



The changing energy mix in Germany

The drivers are the Energiewende and international trends

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Due to numerous political incentives, especially relating to the Renewable Energy Sources Act (EEG), the renewables share has increased sixfold since 1997, with regard to both primary energy consumption (from 2% in 1997 to roughly 12% in 2013) and electricity generation (from a good 4% to 24%). Germany's first energy policy rethink (or Energiewende 1.0) not only sent costs ballooning but also impacted on electricity prices, the generation mix and emissions trading. And despite the EEG the contribution of wind/solar to primary energy consumption (PEC) was a mere 2%-plus in 2013.

The German government is attempting to halt or rein in the skyrocketing of costs using a two-pronged strategy. Firstly, incentives are being focused more heavily on photovoltaics and wind, as they are presumed to be particularly promising areas for progress. Secondly, exemptions from the EEG levy will be restricted in future. Overall, the "green electricity share" is to reach roughly 60% by 2035. But, how will the remaining 40% of "non-green" electricity be generated – given the government's second energy policy rethink (or Energiewende 2.0)? The Energiewende 1.0 showed that the objective of a larger gas share was not achieved; in fact the coal share rose from nearly 43% in 2009 to more than 45% in 2013. CO₂ emissions increased in Germany in 2012 and 2013.

Under coal-friendly conditions (scenario 1) its share drops by "just" 12 points to 33% by 2035. If, however, the environmental and political conditions shift to become more "pro-gas" (scenario 2), the coal share would shrink by no fewer than 17 points to 28%, i.e. by more than one-third. Scenario 2 in particular would also feed through to the PEC, as it would generate fresh impetus for gas in the heating market and for mobility. Rising emissions costs thus benefit gas, which is more environmentally friendly than petrol (assuming that the transport sector were to become included in emissions trading in future). If the targeted Energiewende 2.0 on balance endows the rising volumes of green electricity with the greater economic rationality that is now particularly necessary, it could become a model/blueprint for other countries, too.

Our baseline scenarios assume that over the course of the forecast period until 2035 the ruling parties in particular stick to their targets for boosting the renewables share. The main risks to our scenarios are, firstly, a continued sharp rise in EEG costs and thus also in the levy. And secondly, an excessive delay in the planned construction of power lines, which would result in localised black-outs. Thirdly, it is also conceivable that the declining utilisation of fossil-fuel power plants in the case of public-sector owners might prompt them or their respective political party to overturn their policy. Private-sector and municipal utilities would call more loudly for the introduction of a capacity market in order to operate fossil-fuel plants more profitably. Fourthly, state intervention could become necessary to safeguard or expand capacity ("public power plants" is the buzzword).

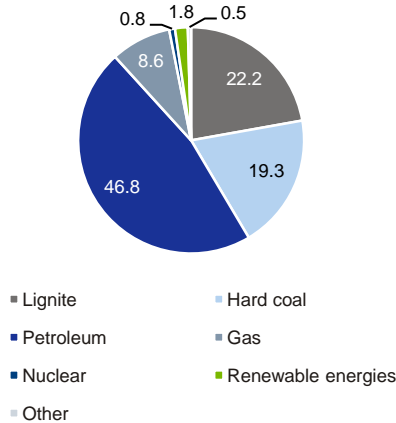


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97% of energy consumption came from fossil fuels in 1973

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Share of primary energy consumption, %, 1973



Source: AG Energiebilanzen

Energy mix already an issue since the 1970s

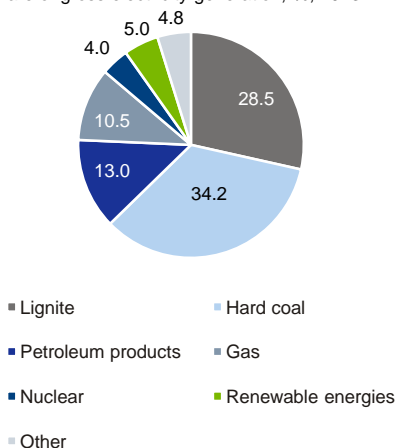
The one constant concerning the German energy mix is change. A look backwards reveals how dynamic this change has been. While primary energy consumption has remained almost constant over the last 40 years, huge adjustments have, however, occurred in the shares of the respective segments. An interesting and enlightening angle is provided by dividing the timeframe into two periods, firstly a phase starting from 1973 and, secondly, the period commencing around 1997.

