electric vehicles (EVs) have a conversion efficiency of 80-90% from tank to wheel, compared to internal combustion engines with an average efficiency of 20-30%. This allows EVs to drive three to four times the distance with the same amount of energy. In residential heating, common heat pump technology can heat space and water with high coefficients of performance (between 3 to 4), meaning that for each kW of electricity consumed about 4kW of energy is generated. Heat pumps have further potential for efficiency gains as the technology advances, whereas traditional gas boilers would struggle to surpass their current efficiency rates of 40-80%.

Finally, electrifying final energy uses also improves safety, comfort and living standards for Europeans. Synergies with digitalisation will enable consumers to take a more active role in managing their energy consumption, become prosumers and save costs. All these benefits demonstrate that acting with urgency in the diversification of the energy supply for transport, industry and households must be part of the European vision for a sustainable, secure and affordable energy system.

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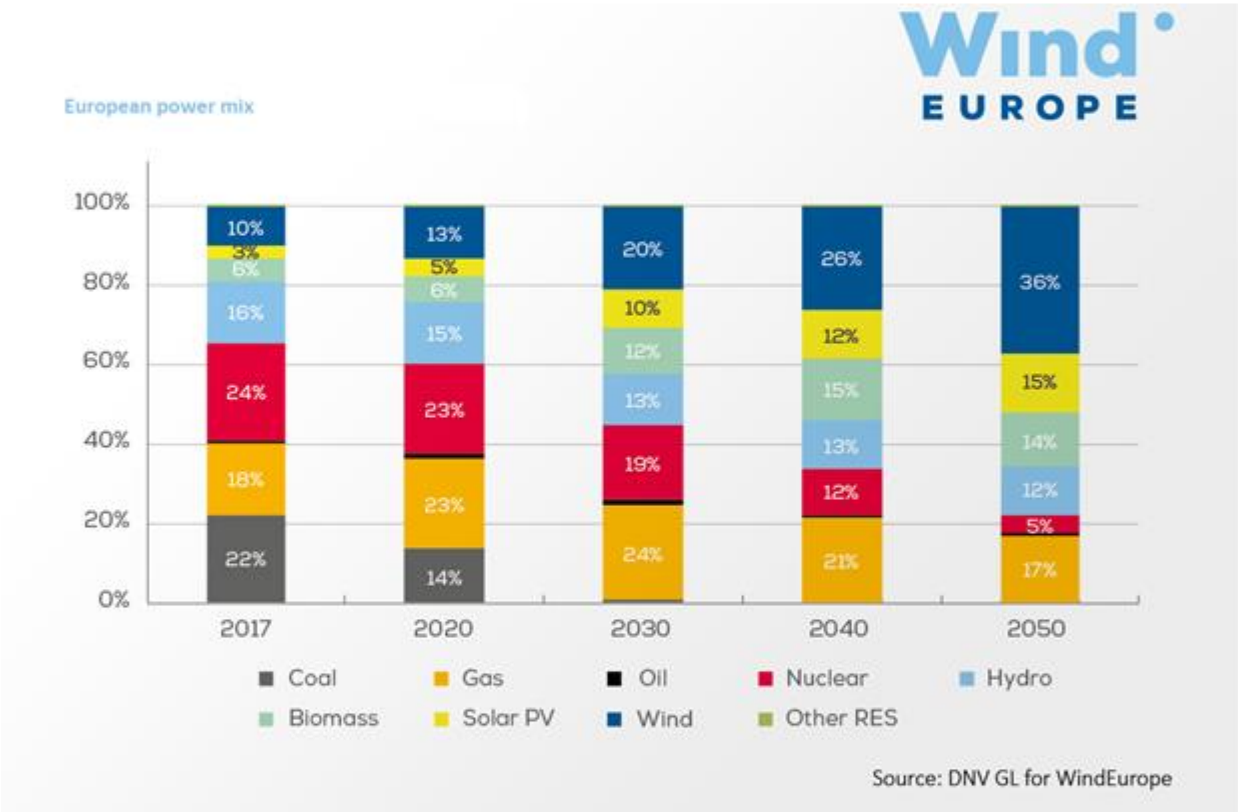
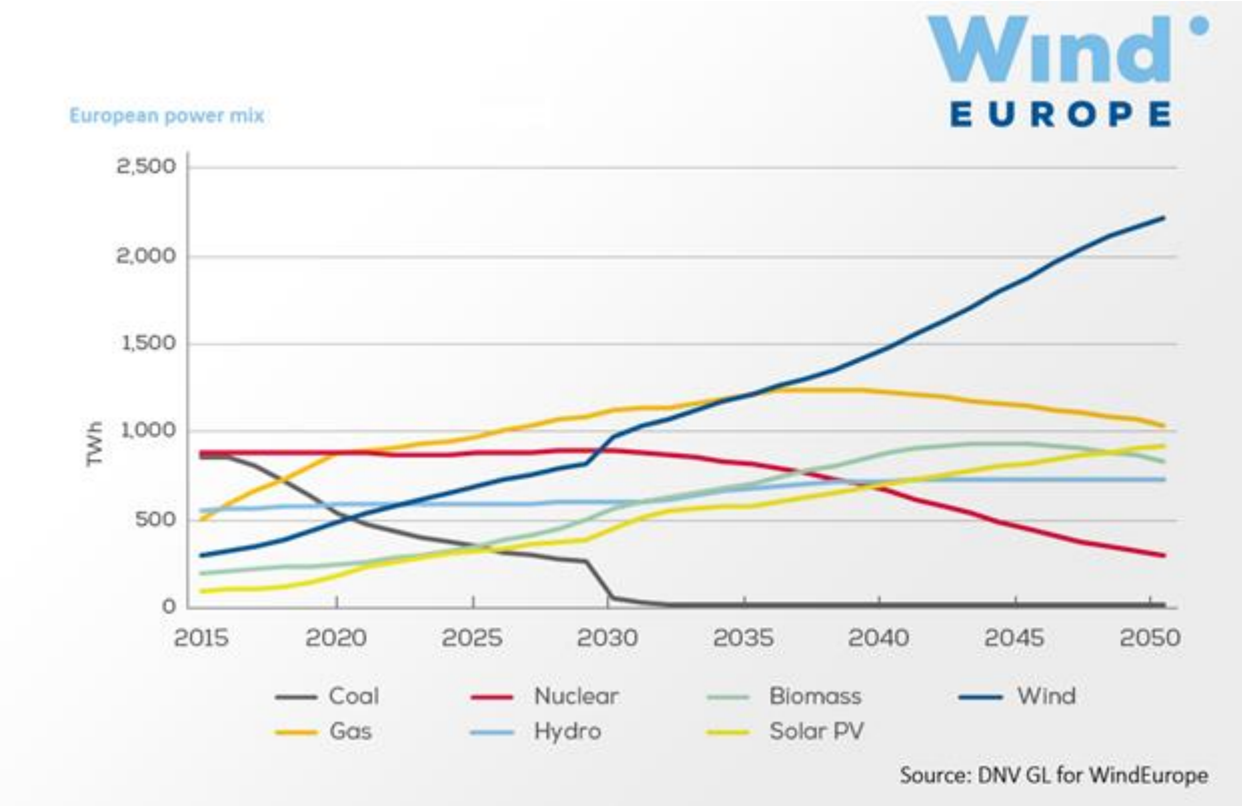
2 European Commission Memo, 18 December 2013. http://europa.eu/rapid/press-release_MEMO-13-1169_en.htm

