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Chief Investment Office

The European Energy Mix is changing**Contents**

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- We expect a steady decline in oil consumption and renewables taking over the leading position.
- Coal is forecasted to become the biggest loser in the European Energy mix, being pushed out by age and economics.
- Natural Gas is the only fossil fuel where demand is rising, predominantly by replacing coal. In spite of this, we see the share of gas declining due to high competition from renewables.
- Atomic's share in the energy mix is set to highly diminish in the upcoming decade due to design life. A bounce back would depend on decarbonization targets and electricity demand.
- Renewables are going to predominate the sectoral transformation enabled by a combination of empowered supply and changing demand, both greatly driven by climate change awareness.

Energy determines our daily lives like almost nothing else. Without it, we could not heat our homes, sustain our economy or run our schools and hospitals. And yet this sector, which is so fundamental to our society, is experiencing rapid changes. In this report we present an overview of the past and future drivers of the energy prices, its linkages to industries and economic developments across the EU. We find that a penetration to the current market can be achieved at low cost levels, changing the basis of the entire electricity mix. A European power system, independent of fossil fuel emissions, is possible and will be a key way of addressing climate change with a transition to clean energy. Plans to reach these goals are being established across the Member States, evolving and improving current markets as you read this article. We therefore forecast movements in the market that will be coming into sharper focus, shaping the European Union and its Member States. Who will benefit in this metamorphosis and who will struggle to keep up with the certainty of change is also a crucial topic of this research report. The rest of the article is structured as follows. Each section describes an overview of critical historic events up to the current level. Then it discovers linkages to dependent industries and economies, examining some of the factors and components that are subject to the transition in the European Energy Sector. This process will allow us to form a sound conclusion on the short-term effects of these macroeconomic events.

Editorial Board**Fabian Max Cisar**

Head of CIO - Research
 Fabian.Cisar@wutis.at
 +852 60915492

Adrián-Huba Takács

President of WUTIS
 Adrian.Takacs@wutis.at

Research Team**Christopher Franzmayr**

Associate – Team Lead

Raoul van der Sluijs

Associate

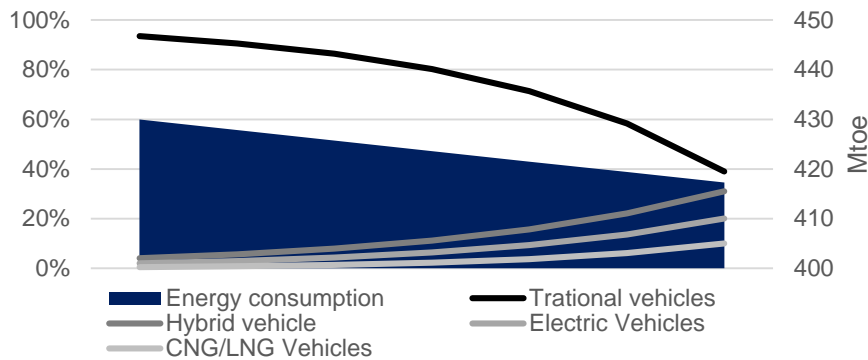
Lisa Altmanninger

Analyst

Ivona Stoyanova

Analyst

Chart 1 EU car market share by fuel and EU energy consumption
from 2018 until 2030



Source: IEA, euractiv

Oil - Leader of the energy sector

„Due to output cuts in combination with growing economies, oil prices are expected to move upwards and reach levels of USD 75 (Brent) by 2025”

Crude oil has had the largest share in gross inland energy consumption in the EU for decades and remains, together with its derived products the largest contributor to global as well as European energy supply. In fact, crude oil accounts for a share of more than a third of European energy-resource and is hence the most commonly used energy source. During the economic downturn of 2008 the decreasing demand for oil led to an oversupply, depressing prices. After the first quarter in 2009 prices rebounded and reached USD 126 which is still the year maximum. From 2014 to 2016 oil prices plunged to levels below the post financial crises era. In the recent years the price recovered due to an increasing demand driven by global factors such as economic growth, OPEC strategic behaviour and Middle East tensions. Recently, the price for one barrel of Brent crude oil plummeted and now stands at around 62 USD (6th of June). Spot prices are nearly 12% lower than the 50-day moving average.

According to the European Commission, Brent oil prices at 70 USD per barrel on average in 2019 may reduce EU GDP by around 0.4% in the same year. Due to output cuts in combination with growing economies, oil prices are expected to move upwards and reach levels of USD 75 (Brent) by 2025. However, upward movements are only expected to be slight since Norway is pushing further exploitation of untapped reserves which will increase supply. There is also a significant additional resource upside expected which is estimated to be around 14-15 billion barrels that are yet to be found. Even though there are still plenty of fossil energy sources in the world, the future of oil demand remains uncertain. In the near future technological innovation will lead to a major transition from using oil to renewable energy resources.

“Last year’s shock in oil prices boosted the contribution of energy inflation to headline inflation in the Eurozone. The projections assign a smaller future impact on the HICP by the fossil fuel’s path.”