The year 1973 was preceded by the lengthy postwar period. A key feature of this period was the reconstruction of economic structures, which was a considerably more dynamic process in West Germany than in East Germany. The unequal economic rehabilitation was an important reason why population numbers in West Germany rose by some 11 million between 1950 and 1970 alone while they fell by more than 1 million in East Germany. Until then, demographic and economic growth in Germany had typical energy implications, not least an increased demand for energy.

86% of electricity in DE* came from fossil fuels in 1973

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Share of gross electricity generation, %, 1973



* old federal states

Source: AG Energiebilanzen

First oil price shock and Club of Rome forecast were unsettling ...

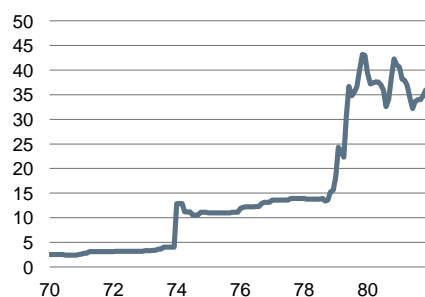
1973 can be regarded as a watershed because the first oil price crisis began in the autumn of that year and highlighted the reliance on energy imports of many developed economies and especially also West Germany (as it was still called then). At the time many people saw the new feeling of dependency fuse with the threat of a global energy shortage that arose as a consequence of the Club of Rome report "The Limits to Growth" in 1972 and refused to subside.

Petroleum, the new global "problem fuel", was namely the undisputed number one in the German primary energy mix in 1973; it accounted for no less than 47% of primary energy consumption (PEC). Together with lignite and (the ever more heavily subsidised domestic) hard coal this meant that oil and coal covered 88% of Germany's primary energy consumption. If we add gas, which became increasingly attractive during the preceding decade (initially) thanks to the tapping of domestic deposits, an intelligent pricing policy (namely oil price indexing) as well as multifaceted infrastructure measures, then fossil fuels dominated PEC in 1973 with a share of 97%. By comparison, the contributions made by the then "young" hopefuls, nuclear energy and renewables, were still quite small, amounting to no more than 1% and 2% respectively. While, however, nuclear was a component in the desired energy mix of the mainstream political parties, renewables were still receiving little support – apart from hydro, which at that time contributed the lion's share of green energies.

Two oil price shocks showed global dependency on oil

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Price per barrel (Brent, Dubai, WTI) in Germany, USD, 1970-81



Source: Hamburgisches Weltwirtschaftsinstitut

... and led to adjustments that were also necessitated by reunification

In the period up until the beginning of phase two, i.e. the second half of the 1990s, there were numerous factors influencing the German energy mix. Important drivers came from outside and inside Germany:

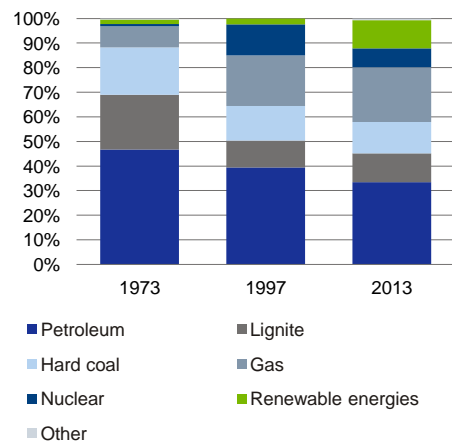
- The most important global factor was probably the second oil crisis in 1979/80 that was linked with the Islamic revolution in Iran. While the nominal price per barrel rose from USD 3 to USD 12 during the first crisis in 1973/74, it had already increased to USD 38 in the course of the second crisis. The many policies already initiated after the first price shock received additional support and were continued. These included further diversification of the energy mix and strategies to boost energy efficiency.