THE POWER SECTOR

The share of renewable electricity generation in the European power mix needs to grow from 34% today to at least 78% in 2050. Wind energy and, to a lesser extent, solar PV will be the main contributors while biomass and hydropower will continue to play an important role. Increasing the share of renewables will be all the more significant, as the total power generation will grow from today's 3,500 TWh per year to up to over 6,000 TWh per year by 2050.

Wind energy could install more than 20 GW/year from 2030-2050. At this rate, wind energy would generate 2,223 TWh of electricity by 2050, equivalent of **36% of Europe's power generation**. Renewables would then account for 66% of Europe's final energy demand, significantly contributing to a 90% reduction of CO2 emissions. Investment costs for onshore wind would average €1.1m/MW by 2050, a decrease of 30% from today. Offshore costs would be €2.2m/MW, a 23% decrease.





EUROPE'S ENERGY FUTURE IS ELECTRIC

1.1. AN OVERVIEW ACROSS SECTORS

Renewables-based electrification benefits Europe, as it decarbonises the European economy while boosting it at the same time. It reduces dangerous air pollutants from cars, industry and homes. It strengthens energy security by decreasing the amount of fuel imports from foreign countries. It improves energy efficiency and reduces the final energy demand. It accelerates digitalisation, allowing customers to take control of their energy bill.

Renewables-based electrification reduces the costs of **climate change mitigation**. These costs would amount to 0.86% of Europe's annual GDP. By contrast, not implementing this scenario would carry costs amounting to 1.2% of Europe's annual GDP.

Renewables-based electrification **drives down energy consumption**, which would be cut by 33% in 2050. Energy demand in industrial processes would fall 36%, 18% in buildings and 46% in transport.

Industrial processes are key to meeting the Paris Agreement. Our assessment foresees that 86% of those would be electric by 2050, allowing for 88% related emissions reduction. The current policies in place, even if strictly implemented, would only deliver a 62% share of electricity in industrial processes by 2050 and would not allow to stay well below the 2°C threshold.