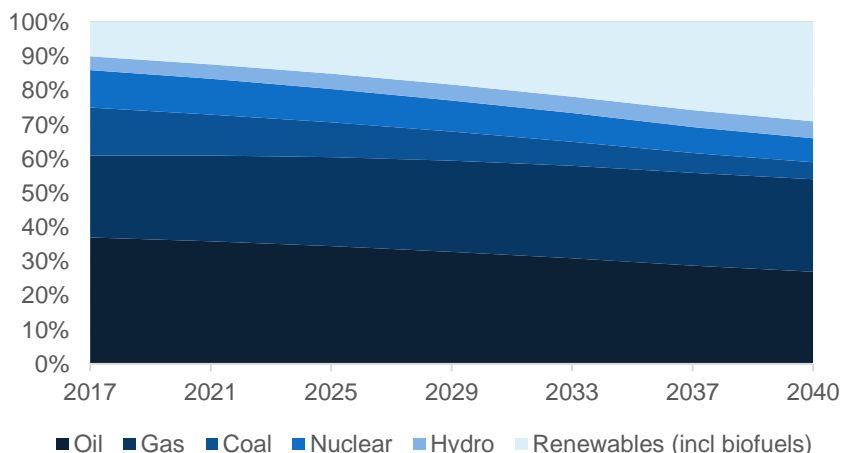
In addition to that, the EU committed to the reduction of CO₂ emissions and is therefore introducing regulations to foster renewable energy sources (in the following just “RES”) and low carbon emission technologies. As of December 2018, European oil demand further declined, with a decrease of 755,000 barrels per day, especially due to weaker consumption in Germany. While global oil demand is expected to rise by 0.5%, the European demand is expected to remain at its low levels. Rising crude oil prices are similarly causing higher production costs, hence, lowering households’ wealth which influences the demand for other commodities in a negative way. In the same way, other energy resources are affected. The substitution of oil as an energy resource highly depends on its volatile price as well as the level of technological innovation in the field of renewable energy. Oil and gas constitute direct substitutes and maintain a strong price relationship. Therefore, a decrease in oil-prices will lead to a lower demand in gas; causing the gas-price to follow the oil price in the medium-run. Within Europe gas contracts are tied to oil prices.

There are many different factors such as basic supply and demand factors, production costs, political turmoil and to some extent interest rates, that play a role in the influence on oil prices. Since oil is an important energy source and input factor for production, an increase in oil prices leads to an increase in the overall costs of production, leading to higher product prices, thus increasing inflation. This is especially true for energy intensive sectors in manufacturing cement, non-metallic minerals, steel and of course petrochemicals. Also, not neglectable are products that require long distance transportation by truck. Last year’s shock in oil prices boosted the contribution of energy inflation to headline inflation in the Eurozone, according to the ECB. The projections assign a smaller future impact on the HICP by the fossil fuel’s path. The conclusion is based on a mean oil price, with expected high variance that serves as a reminder of the uncertainties regarding energy inflation projections. With a looming supply surplus, slower growth and declining oil demand, ECB’s claim does not seem too far stretched. In the past five years, we have seen a strong inverse correlation between the terms of trade and oil price fluctuations. When oil prices rose, the terms of trade deteriorated; this then diminishes household purchasing power.

“While the transportation sector’s dependency on crude oil is decreasing, we see the chemical & petrochemical industry as potential winners in the medium run...”

Given that oil is still far more present in transportation than other fuels, as for example natural gas, we see limited substitutes and therefore, a price-inelastic demand for oil in transportation. This shows us that higher oil prices decrease the terms of trade, which is true for Europe, because it is a net importer of oil. However, this price elasticity is set to change as cars and other vehicles diminish their oil usage due to electrification, alternative fuels and efficiency improvements. This shift and the lower demand on traditional, petrol filled cars might drive crude oil prices down, hence slowing the transition to electric vehicles. Nevertheless, the trend towards renewable technologies should remain. While the transportation sector’s dependency on crude oil is decreasing, we see the chemical & petrochemical industry as potential winners in the medium run, where demand for crude oil and natural gas is forecasted to rise in the upcoming years. Until 2025 we see an upside for companies that work in the chemical & petrochemical industry to increase their sales in Europe. Big domestic players include BASF from Germany, Lyondellbasell from the Netherlands, Ineos from the UK, Bayer from Germany, Air Liquide from France, Akzo Nobel from the Netherlands, as well as oil & gas companies such as BP and Shell where petrochemicals are a crucial part of their portfolio. In the long run, the trend might be halted, and oil consumption may as well decrease in these industries due to stricter EU regulations, that aim to reduce the production of plastics and foster recycling. European authorities already implemented bans on single use plastics that will be enforced in the following years.

Chart 2 Outlook of EU energy consumption by fuel
from 2017 until 2040



Source: BP

Coal – The end of an Era

“Already in 2019 total coal generation is likely to fall below gas generation as coal to gas switching due to higher carbon prices puts a further dent into production, marking a historic first-time event that further shows the erosion of this segment.”

For almost 200 years coal has experienced continuous growth due to its affordability, easy access and transportation requirements. Therefore, especially industrializing economies prefer it as their main energy source leading it to a current 38% share of global electricity generation and 15% of power generation in Europe. Even though renewables are increasingly penetrating the market and coal consumption has already peaked in Europe, coal still dominates overall energy price trends. The major types of coal that set marginal prices are hard coal and lignite, which were also the main target of coal phase-out plans. Hard coal generation fell by 9% in 2018, balancing at a level 40% lower than in 2012. Germany and Spain were the key players triggering this transition as they put three quarters of Europe’s hard coal generation under phase-out. The lignite story is a little different with generation falling by 3% in 2018 led by Germany who accounts for half of total generation, showcasing a switch from this even dirtier kind of coal will be harder facing more political tangles. The rest of hard coal production is left within Poland, the other half of European lignite generation in the Czech Republic, Bulgaria, Greece and Romania.