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PEC mix shifting 4

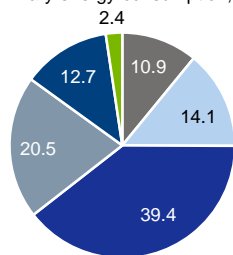
Share of primary energy consumption, %



Source: AG Energiebilanzen

Gas & nuclear grew their share of primary energy consumption until 1997 5

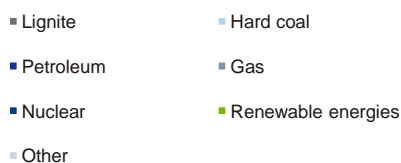
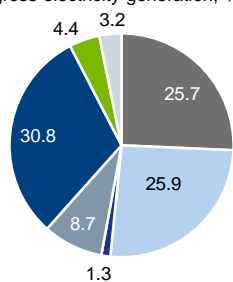
Share of primary energy consumption, %, 1997



Source: AG Energiebilanzen

Nuclear power generated nearly 31% of gross electricity in 1997 6

Share of gross electricity generation, %, 1997



Source: AG Energiebilanzen

— At the national level German reunification fed through to the supply of energy and its consumption. This resulted in adjustments to the German energy mix, because parts of east German industry – like the automotive industry there – would not have managed to survive the transformation process without massive restructuring. Moreover, there were considerable adjustments in east Germany’s power plant and energy consumption structures in the residential sector (e.g. home heating and insulation) and mobility right through to information and communication.

On balance, in the period following the first oil crisis many previously unexpected developments started to take shape. For instance, PEC increased far less than feared by market observers back in the early 1970s. Linked with this was the phenomenon that energy prices (e.g. of oil) actually developed considerably more modestly than the sometimes dire long-term forecasts that were doing the rounds in the early 1970s. These pleasing developments for consumers were the product of many factors such as social and economic structural change (not least in east Germany), technological progress that brought increasing energy savings, and not only tax incentives, but also statutory requirements as well as the – initially often underestimated – growing energy-saving and environmental consciousness of increasingly larger population groups.

Until 1997 virtually no quantitative change in PEC, but energy mix shifting

All this also fed through to the primary energy mix. If we compare energy consumption in 1997 with that in 1973, at least two significant developments can be discerned: firstly, primary energy consumption in Germany was scarcely higher in 1997 than in 1973. Saving energy in connection with the convergence of east and west Germany was indeed a factor, but the consumption trend overall shows that despite economic growth it was possible to make big savings.

Secondly, considerable adjustments in the actual energy mix can be seen. The policy of “giving up oil” produced initial successes. After all, oil only contributed 39% to primary energy consumption in 1997, which is anyhow 8 percentage points lower than in 1973. Gas and nuclear, by contrast, increased their shares. Gas benefited from its growing popularity in the heating market. For homeowners the new gas heating systems were often more convenient than oil-fired systems, not least because the standards with which oil tanks had to comply became more and more demanding. And a particular gas price risk – as already mentioned – was prevented via oil price indexing. On top of this, gas became increasingly popular also in the secondary energy mix, i.e. for power generation. Factors that contributed to this were the combination of relatively modest investment costs and comparatively high power generation flexibility of gas plants. All in all, gas managed to more than double its share of primary energy consumption from 9% in 1973 to 21% in 1997.

The second big winner in the primary energy mix was nuclear, which in 1973 only accounted for 1% of energy consumption, but by 1997 had grown to an impressive 13%. Since nuclear energy is only used to generate electricity this makes the rapid increase all the more impressive. This increase offset some of the decline in use of the two types of coal. For many years expensive domestic sources of power generation continued to be used, which led to less power being generated from hard coal. The decrease in power generated from lignite in east and west Germany was connected with the reunification-driven structural adjustments.

Besides gas, nuclear and the two types of coal another important development was the expansion of “green” power generation; this, however, certainly also influenced the primary energy mix. In absolute terms and relative to the other

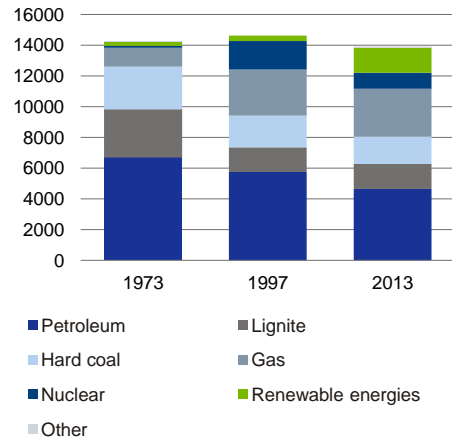


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The shift in German PEC

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Composition of primary energy consumption, petajoules