In **buildings**, the use of electric heat pumps will drive energy savings and emissions reductions. Although they represent only 2% of today's final energy demand for heating and cooling, they are quickly spreading. Electrification should reach the level of 78% by 2050 in commercial buildings and 59% in household buildings. This would allow for a 70% related emissions reduction in this sector by 2050.

The mass uptake of **electric transport** will take place under all foreseeable scenarios, but needs policies to sustain it. Sales of passenger vehicles with internal combustion engines will peak in 2025 under current policies. Electric cars should account for 95% of new sales by 2035 and rail transport should be 90% electric by 2030. Hydrogen is a key part of the transformation process. According to our assessment, hydrogen demand could be up to 426 TWh/year - equivalent to 4.8% of energy demand in 2050 - mainly to heat buildings and as a fuel for road transport. The uptake of hydrogen cars, however, requires further policy ambition.

Electrification is also essential for the optimal integration of variable renewables. The massive uptake of electric batteries for passenger vehicles would provide enough short-term storage capacity for managing high shares of wind and solar PV, even assuming that only 10% of EV battery capacity is made available to the grid.

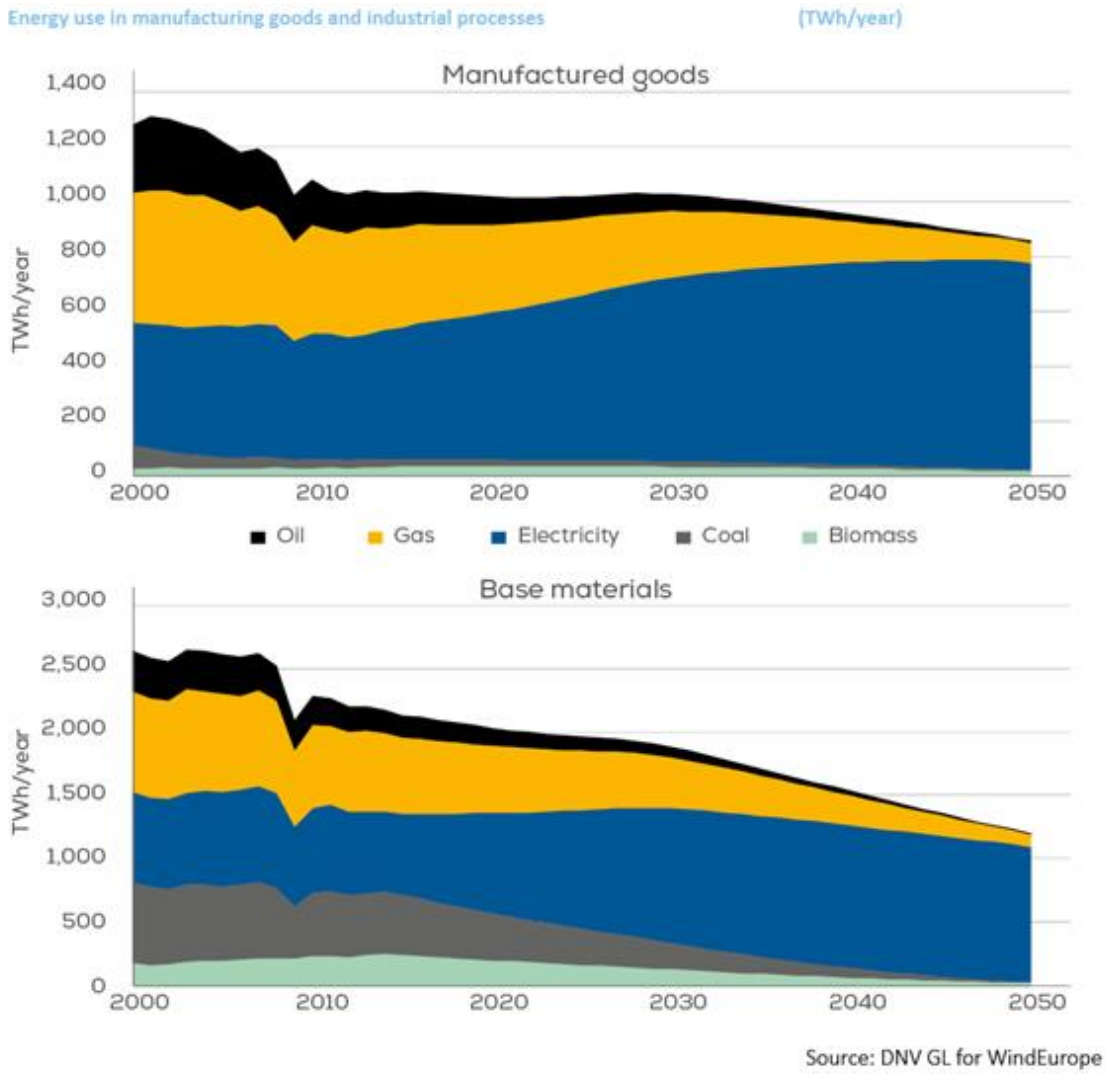
1.1.1. INDUSTRIAL PROCESSES

In our assessment, decarbonising the EU economy by 2050 will require a **widespread electrification of heat processes in industry**. Heating and cooling represents approximately 75% of all energy demand in industry and 37% of the total heat demand in the EU. It comprises 85% for heat-consuming processes and 15% for space heating. While the energy savings potential is vast, electrifying heating in industry would require significant commitments from business and political leaders. The rewards would be considerable. Industry could reduce its CO2 footprint by almost 90% from today according to our assessment, by a combination of electrification, energy efficiency improvements and, possibly, CO2 capture and storage (CCS).

In this assessment the manufacturing, where heat use is less significant, would increase its use of electricity from 46% to 86%. In other industrial processes for the manufacturing of base materials such as steel, iron, cement, aluminium and other metals, it means that the share of electricity would almost triple, from 34% today to 85% in 2050.

This increase in electricity use would require major transformations in processes, from technology upgrades or replacements to operational practices and even business models. For example, gas burners currently dominate a large fraction of industrial heat loads because they can deliver higher temperatures, typically over 500°C. Replacing such technology would require sizeable investments, although technology solutions exist today. In addition, industrial processes are typically highly integrated and changing one stage would require several other changes and retrofits. Nevertheless, this shift is possible as demonstrated by many industrial sectors, including the cement, steel, ammonia, glass and ceramic, which are already exploring direct electrification with renewables. Today, resistance, induction and infrared heating represent 80% of the available electric heating applications. Our assessment shows examples of direct electrification already undertaken by different manufacturing sectors[3].