This might be a surprise as rationally speaking these countries’ existing plants are outdated and prove a poor economic outlook combined with the wind and solar potential these countries are missing out on. According to Bloomberg, renewables will be eating up more and more of the existing market for coal. Bold forecasts see coal as the biggest loser and completely wiped off the European energy mix by 2050, pushed out by age and economics. New technologies enabled a spectacular reduction in cost not just for wind and solar technologies, but also for batteries, rightfully threatening coals’ position in Europe’s electricity generation mix overall. Already in 2019 total coal generation is likely to fall below gas generation as coal to gas switching due to higher carbon prices puts a further dent into production, marking a historic first-time event that further shows the erosion of this segment. We also predict a larger focus on the lignite phase-out soon as hard coal generation falls short of lignite, and faced with the challenge of dispatchable power (the ability to respond to grid requests to ramp electricity generation up or down at any time of day) there is no reason not to believe so.

“We predict further technological advancements to eventually completely substitute coal as a feedstock, and natural gas to replace coal as primary carbon management technique.”

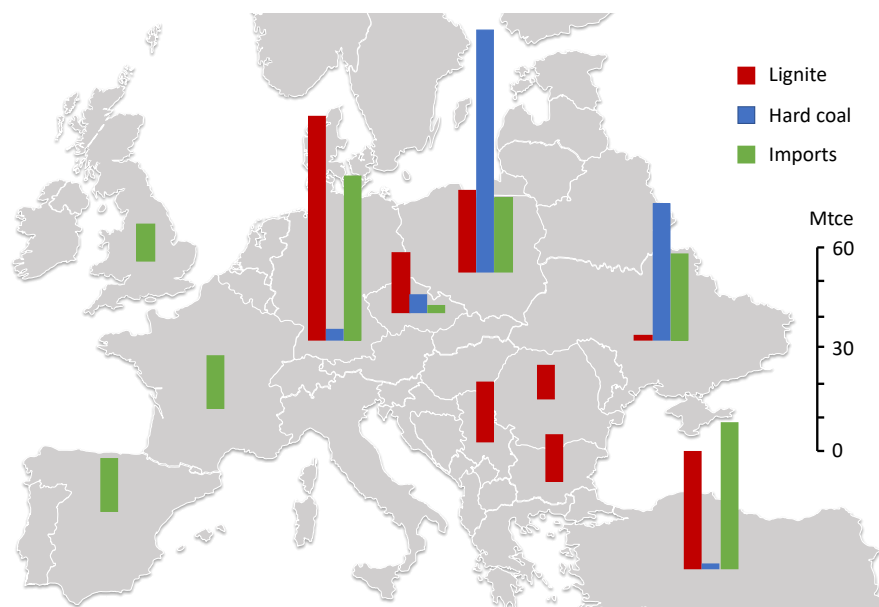
The execution of coal phase-outs will shift demand towards renewables, and in correlation with this sector major events are unfolding. Coal and renewables will swap their positions in the consumed power mix eventually. Already this year fuel and carbon costs alone were on par with wind and solar for the first time, leaving electricity prices originating from them at 45-60 €/MWh. This, in combination with photovoltaic and wind plants, are already cheaper than building new large-scale coal plants, which leave coal without much to answer. Another competitor to coal is natural gas, forecasted to be the fastest growing fossil fuel overtaking coal to become the second-largest source of energy after oil by 2030. Overall the EU is still heavily dependent on fossil fuel imports and subject to the impact of volatile global fossil fuel prices. A decline in coal imports and the coal contribution to the import bill is partly attributable to the growing penetration of renewable energy in the EU energy mix.

Dismantling the effects of coal further under the perspectives described above, its connections to other market participants show that it is a main resource of primary energy for manufacturing industries. It is used to produce steel, cement and aluminium. Remarkably these industries are focused on improving their energy efficiency and carbon intensity the most, decreasing their dependencies on price fluctuations in the coal market. There are still strong ties apparent, but the overall demand of coal for heat generation and as a feedstock is constantly diminished. Coal-derived fuels and energy carriers still play a significant role in the energy needs of the transport sector. Transport, Infrastructure and Construction together with the cement industry require coal as a predominant energy source and construction material. Paper manufacturers and the Chemical and Pharmaceutical industry are the other major users of coal by-products. We predict further technological advancements like Electrolysis in the steel industry, alternative fuel use for cement or usage of alternative cementitious materials to eventually completely substitute coal as a feedstock, and natural gas to replace coal as primary carbon management technique in the chemical industry. Even though the coal industry is fiercely lobbying to prolong their fate, stronger emission controls and further controls as well as the coal phase-outs of major EU countries have sealed their fate in Europe.

Coal grows to be less and less viable both as a source for electricity and as feedstock suffering from tighter air pollution limits, cessations of subsidies and overall higher carbon pricing. As society gets more and more aware of not only the health damages they are facing, but also as the availability of sustainable alternatives grows, the case of a Europe beyond coal is sealed. It is not a question of if, but when. We therefore predict companies such as RWE, EPH, Uniper and Steag, PGE, ENEA and ZE PAK to come under considerable pressure facing the given macroeconomic environment, making it a key strategy for them to either find a suitable substitution for their coal business or accept revenue losses to competitors. On the other hand, we predict the connected industries such as Steel, Chemical, Paper and Infrastructure to be able to use substitutes effectively enough to sustain their needs. Renewables, Biomass or even Nuclear could easily replace coal and therefore a clear competitive pressure on these industries cannot be deducted given the extent of this report. A step above, countries with regions dependent on coal mining and coal-based energy generation such as Czechia, Greece, Poland, Romania and Slovakia are to undergo structural changes in the following transition process to other sources. Transition means change, and as some move forward, these countries are the ones most likely losing in the predicted outcome. Overall, coal has passed its prime and innovation as well as economics finally determine its end in Europe.

“Overall, coal has passed its prime and innovation as well as economics finally determine its end in Europe.”