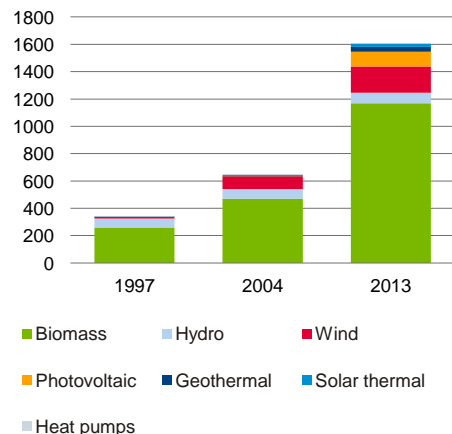


Source: AG Energiebilanzen

Biomass the leader: Wind/solar expanding faster of late

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Renewable contributions to PEC, petajoules

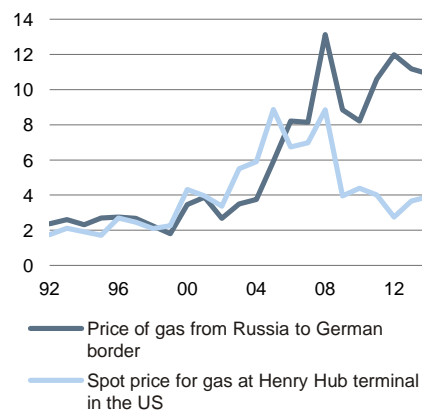


Source: AG Energiebilanzen

Gas much cheaper in the US than in Germany

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USD per million metric BTU, 1992-2014



Source: IMF

energy sources the growth in renewables was not spectacular; their share of the primary energy mix only came to a good 2%. The initial incentive programmes played a part in this, for example the support for photovoltaics in 1990/91.

End of the 1990s major new policy decisions ...

There are several reasons to regard 1997 as a watershed: Germany had implemented its first important, reunification-driven adjustments in the energy sector, for instance. In the European energy markets the desired liberalisation of grid-based energies (internal market directive came into effect for electricity in 1997 and for gas in 1998) promised a “new energy order” thanks to more international competition in electricity and gas.

From a more global perspective the then development in the price of oil, which remains the most important source of energy, was of no little significance. The phase began during a period when the oil price corrected “downwards” and for a few days – during the Asian crisis at the end of 1998 – even dropped to a low of USD 10 per barrel. This in turn also had a dampening effect on import prices for gas – because of the indexing of the gas price to the oil price – and thus boosted its competitiveness, for power generation for example. In addition to all these international events and competition-related decisions there is one particularly important reason for the cutoff date for the period from a German point of view. The German elections in 1998 resulted in the first SPD/Greens coalition in Germany. And this coalition soon agreed to a new energy policy with major shifts in emphasis for all those involved.

The new government’s agenda at the end of the 1990s contained two fundamental decisions that were meant to reform the electricity sector above all: firstly the gradual phasing-out of nuclear power generation in Germany, i.e. the swansong of an energy source that just a few years previously had been regarded as promising by the majority of people. And secondly, the rapid construction of new power generation and usage structures based on renewable energies.

... are impacting on the energy mix to this day

In the following period until 2013 there was a wide range of interventions in energy policy in Germany. Despite many changes of government during this long phase – i.e. starting with CDU/CSU/SPD and then later CDU/CSU/FDP – the previously mentioned important fundamental political decisions remained relatively stable. One notable exception was the early phase of the CDU/CSU/FDP coalition, in which there were indications that there would be a significant extension of the operating lives of nuclear power plants which had been reduced by the SPD/Green coalition. However, this change of course was quickly revised as a consequence of the problems in Japan in 2011 – in one word: Fukushima. Essentially, this meant that firstly German energy policy returned – apart from certain details – to the exit path upon which it had previously embarked. Secondly, the subsidies for new renewable energy installations were reduced by less than previously indicated, which extended their boom period.

The changes in the German energy mix are a reflection of other trends in addition to those mentioned above. For instance, the start of emissions rights trading in Europe put a price on the climate effects of the different energy sources. This trading acted as a brake on investment decisions in favour of coal-fired power stations – at least initially (i.e. from 2005). Besides these regulatory tweaks there were also completely new, hitherto barely conceivable technological trends and leaps. Above all, the US breakthrough of gaining

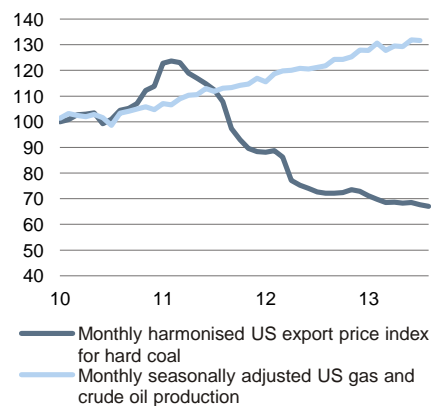


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Rising gas production in the US stoking the decline in US hard coal prices