Another key factor for electrification in industry is the fuel cost. The decreasing electricity prices driven by cost reductions in renewable technologies such as wind and solar could make them more attractive. However, this would depend on the level of taxes and levies and the distribution among fuels and energy consumers.



In addition to direct electrification, the transformation of renewable electricity into other energy carriers such as gas (e.g. synthetic gas, hydrogen) would become necessary. In some sectors such as cement, steel, fertilisers or refineries, Power-to-Gas is among the most promising CO2 emissions abatement options available. This is also known as indirect electrification.

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[3] See page 30, *Breaking New Grounds*, WindEurope with DNV GL, September 2018. Full report available at https://windeurope.org/wp-content/uploads/files/about-wind/reports/WindEurope-breaking-new-ground.pdf

The use of hydrogen is widespread in many industrial processes, notably for the production of fertilizers (through the production of ammonia) and chemical products (through the production of methanol). Substituting this natural-gas formed hydrogen with green hydrogen from electrolysis (based on renewable electricity) would yield significant CO2 savings. Green hydrogen and ammonia could also reduce CO2 emissions in the production of iron and steel. As an example, the Swedish steelmaking industry is currently developing this option.

Green hydrogen, blended with CO2, can produce synthetic methane too. The required CO2 could come from sustainable sources such as the surrounding air or from biogas plants. This would help into reuse CO2 that would otherwise be released into the atmosphere.

1.1.2. BUILDINGS

The cheapest, cleanest and most secure energy is the energy not consumed. Traditionally efficiency has meant ‘using less’, but policies should pursue a goal of ‘producing the same or more while using less’. Minimising energy use per unit of economic output entails a genuine transformation of the European economy.

Last June, the EU agreed on a non-binding 32.5% energy efficiency target by 2030 with an upward review clause in 2023. Policy makers will use a range of measures across different sectors in order to meet this 32.5% target. For example, the implementation of the Energy Performance of Buildings Directive (EPBD) agreed in May 2018 could have a significant impact in energy efficiency policies across countries.

The Directive aims at boosting energy efficiency in buildings through ambitious long-term renovation strategies towards a decarbonised building stock by 2050. This would transform Europe’s energy system; buildings account for 40% of Europe's energy consumption and two-thirds of Europe’s buildings were built before energy performance standards were set up. Furthermore, the building renovation rate is only around 1% per year. Increasing this renovation rate has the potential to reduce between 5% and 6% of the EU’s total energy consumption and to reduce CO2 emissions by about 5%.

The decarbonisation of this sector will be a key factor in Europe meeting its climate objectives. Population growth and standard of living conditions are the main drivers for energy demand in this sector, both of which we expect to continue growing to 2050. The breakthrough should come from cooking, space heating and water heating, currently dominated by gas. Appliances, lighting and space cooling are already generally electrified.