Chart 3 Hard Coal and Lignite: Production & Imports 2018 of selected Countries



Source: Euracoal

Natural Gas - the only surviving fossil fuel

“Additionally, an increase in carbon tax might change the merit order between coal and gas as coal plants emit almost twice as much CO₂ as gas plants.”

Starting with the 1990s, the natural gas' proportion in the European energy mix oscillated between 15-26%. After 2008, natural gas consumption only peaked once in 2010 before experiencing a steady decline until 2014. This can be attributed to three major factors. First, following the financial crises, European electricity demand stagnated, especially due to a decline in major consuming economies such as Germany, Spain, France, Italy and the UK. Even today the electricity consumption curve tends to stay flat as a result of decoupling consumption from economic growth. Second, the rapid development of RES led to increasing capacity which caused lower profitability for thermal plants through the merit-order effect. And lastly, the global plunge in coal prices switched the merit order between coal and gas in advantage to the former one. As an effect in some European countries the capacity factor for gas-fired plants dropped by 30 percentage points to 40%. In 2016 gas consumption rebounded, especially after international coal prices almost doubled in the same year and a more aggressive carbon pricing strategy, that aims to substantially increase tax on carbon emissions, was introduced by EU countries. As a result, in only two years until 2017 gas-generated electricity increased by 30%.

The outlook for the European gas industry is promising. Even though nuclear energy and fossil fuels, such as oil and coal are expected to lose market share, natural gas might grow and supply up to 30% of Europe's energy demand until 2025. One reason for the increase in share is that gas-fired plants offer the opportunity to fill capacity gaps in peak hours that cannot be supplied by RES. Additionally, an increase in carbon tax might change the merit order between coal and gas in favour of gas, as coal plants emit almost twice as much CO₂ than gas plants. In the long term, until 2040, natural gas is expected to lose market share to RES, however, maintaining above 25% in the European primary energy consumption and staying above the level in 2017 where the proportion in Europe stood at 23%. Whereas demand in gas increases, European gas production (especially in the North Sea) decreases. It is likely the US will make use of this circumstance and increase exports of LNG to Europe to battle Europe's dependency on Russian natural gas.

“Even in relative terms, natural gas to total fuels, 30 to almost 50% of the energy input in these industries derives from natural gas. Price changes in natural gas are reflected in the production costs in connected industries.”

It is worth knowing that worldwide LNG supply is growing and that the Asian demand is being met, hence, leaving excess LNG for the European market. Prices of natural gas are mainly influenced by demand and supply. On the supply side production volume, storage and the volume of imports and exports affect prices. The demand side is shaped by weather conditions. Cold winters require more heating, and hot summers lead to more cooling, especially in power plants. Another demand-side factor is availability and prices of other fuels (as already mentioned this affects the merit-order). The fossil fuel is an input factor in many industries. In fact, a third of the European natural gas supply is used in the industrial sector either as a resource to produce heat or as an ingredient to produce plastics, pharmaceuticals, chemicals and fabrics. Therefore, rising gas prices lead to higher production costs, thus driving up inflation. In the third quarter of 2018 4% of the Harmonized Index of Consumer Prices (HICP) increase is attributed to natural gas.

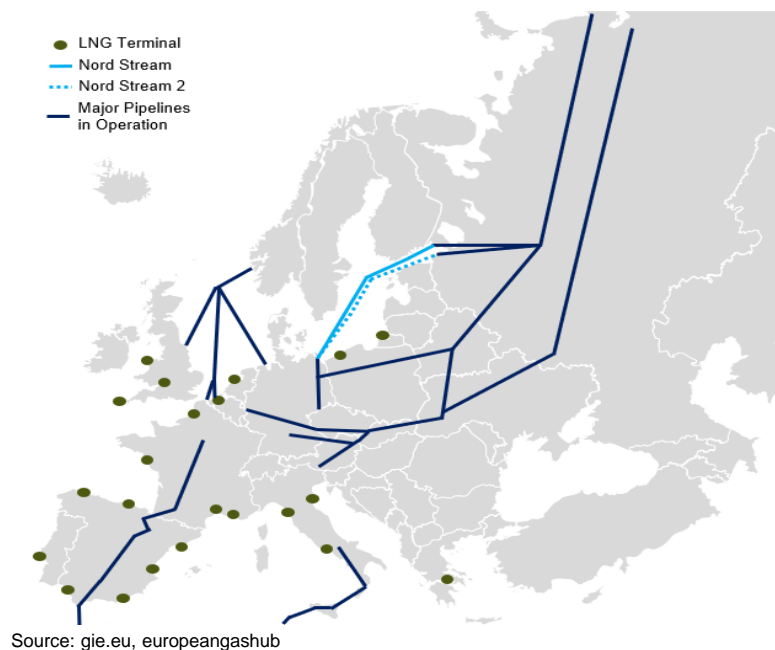
When looking at the total European gas consumption, figures show that one third of it is attributed to the industrial sector. Also, from all energy sources used by industrial consumers, natural gas' share makes up roughly 30%. This leads to the conclusion that natural gas is the most essential energy input factor for production after electricity. In absolute terms the non-ferrous metal, the iron & steel industry, the non-metallic minerals and the food & tobacco industry use most of the natural gas that is consumed by the industrial sector. Even in relative terms, natural gas to total fuels, from 30 to almost 50% of the energy input in these industries derives from natural gas. Price changes in natural gas are reflected in the production costs in these industries. Changes in iron & steel, but also of non-ferrous mineral prices affect the automotive and aerospace industry. Non-metallic minerals are used for glass and cement, hence a shift in production costs is crucial for the manufacturing and construction industry.