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July 2010=100



Sources: Bureau of Labor Statistics, Federal Reserve Bank

access to cheap, unconventional (shale) gas also impinged on Europe and even Germany with its particularly idiosyncratic energy policy. The latter occurred indirectly, since the US market saw cheap unconventional gas displace hard coal, which in turn found its way to Germany by ship “at a cut price” – and thus influenced (and continues to influence) Germany’s energy mix. In a short space of time the US became one of Germany’s most important suppliers of coal.

Policymakers started Energiewende 2.0 in 2013/14

Despite an expanding economy since 1997 the level of PEC had fallen by nearly 5% by 2013. In the period under observation the energy mix underwent novel changes that were quantitatively and qualitatively tangible: for instance, the fossil fuel share of German PEC is now “just” 80%, 5 percentage points lower than in 1997.

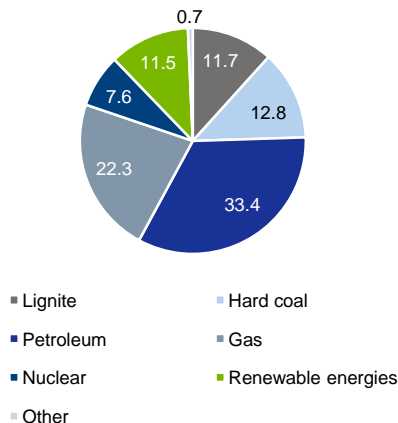
It seems surprising that the growing subsidisation of “green” energies did not occur to the detriment of conventional and electricity-compatible fuels, i.e. coal and gas. The combined share of hard coal and lignite in 2013 (i.e. 24.5%) was a mere 0.5 of a percentage point below the 1997 level. Despite the growing concern about power generation during the last few years the gas contribution to PEC in 2013 was 22.3% and thus 2 percentage points higher than in 1997. The main reason for the decline in the PEC share of fossil fuels lay squarely with oil; its declining importance in the heating segment and the multifarious efforts to boost efficiency in the mobility sector enabled the PEC share to be reduced by 6 percentage points. The second big “loser” in the energy mix was – triggered mainly by domestic policy as a consequence of the Japan crisis three years ago – nuclear power, whose PEC share dropped by around 5 percentage points compared with 1997 to 7.6%. Renewables managed the biggest “leap forward” – thanks to a variety of political interventions – from a good 2% in 1997 to nearly 12%; the solar/wind share comes to 2.3 percentage points.

To date, the biggest driver of the increased importance of renewables in the primary energy mix has been the EEG legislation, despite its having been amended on numerous occasions. Whereas in 1997 renewables had a share of merely 4%-plus of Germany’s gross electricity generation – with the hydro contribution nearly five times larger than that of wind and biomass combined – by 2013 this figure had already risen to about 24%. While the hydro share, however, has remained largely flat, it is now outshone considerably by wind, biomass and photovoltaics, as these combined amounted to an impressive 20% or so in 2013. Another “winner” in the power generation mix over the period as a whole was gas, which grew from almost 9% in 1997 to nearly 11% in 2013. However, prior to 2013 the gas contribution still came to 3 percentage points more and was thus considerably higher. During the period not only nuclear but also hard coal suffered a decline in share; by no less than one-fifth to just 20%. The lignite share, by contrast, was roughly the same in 2013 as at the beginning of the period. This was by no means foreseeable when emissions rights trading began.

Renewable energies with 12% share of energy consumption in DE at last count

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Share of primary energy consumption, %, 2013

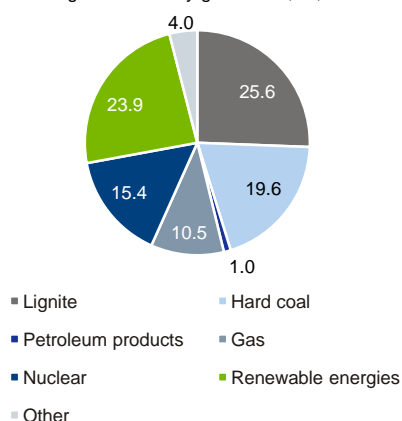


Source: AG Energiebilanzen

Renewables contributed nearly 24% to gross electricity generated in 2013

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Share of gross electricity generation, %, 2013