In our assessment, **energy consumption in commercial buildings would stay flat, and electricity use will increase from 50% today to 78% by 2050, at the expense of natural gas**. In households, energy efficiency gains will be more significant, with a decrease of 27% in energy consumption accompanied by a doubling of electricity use, from 29% today to 59% by 2050. The use of electric heat pumps will drive energy savings and emission reductions. Although they represent only 2% of the final energy demand for heating and cooling today, they are quickly spreading. The heat pumps stock at the end of 2017 exceeded 10.6 million units and, with a current annual market above 1 million units, their contribution could increase significantly in the next decade.

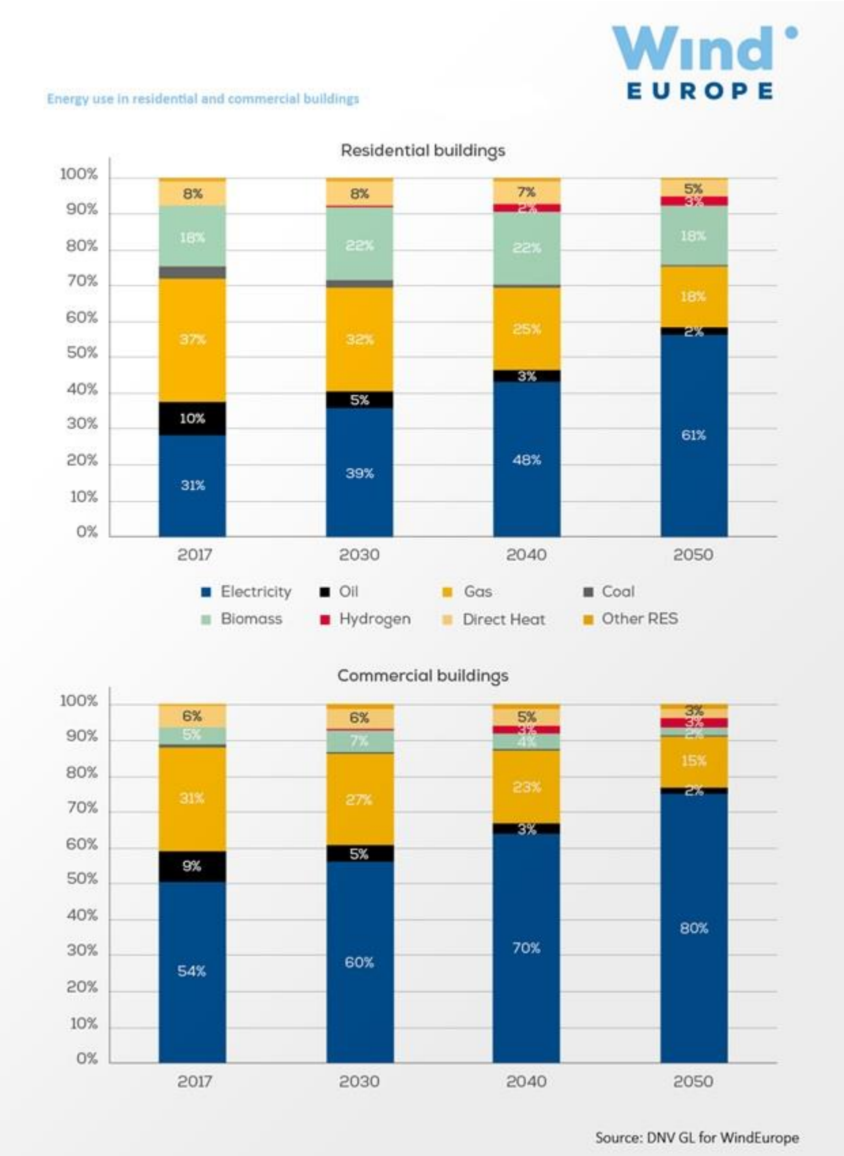
Particularly heat pumps used in district heating networks – which generate heat in central plants and pump hot water into homes via underground networks – will play a central role in driving the electrification in residential buildings. District heating accounts for just 9% of space and hot water heating in the European Union. These networks are mainly used in the energy systems in the Nordic countries and Germany. Switching these networks to use heat pumps instead of fossil fuels would tap into the increasing demand for heating in fast-growing cities like Berlin and Frankfurt.

Electricity will grow most where gas transmission and distribution lines require upgrading, triggering a replacement by electric cables. However, the conversion of a significant fraction of those gas pipelines could make it possible to transport hydrogen and/or synthetic methane. One third of the hydrogen demand (as energy carrier) would come from buildings in 2050, according to our model, representing about 3% of buildings' final energy demand.

However, hydrogen use for heating would compete against the emergence of heat pumps and their continued improvement. Grid expansion and renewal of the building stock could make cost-conscious customers switch to electricity for their heat demand, just as some had made the switch to hydrogen 10-20 years prior.