Until 2035 primary consumption of natural gas will increase at declining growth rates. Whilst its share in the electricity mix will partially shift towards RES, the fossil fuel will gain importance as primary energy resource in the industrial sector by making the use of coal less attractive. When gas prices rise, short-term demand for coal will increase. However, this contributes to higher carbon pricing, hence, making coal a less competitive fossil fuel once more.

Measures such as the “Market Stability Reserve” that tighten the amount of carbon emission allowances, drive up carbon prices and accelerate the transition from traditional fossil fuels to RES and to a higher proportion of natural gas. Furthermore, the increasing LNG imports from the US and the completion of Nord Stream 2 lead us to the conclusion that import gas prices will be more competitive.

Nord Stream 2 bypasses Ukraine and Poland saving transition costs for EU importers and after receiving a license in Denmark and solving a legal dispute with the EU over new regulations, the project will start operating between Q4/2019 and Q1/2020. Gazprom will be the sole supplier of natural gas using the Nord Stream 2 pipeline to meet the increasing gas demand, while at the same time European gas production is declining in the Dutch North Sea. The Russian supplier finances 50% of the project, the other half being funded by OMV, Shell, Engie, Wintershall and Uniper. We believe that these five Western-European lenders will benefit from their funding, aside from the interest, by getting stakes in future projects. The importance of natural gas in the primary energy consumption is steadily increasing. Political uncertainty remains whether Europe will obtain an increasing share of its gas from LNG imports or via pipelines from Russia. Regardless of the supplier country, natural gas is predicted to continue its hike, enlarging its share in total European energy consumption for at least a decade.

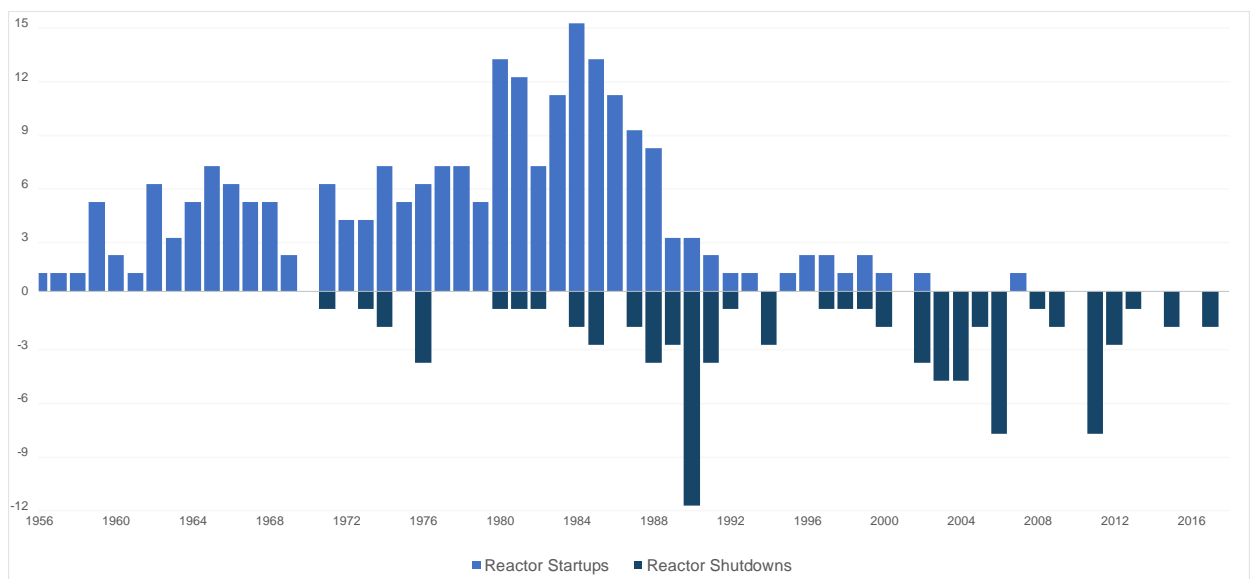
Chart 4 Major Gas Pipelines and LNG Terminals



Atomic- one step forward, two steps back

The European Commission confirmed that nuclear energy will be the backbone of 2050 carbon-free Europe. Yet, if nuclear power plant construction remains as planned today, only 1% of the current facility will be operable by then. Every country has been provided with the possibility to choose its own sustainable electricity mix. In the broad sense, nuclear's share is set to diminish either by planned phaseouts, as in Germany and Belgium or the nature of lifecycles as shown below:

Chart 5 Reactor Startups and Shutdowns 1956-2018



Source: The world nuclear industry status report 2018

The majority of the power plants were built in the last century. In our millennia, Europe seems intact by the nuclear renaissance, observed in Asia, with just 3 reactors started so far, and 4 more planned up to 2025. Moreover, there is an underlying trend of giving up on this source when incidents occur as seen in 1986 in Chernobyl and Italy's retreat, mirrored by 2011 Fukushima accident and Germany's and Belgium's response. Both countries have set to abandon atomic energy by gradually closing their operating nuclear power plants. So far the quantitative decrease has been offset by capacity increases in remaining reactors in Germany and imports, as seen during last year's forced shutdowns in Belgium. The consequent load-shedding plan of Belgium has shed light on the importance of atomic energy in meeting electricity demand in a low-carbon, inexpensive way.

“With an average age of plants of 33.4 years as of 2018, government and local support are needed to sustain these projects. The capital intensity boosted further by recent regulations, and underlying default risk repels public and private investors.”