Source: AG Energiebilanzen

One main reason for the Energiewende 2.0 is the rising costs

The energy policy pursued to date has resulted in a sharp rise in costs. The subsidies for renewables in 2014 alone total some EUR 24 billion. The EEG levy for 2014 therefore increased to 6.24 cents/kWh from 5.28 cents/kWh in 2013 and nevertheless “only” 3.27 cents/kWh in 2012. The answer from the CDU/CSU/SPD is a two-pronged strategy to rein in the ballooning costs. Firstly, the EEG subsidy will in future be focused primarily on renewables with the greatest expected potential to make progress, that is mainly wind and photovoltaic. Secondly, the exemptions relating to the EEG levy will be applied



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EEG 2.0 targets

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The recently passed legislation to reform the EEG, also referred to as “EEG 2.0”, is intended to rein in the rising costs of the Energiewende.

In order to achieve the predefined target for renewable energies to account for 80% of gross electricity consumption in 2050 the following interim targets were set:

- Renewables to have a 40-45% share of gross electricity consumption by 2025 and
- a 55-60% share by 2035.

The structure of the EEG to date has made the costs of the Energiewende too high. That is why the EEG 2.0 funding focuses on expanding the most inexpensive technologies in the following expansion corridors:

New offshore wind capacity of 6.5 GW is to be installed by 2020, and 15 GW by 2030.

- Onshore wind capacity is to be increased by 2.5 GW (net) per year
- Photovoltaic capacity is to be expanded by 2.5 GW (gross) per year
- Biomass is to be increased by around 100 MW per year
- Geothermal and hydro do not require measures to manage capacity.

Source: Gesetzentwurf des novellierten EEG, Bundesregierung

more strictly in future and thus result in fewer companies being exempted from the levy. Both measures appear to be appropriate, but will “merely” dampen the EEG-driven price increase, and will by no means compensate for the price advantage enjoyed by other advanced economies such as the US.

Energy mix of the future (2035) dependent on many factors

The CDU/SPD government has already set important targets for Germany’s future energy mix and its composition. The coalition parties have agreed new targets for the green electricity share of 40-45% by 2025 and 55-60% by 2035. We consider both targets to be attainable as they are supported by Germany’s two nominally largest parties. Nevertheless, we believe that this will trigger further cost increases for which convincing arguments must be made to the general public and the business community, especially as Germany’s policies are far more ambitious than those of many other countries. In future coalitions the biggest party is always likely to be dominant, which promises that targets will be basically stable. If by 2035 “Alliance 90/The Greens” are also in government, a figure of 60% should be achievable and thus accepted.

Given the target renewables share of the future energy mix that has been set by policymakers the following question presents itself: what will the rest of Germany’s power supply and primary energy consumption look like by 2035 – especially against the backdrop of the Energiewende 2.0 and the foreseeable global development of energy markets? For example, with regard to electricity: which energy sources will deliver the remaining 40% of “non-green” electricity in 2035?

Ultimately there are two likely scenarios for closing the renewables gap to 100%. Firstly, since nuclear power will already have been phased out for more than a decade in 2035 the analysis initially focuses on the competition between the remaining fossil fuels. Secondly, the scope of the analysis will be reduced further since oil has no future in Germany as a source of electricity as things currently stand. So the core issue is the competition between coal and gas at present and in future. And in this respect it appears worth considering at least two scenarios, whose features and outcomes depend on the respective expectations for the future.

Future energy demand is determined by numerous factors; not least by the presumed population development, economic growth and the prices of individual energy sources and of CO₂ allowances which are an important cost element. All this in turn influences efforts to boost efficiency and reduce consumption as well as – very generally – technological progress pertaining to energy generation and consumption. While forecasts concerning population and economic growth appear relatively reliable, there is a wide range of opinions about future energy and emission allowance prices; that is why we have come up with different scenarios.