When looking at specific heating applications in buildings (cooking, space heating and water heating), the role of electricity is even more modest. Buildings would reduce their direct emissions 70% from today, mostly by replacing gas and oil by electricity. According to our assessment, buildings would emit 160 MtCO2 by 2050, compared to the 267 MtCO2 that would be emitted under accelerated electrification.

The remaining unabated emissions will be due to the use of natural gas and, to a much lower extent, the use of oil in a very limited number of buildings.



1.1.3. TRANSPORT

The electrification of the transport sector, in particular road transport, will be the main driver of energy savings and CO2 savings, in spite of continued growth in passenger cars for the next decade. The uptake of electric vehicles is expected to develop following an s-shape growth. If costs of EVs continue to decrease and are on a par with internal combustion engine vehicles by 2024 (light vehicles) and by 2027 (heavy vehicles), then half of all new sale vehicles will be EVs shortly after 2025 (for light vehicles) and shortly after 2030 (for heavy vehicles).

Nevertheless, stricter environmental regulations and a massive rollout of recharging infrastructure across the continent should sustain this uptake.

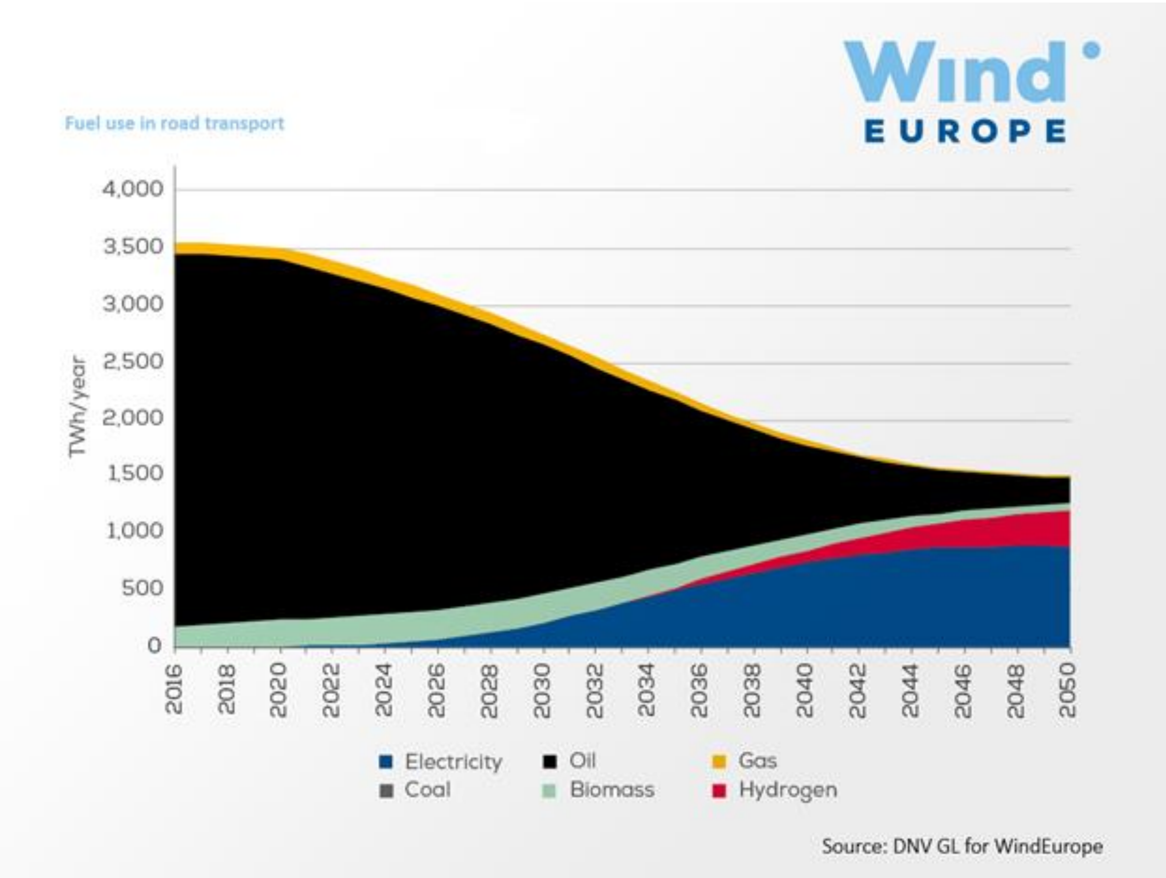
The world's light vehicle fleet propelled by combustion engines (ICE) is very likely to peak in 2025 as electric vehicles (EVs) have started their exponential growth phase and urban dwellers increasingly opt for car-sharing rather than car ownership. In Europe, the light vehicle fleet has shrunk 30% since 2016, and the remaining fleet will be almost entirely electrified.