Those were the reasons behind 70s and 80s expansion, set to meet rising electricity demand, coupled with post-war economic expansion. Moreover, the current largest European atomic producer, namely France, was prompted by the 70s oil crisis and rising need for supply security. In the current decade however, electric demand seems more dissociated from GDP growth dictated by increased efficiency and overall economic position of the continent. The envisioned change in electrification of transport and heat is set to turn the trend by 2030. This poses a challenge to the atomic sector, with an average age of plants of 33.4 years as of 2018. Government and local support are needed, both shy in recent times. The capital intensity of such projects boosted further by recent regulations, and underlying default risk repels public and private investors. If we consider the whole lifetime cycle, it has proved to be a less expensive source of energy due to its small susceptibility to Uranium prices. What drives costs up is the public incentivized construction prolongations. That can potentially be solved by recent technological developments. Waste remains troublesome.

With UK's scheduled departure, Europe is set to lose a strong promoter of atomic energy, with Finland, France, Eastern Europe, primarily the Visegrad Four and partially Sweden remaining as supporters. The nuclear sector is needed to meet CO2 targets as a stable source, if fossil fuels abandonment targets are met. It remains crucial in the present but proves unsupported in the future. Although nuclear energy is deemed to take a large part in the fight against climate change, the current stance of Europe does not portray unanimity. The phaseout plans and aging power plant base are in dissonance with a long-term upkeep of the sector. For the past years, the atomic share in the mix has been stable, with local shutdowns being compensated by reciprocal increases of output in the operating reactors and imports. The recent energy demand has been decoupled from growth, but that is projected to change in the upcoming decade. If fossil fuel usage were to diminish, the old continent would have to rely on a low-carbon production aside from renewables due to their inconsistent energy generation, especially solar, which in bad weather conditions turns into a consumer. The nuclear sector provides mainly electricity and a small part is dedicated to heat supply. Since the production itself consists primarily of heat generation, efforts are being made to utilize it optimally.

“The economics of atomic power generation will change as capital intensity decreases and construction schedule is squeezed, a commercialization is not excluded as an option.”

With technological progress, such as small modular reactors (SMRs), a double shift is pursued. First, the economics of atomic generation will change as capital intensity decreases and construction schedule is squeezed. Second, a commercialization is not excluded as an option. The presumable increase in safety due to passive cooling combined with the ability to switch from heat to electricity generation according to demand making it a very attractive alternative to the larger predecessors. In spite of the low correlation with uranium hikes due to the nature of fuel usage and waste recycling, older power plants might have a hard time competing with lower gas and renewable prices. Aside from district heating of residence and commercial buildings, the nuclear non-electric process has potential in the fuel synthesis and desalination of sea or wastewater. Along the replacement of CO₂ emitters in the energy intensive industrial applications, such as fuel extraction and refinery, nuclear power is used in the petrochemical, hydrogen and steel production. From the current standpoint, it seems that nuclear power has lost its attractiveness both to the private and to public sector.

By the end of 2019 Europe is set to witness a closure of the German reactor Philippsburg 2 and further delays to the startups of Olkiluoto 3 and Flamanville 3, in Finland and France respectively. Optimism for less capital intensity and compressed construction schedules have fallen short with an average 9.5 years delay and increase in initial budget estimates, spiking threefold in EDF's case. The French electricity supplier has seen a plummet in its shares and is seeking a way to make nuclear power generation more independent from the rest of its operations. The two balance sheet mechanism aim at creating a subsidiary rather than invest solely in renewables. This move can be seen as a summary of the short-term European green solution, given the drop of RES prices. Hopes for investment returns are further echoed in recent impetus for changes in ARENH. Long-term stability of the nuclear sector depends heavily on the states' willingness to decarbonize energy production and on severer penalties on fossil fuel usage. Besides labour concerns and lobbying, it is highly unlikely at the current technological levels that the European mix can constitute solely of RES. Grid replacement are expensive and dependence on weather conditions represent barriers. Green solutions have been traced in the face of SMRs which can fill in market shortages and fuel solar panels when needed.

An obstacle can be seen in initial R&D costs which tend to overshadow the end product benefits, combined with an opposition to fund spending in favour of renewables. If the net zero emissions target by 2050 is to be met, we can expect a future renaissance in atomic trust and investments into alternative, commercial reactors. Europe stands at a threshold and long-term outcomes depend on decisions within sight. To prevent age-instigated reductions in the market mix share, Europe should do more than just increase the capacity of remaining reactors. By 2030 the majority of plants will operate beyond their design life. Future scenarios depend on the Euratom Research and Training Program (2021-2025) and similar scientific efforts. Why the nuclear power is losing support in the face of renewables will be discussed below.