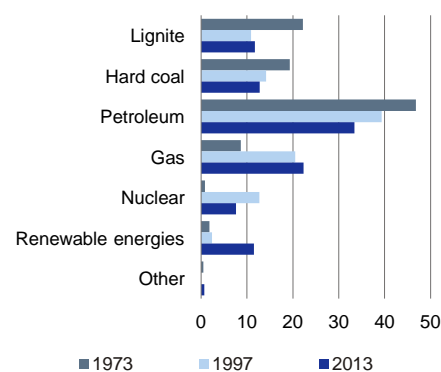
Germany’s population will drop to around 75 million or 77 million by 2035 from its current level of about 80.5 million, depending on whether one assumes net immigration of 100,000 or 200,000 persons p.a. Despite positive net immigration this corresponds to declines of no less than 5.5 million or 3.5 million persons, or decreases of 7% and 4% respectively. This will reduce demand for energy.

The prospect that economic growth, i.e. the increase in gross domestic product (GDP), is likely to be 1% p.a. at best until 2035 – partly on account of the demographically-induced shrinkage in the potential workforce – also tends to suggest that the demand for energy will trend downward. This is supported by energy-saving technological progress, population ageing and the shift in employment towards the service sector.

Renewables gaining importance

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Share of primary energy consumption, %, 2013



Source: AG Energiebilanzen

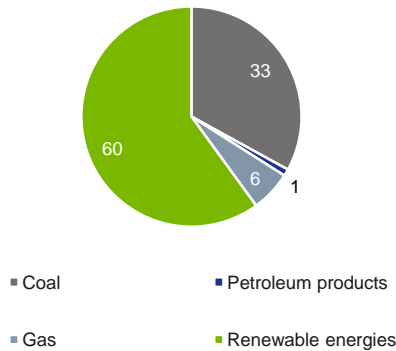


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Scenario 1: Coal remains an important element in electricity generation into 2035

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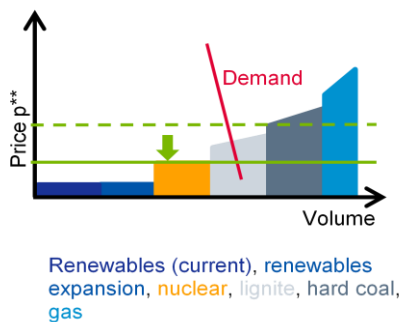
Share of gross electricity generation, %, 2035



Source: Deutsche Bank Research

Current renewables expansion leads to Merit-order effect on the electricity market

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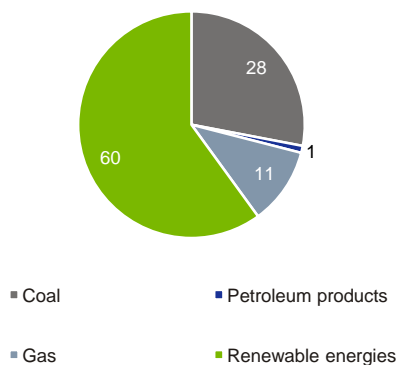


p** = Wholesale price in the future
Source: Deutsche Bank Research

Scenario 2: Gas manages to cement its position in electricity generation into 2035

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Share of gross electricity generation, %, 2035



Source: Deutsche Bank Research

Scenario 1: Coal remains important for generating electricity

In Germany coal is currently used mainly to generate electricity and partly also for heating purposes. There are, however, major differences between hard coal and lignite: domestic lignite is virtually unexportable because of its low energy value. The use of this relatively high-emission, but price-competitive fuel has been part of Germany's industrial fabric for decades. In contrast to lignite, there is a functioning world market for hard coal.

With the agreed end to domestic hard coal mining in 2018 and the advent of emissions trading there were many predictions of a rapid end to the use of hard coal (and also of lignite). The conflation of several trends prevented this, however: firstly, emissions prices softened appreciably following the introductory phase – for example due to the EEG – which enhanced coal's price competitiveness. Secondly, there was also the global economic correction in 2008/09, which in turn depressed energy demand and – given bounteous global coal capacities – led to price concessions for hard coal. Thirdly, the shale gas boom in the US resulted in the substitution of domestic coal power; the resulting surplus US coal flooded onto the world market and generated rising sales – thanks to competitive pricing.