The role of hydrogen would become more relevant in locations with well-developed gas infrastructure. In such locations, hydrogen would serve not only buildings' heating demand, but also up to 16% of heavy trucks will run on hydrogen. The lower cost of variable renewables (making electricity cheaper) and their need for demand-side flexibility (as they are not "dispatchable") would improve the potential for electrolysis-based hydrogen production (hydrogen can be easily stored and transported in large quantities). However, **direct electricity will still provide the vast bulk of propulsion for light vehicles, and a five times higher fraction of propulsion than hydrogen for heavy vehicles. By 2050, however, hydrogen will rival diesel as the most important fuel source for long-distance trucks**.

Pursuing policies towards Paris compatibility would also require emissions reduction in shipping and aviation. Oil heavily dominates inland maritime and domestic aviation, each representing 11% of all transport demand in 2017. Both sectors would experience significant change of fuels until 2050, with larger contributions from biofuels and natural gas, but electrification would remain marginal with less than 5% in each case. In both sectors, energy consumption is expected to peak within two decades at levels about 15% higher than today, mostly thanks to increased efficiency of jet technology.

Shipping will see electrification of short-haul transport reducing its energy consumption by one quarter. Cruise segments will favour hydrogen. Air transport could see embryonic electricity propulsion by mid-century for the shortest haul flights.

Rail is 70% electrified today, and would increase over 90% by 2050, although its share of total transport energy demand is a mere 2%.

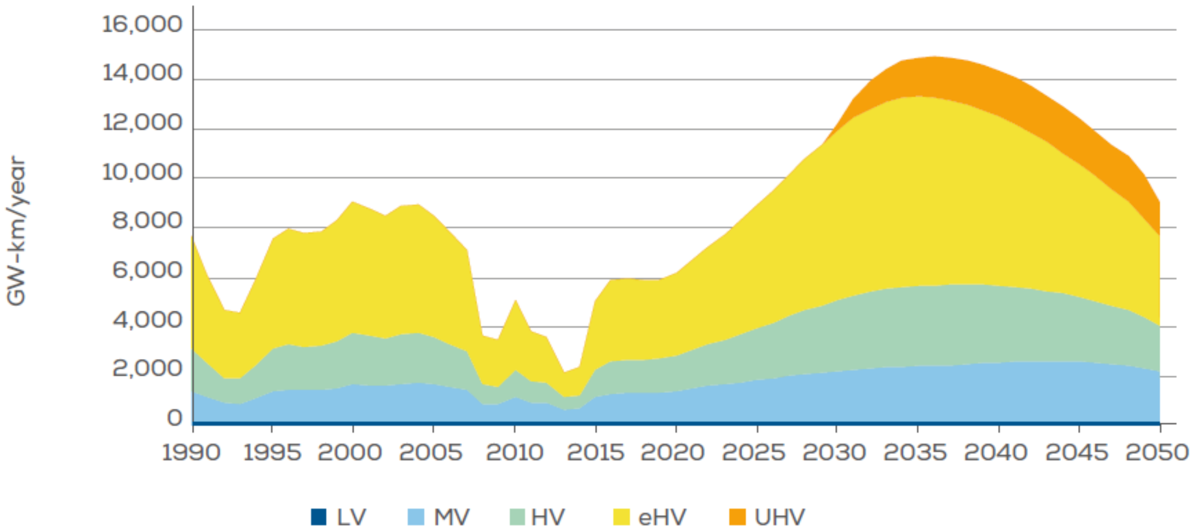


BUILDING UP A RENEWABLES BASED ENERGY SYSTEM

Further development of the power grid infrastructure is a ‘no regret’ option, even in the less ambitious accelerated electrification scenario. Doubling the electricity share in Europe’s energy mix would require larger and stronger grids. An estimated average of 12,000 GW-km/year of additional power lines would be needed to 2050. This is in stark contrast to what Europe has been building in the last 10 years, but is comparable to the rate of deployment in the 90s and early 2000s.

Distributed resources, including renewables, electric charging infrastructure and heat pumps would drive the build-out of low voltage grids around Europe, but the overall need for grid capacity would be driven by the total increase of demand from electrification and the need to optimise system operations at regional level.

Grid capacity additions by voltage class



Source: DNV GL for WindEurope

Europe will need a highly flexible energy system to operate the very large shares of wind and solar energy in the Paris-compatible scenario. It can get this flexibility through smart electrification and sector coupling. These will enable the demand response required to match renewables generation with energy demand. In this way, the power capacity needed to provide a reliable system would be optimised, keeping the reserves for balancing to affordable levels. In addition, electrification and sector coupling would help to minimise the curtailment of valuable renewable energy.