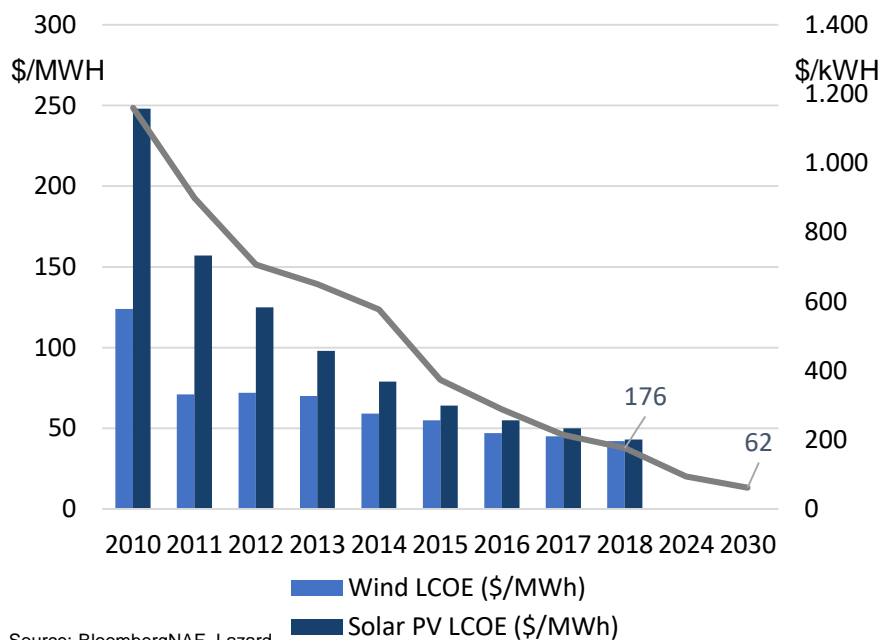
Renewables - the green future is coming

“In 2018, the share of RESs amounted to 32% with currently only 12% coming from wind and 4% from solar energy. Renewable energy generation has increased by more than two thirds from 2007 to 2017, equivalent to an average growth of 5.1% per year.”

Concerning the present status of renewable energy sources (RESs) one clearly has to highlight their importance for the long-term decarbonisation of the EU energy system. Not only the EU has made it to one of its strategic targets to promote renewables as energy source, but also more and more national governments have established their own ambitious goals by hugely subsidizing this energy class and by withdrawing from fossil-based sources. In 2018, the share of RESs amounted to 32 % with currently only 12% coming from wind and 4% from solar energy. On the one hand, renewable energy generation has increased by more than two thirds from 2007 to 2017, equivalent to an average growth of 5.1% per year. The most important contributor are wood and other solid biofuels, followed by wind and hydro power. In 2017 wind power became for the first time the most important renewable source of electricity outpacing hydro power, since its electricity production has remained at a relatively unchanged level over the last decade. On the other hand, also the consumption of RESs has more than doubled, amounting only 8.5% in 2004 and 17.5% in 2017. Definitely, the dramatically falling costs of wind and solar power production triggered by the accelerated technological progress are, next to climate change awareness, the main drivers for these developments allowing the sector to compete head-to-head against conventional energy sources. Additionally, this growth trend was strongly consumer driven, which is shown by the steep demand curve for renewable electricity documented with Guarantees of Origin.

Forecasts of RESs doubling by 2030 and rising more than 80 % by 2050 in the European energy mix are commonly predicted and are said to be primarily achieved through cheap solar (photovoltaic) and wind energy. Besides the long-term government support, the positive development will be firstly, substantially influenced by technology and secondly, driven by the growing role of consumers i.e. households, organizations as well as the corporate sector, who will purposefully demand and invest in sustainable policies and services shaping the future energy sector.

Chart 6 Electricity prices in wind and solar drop combined with battery prices



Source: BloombergNAF, Lazard

Particular tipping points will be the predicted, drastic share growth of electric vehicles (EV) in the automobile industry, which will provoke a shift from oil to increased electricity demand. Exactly this growing demand for EV as well as further steep learning curves will then cause a continuing plunge of battery prices. The arrival of cheap battery storage will mean that it becomes possible to optimize the delivery of electricity from wind and solar, so that these technologies can meet demand even when the wind is not blowing, or the sun is not shining. These projected developments are making renewable energy the most important source of future energy leading to an end of the coal era. Additionally, oil demand is said to be shrinking considering the increased electrification as well as gas, which will be particularly under pressure given the increasingly competitive renewable energy prices.

Within RESs, we believe that wind energy will be the main future energy source taking up the biggest share, followed by solar which will be growing extensively as well. Hydro power growth is limited due to the lack of more suitable sites as most of them are already occupied and biomass burn cannot be considered as “clean” since it causes CO₂ emissions.

“The primary growth potential for RES lies in an increase in the use of bioenergy, as it provides process heat at all temperatures, whereas electricity-based technologies can only be used for low-medium temperature heat.”

Under the given favourable political and socio-economic circumstances regarding RESs, we now want to take a closer look at the end-use sectors, where they actually play a key role. Buildings accounted for nearly 40% of all energy demand, among merely 22% were covered by RES in 2015 due to the existence of old buildings combined with a very slow building stock turnover. However, we see a significant growth potential for the deployment of water heaters, electrification of heat pumps and direct use of biomass. The conversion of fossil-fueled district heating systems into renewable ones is another possibility to accelerate the RES deployment in this sector. Furthermore, what makes the RESs so appealing, is that a bulk of heating and cooling options are nowadays cheaper than the conventional alternative as well as a lot more efficient. The industrial sector represents roughly one-third of the EU’s total energy consumption (including non-energy use of fuels as feedstock representing about a quarter of its total) and about two-thirds of energy use is for heating purposes. Therefore, currently, the primary growth potential for RES comes from an increase in the use of bioenergy, as it provides process heat at all temperatures, whereas electricity-based technologies, such as heat pumps, can only be used for low-medium temperature heat as well as deployment would cause the need of modification in production processes. For sectors that require high-temperature process heat levels and that dominate industrial energy use (e.g., iron and steel, chemicals) electricity-based technologies are still at the R&D stage, although, in recent years, corporates have shown increasing interest in sourcing renewable electricity. Transport is currently the sector with the lowest penetration of renewable energy but shows significant potential for an increase due to the very promising long-term development of electric mobility as aforementioned. The level of adoption of EV is still in the early stages, but figures show an exponential growth so far. Several countries, as well as the EU, have announced to implement or have already implemented supportive policies.

“Europe will maintain a global leading role in renewables rooted in a growing domestic market. European and national policies will further drive the green transition of the energy sector.”