Coal use in Germany until 2035 has, under certain assumptions, a rosier future than has been forecast for a long time. And this certainly has nothing to do with the end of domestic hard coal mining by 2018, i.e. no more coal will be produced from 2019. One argument that would suggest an only modestly declining coal contribution, which currently appears very plausible, is that – firstly – the prices remain low on the global hard coal market. Secondly, there is the premise of an only relatively modest recovery in emissions prices – also after 2020. This is indicated to no small extent by EU policy, which is also shaped by comparatively coal-intensive countries; these may in future also – as could already be observed in recent years – take action to combat what they regard as all too heavy burdens resulting from excessively rapid and sharply restricted emissions trading. Along with hard coal, German lignite has also been a net beneficiary. Thirdly, we see no trend reversal in the US, the new coal exporter that has been flourishing rapidly of late. The reason for this is that we also do not expect an all too swift end to the current gas boom in North America by any means. Moreover, fourthly, the special pricing method for gas reduces its competitiveness in Germany. Despite many efforts to the contrary, the import prices of eastern pipeline gas and the oil price are still quite close.

Scenario 2: Gas cements its position in electricity generation

In the gas scenario there are several drivers for the fuel in future. Since we expect the renewables targets in Germany to be attained by 2035, the momentum will have to be generated elsewhere. It therefore appears that, firstly, a more rapid increase in coal prices is possible, should for example US exports be lower than expected in future. In addition, a swift and sustained improvement in the global economy would probably boost coal prices more than gas prices. Secondly, the EU could – motivated by environmental problems, for example – push for a more ambitious climate strategy after all, which in turn would trigger a huge surge in the cost of emission allowances. Since this would hit coal harder than gas, gas would benefit. Thirdly, there could ultimately be a vote in Germany in favour of fracking, unconventional gas as a result of the latest conflict between Russia and Ukraine¹. This would reduce the price of gas further and enhance its competitiveness. Fourthly, a similar impact would probably come from a huge expansion in LNG infrastructures since ultimately Germany would more frequently enjoy the lower

¹ For details see Deutsche Bank Research (2014). The economics of sanctions: The West can afford to be tough.



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Risk factors

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Risk factors for a departure from the expansion targets for renewables to generate electricity:

- Blackouts in the electricity supply with a huge shift in the will of voters
- Further massive increase in costs due to the EEG and thus the levy
- Delay or non-implementation of expansion to the power grid
- Future uncertain for the renewables installations that lose EEG funding; shut down, new funding or profitable enough?
- Utilisation of fossil-fuel power plants declines sharply; lower utilisation means no longer profitable; pressure to introduce capacity markets from private-sector providers and municipal utilities
- State intervention possible (Bundesnetzagentur) to secure capacity; (fossil) "state power plants" conceivable to provide security of supply

These developments may lead to higher electricity prices which would ultimately reduce EEG acceptance among voters; pressure from (municipal) power generators increases; politicians could thus backpedal on their renewables targets.

Source: Deutsche Bank Research

gas prices found in other parts of the world. Fifthly, a capacity market would be helpful, while the need for it is currently still a contentious issue.

On balance, gas thus cements its position in electricity generation. Gas plants would remain in service for longer again, because they would operate more competitively. This would not only be beneficial from an environmental point of view, as the expansion of renewables would also result in greater flexibility being required of the remaining power plants in future. And, as we all know, gas plants are particularly flexible.

Conclusion: Risks to cost-efficient implementation

The electricity contribution of fossil fuels will drop to 40% by 2035 from 56.5% in 2013. Under coal-friendly conditions (scenario 1) this share will drop by "just" 12 points to 33% by 2035. If, however, the environmental and political conditions shift more strongly "in favour of gas" (scenario 2), coal would decline by no fewer than 17 points to 28%. Scenario 2 in particular would also feed through to the PEC, as gas would generate fresh impetus in the heating market and mobility.

At present cheap coal prices especially support scenario 1. More extensive and faster action on emissions trading appears to be necessary, not least at the international level, in order for the gas scenario to materialise. At present, however, such action seems unlikely. Although it cannot be completely ruled out that Germany does a go-it-alone on coal which completely disregards all the issues mentioned above, i.e. making a rapid end to coal use in Germany. Economic rationality and special interests in the coal-friendly Länder suggest that will not happen.

Our scenarios are based on the big mainstream parties sticking to their expansion targets for renewables during the forecast period. If everything should "go smoothly" – despite all the risks and challenges – Germany's energy mix should be considerably more sustainable and environmentally friendly in 2035. Even though the policy goals are clear, cost-efficient implementation of the Energiewende remains a problem. Also, there is an astonishing public and political focus on the EEG and especially on solar and wind (2.3% of the PEC). There should be a stronger political focus on more important international agreements on emissions trading, the increased (national) inclusion of transport and building refurbishment in efforts to reduce emissions and boost energy efficiency.

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