Flexibility is important to manage variability from demand and supply in the power system at different time scales. For example, where solar energy varies with the day and night rhythm, wind energy varies by slowly moving low-pressure areas (at a time scale of multiple days). Furthermore, solar and wind energy show variability on both hourly and shorter time scales (minutes down to sub seconds), due to wind variations, wind gusts and cloud coverage. Hydropower, while being dispatchable in most cases, also presents important seasonal and inter-annual variability. Demand is generally predictable at aggregated scale, but sudden changes need to be addressed too (e.g. half-time break during the final of a major sporting event). This is why flexibility solutions need to cover the whole spectrum, from the sub-second to hourly, monthly and yearly variations.

Existing flexibility comes from flexible generation (both conventional and renewable), demand response (both consumption patterns and smart technologies), interconnectors, storage and sector coupling. While a number of technologies focus on improving the flexibility they can provide, other technologies look at reducing the need for flexibility (for instance, improved forecasting of renewable sources). Flexibility may also come from improved market design, e.g. intraday trading is a clear example of how to adapt the market to the new realities, significantly reducing balancing and reserves costs. Bringing the gate closure time in these markets near to real-time can also reduce the system dependency on balancing reserves. Other examples include the possibility of aggregating generation at larger geographical areas and/or aggregating different technologies when bidding in the market. The most significant element of system flexibility will come from new electric loads such as heat pumps, electrolysers, smart charging infrastructure and storage solutions.

RESEARCH AND INNOVATION

The EU is able to compete in mature industries such as aviation and automotive because of its sustained efforts to support Research & Innovation. If the EU is to deliver on its commitment to be a global leader in renewables, the same logic should apply to wind energy technology. Europe needs to support this strategic sector by sustaining the current cost reduction trend, both in onshore and offshore wind, while at the same time ramping up the transition towards a flexible energy system with variable renewables at its core. Delivery on this will pose Research & Innovation challenges.

The European wind energy sector invests over 1 billion Euro, nearly 5% of its direct contribution to GDP, annually in the development of new cutting-edge technologies to drive down costs even further and facilitate the integration of wind energy into the energy system. Still, public support is central to retaining global leadership in the wider energy transition and to keep EU companies competitive in the global market. The share of EU content in global installed capacity has been dropping since 2011 and any further decline puts existing jobs (262,000 in 2016) and the positive trade balance that wind energy creates for the EU (€2.4 bn in 2016) at risk. A stronger EU wind energy industry could double its employment level in the EU and contribute twice as much to the EU's GDP by 2030.

EU support in the form of project grants and other financial instruments such as equity and mezzanine finance will remain instrumental in keeping the industry-wide cost reduction trend going. Achieving competitiveness vis-à-vis conventional energy still requires major technological breakthroughs. EU programmes such as Horizon 2020, InnovFin and NER300 have greatly helped the sector to move forward. We urge the European Commission to earmark support for the wind sector in the upcoming programmes Horizon Europe and the ETS Innovation Fund, as more progress is still to be made.

Importantly, EU support should focus both on the improvement of current wind power turbine technologies, on- and offshore, as well as on innovative concepts throughout the entire supply chain.

The European Technology and Innovation Platform on Wind Energy (ETIP Wind), which WindEurope coordinates, has identified 5 key priorities for Research & Innovation over the next years. They are: grid & system integration, operation & maintenance, next generation technologies, offshore balance of plant and floating wind.

POLICY RECOMMENDATIONS

Europe must make a clear choice in favour of the renewables-based electrification of industrial processes, buildings and transport as the key driver of its decarbonisation strategy.

We consider the following recommendations as a first, minimum step towards achieving the targets set forth by the European Union and further analysed in this position paper:

• The EU should ramp up its emissions reduction objective for 2030 to 45% now and use the 2023 ratchet-up mechanism to adjust its emissions reduction trajectory to its long-term decarbonisation objective.

• Member States should adjust their energy tax regimes for electricity and fossil fuels to incentivise decarbonised energy use.

• Market design rules should enable the use of dynamic electricity pricing contracts and time-responsive grid tariffs to incentivise demand-side flexibility.

• Market design rules should avoid market exit barriers for the most carbon intensive power generation assets.

• ENTSO-E's 10 Year Network Development Plan should reflect the infrastructure needs of the Paris-compatible scenario and accelerate the roll out of smart low voltage grid.

• The EU's Connecting Europe Facility should prioritise electricity projects and the deployment of ultra-fast vehicle charging infrastructure.

• The EU and Member States should adopt zero emissions vehicle sales targets as part of the post-2020 CO2 standards for passenger cars and light commercial vehicles.

• To unlock the massive potential of renewables powered green hydrogen, Horizon Europe and national R&D programmes should prioritise R&D funding for electrolysers. Governments should also adopt network charge exemptions that enable electrolysers to benefit system operations.

• Member States should spell out electrification measures as part of the National Energy and Climate Plans to 2030 notably for industrial processes and buildings.

• The EU should mainstream the electrification of industrial processes as part of its strategy for a smart, innovative and sustainable industry.