Several manufacturers are already planning on including EV in their product lines as well as multinational companies are increasingly committing to shift towards this trend. However, today, the main source of renewables in the transport sector is coming from biodiesel, which raised concerns in the EU due to their effects on greenhouse gas emissions over their life cycle. Biofuels also become under pressure by low crude oil prices.

Europe will maintain a global leading role in renewables rooted in a growing domestic market. European and national policies will further drive the green transition of the energy sector. We strongly believe that these policy incentives will continue fueling not only supply but also end-consumer demand for RES and empowering ongoing technological progress in this sector. For solving the problem of the intrinsic nature of variable renewable energy, the policymakers are enforcing further integration of the European power market for facilitating the cross-border trade of electricity. Cheap energy storage solutions play additionally an important role in providing the required flexibility to the system by absorbing excess power production and releasing it back to the grid at times of higher demand, so key renewable technologies such as solar PV and offshore wind can be harvested cost-effectively. The transition of the energy sector is coming along with substantial electrification of firstly in the buildings and secondly in the road transport sector.

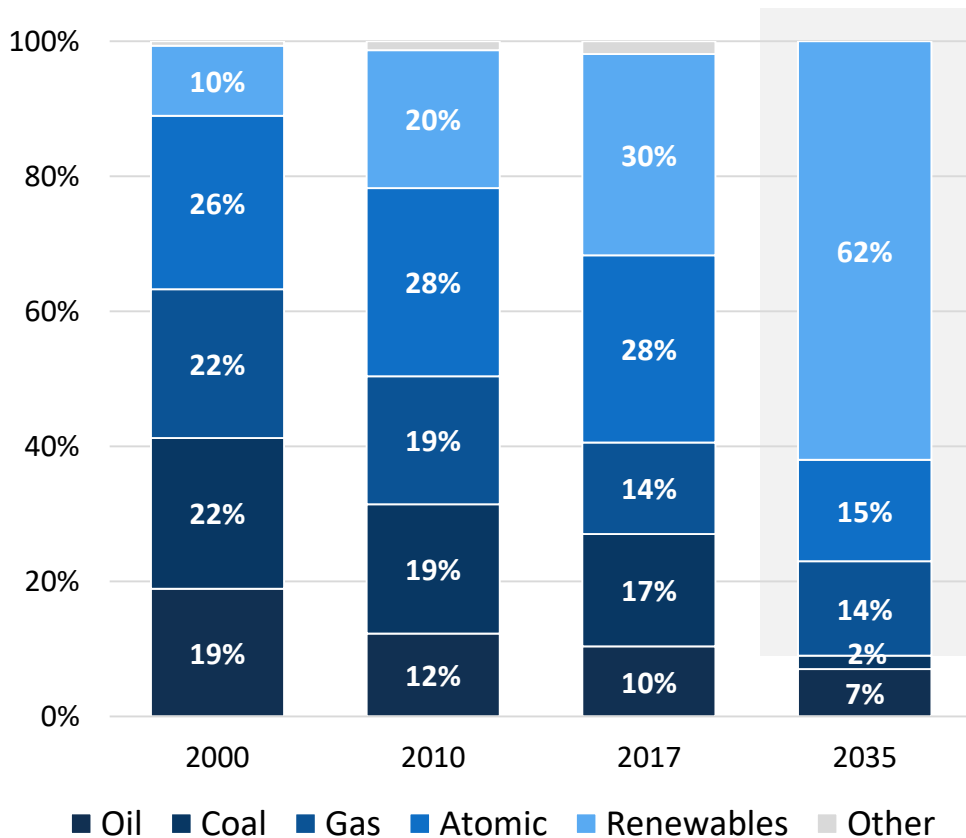
On the one hand, the continuing urbanization and expansion of urban areas are triggering a replacement of the usage of natural gas and coal by renewables for district heating and cooling. Additionally, people opt for newly constructed buildings being designed in accordance with renewable energy technology requirements. On the other hand, despite the complete replacement of the existing fossil-fueled vehicle stock will take a couple of decades. Several manufacturers have already announced plans to extensively change their portfolios towards these vehicles. Examples comprise Volvo Cars, Volkswagen and BMW. Moreover, the number of public charging infrastructure, which is necessary for the successful penetration of EV, is growing rapidly in the Netherlands, Germany, France, and the UK. Accordingly, we expect Germany, France and the UK to lead the transition as the biggest new car markets. EU investments in infrastructure are supporting the shift to electromobility.

The regulatory long-term renewable targets provide a strong and reliable signal to investors who are interested in extending their portfolio by means of making investments in the energy sector. Additionally, we predict that the shift towards RES will inevitably disrupt the whole buildings and transport sector revealing a fortune of possible lucrative investment opportunities.

Conclusion

Concluding our energy sector analysis, we want to summarize our findings and use it to give a concrete outlook for the energy market mix in 2035. After recapping what happened in the past and explaining the current mechanisms as well as analysing the relevant drivers and influencers behind each respective sector, we undoubtedly see a tremendous shift towards a greener future. This structural shift will cause a slowdown in oil demand resulting in a significantly lower market share. We predict that by 2035 the end of the coal era will have arrived, whereas the gas share will grow steadily, as we foresee supply guaranteed either by Russia or LNG imports. For us, the current reluctance towards building up new nuclear plants indicates an ongoing withdrawing from atomic energy and thus, making it practically non-relevant vis-à-vis other competitors. The future market winner, therefore, is unambiguously coming from RES i.e. primarily solar and wind energy leading to a doubling of RES's market share.

Chart 7 **Energy Mix Forecast (Production)**



Source: Bloomberg & Own estimations

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