

## 1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

### EXECUTIVE SUMMARY

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German policy makers have taken a fundamental policy decision to move towards a sustainable energy supply over the long term. In September 2010, the federal government adopted a comprehensive new strategy, the Energy Concept, which established the principles of a long-term, integrated energy pathway to take the country to 2050 and which determined renewable energy as the cornerstone of future supply. The Energy Concept built on the success of previous policies, notably the Integrated Energy and Climate Programme of 2007, but adopted more ambitious goals. The federal government deliberately set Germany on the path towards becoming one of the world's most energy-efficient and environment friendly economies, while at the same time seeking to maintain affordable energy prices and a high level of economic prosperity. A key feature of the Energy Concept was a proposal to extend the operating lifetime of the German nuclear power fleet by an average of 12 years, therefore postponing the nuclear power phase-out agreed by the former government.

Following the Fukushima Daiichi nuclear accident in March 2011, a political decision which enjoyed extensive public support was taken to accelerate the phase-out of Germany's nuclear fleet by 2022 starting with the immediate closure of the eight oldest plants. This decision, combined with the political target to further progress towards a low-carbon energy sector, had a major impact on the German energy policy outlook, which resulted in the adoption of a second package of measures, needed to accelerate the energy transition. This second Energy Package, which completed what is commonly known as the *Energiewende*, contained seven legislative measures to support renewable energy and grid expansion, promote energy efficiency, fund the reforms and reverse the previous decisions to extend the lifetime of the nuclear plants.

The scale of Germany's ambitions, coupled with the size and energy intensity of its economy, and location at the heart of Europe's energy system, mean that further policy measures are necessary if Germany's energy transition is to maintain a balance between sustainability, affordability and competitiveness. Furthermore, decisions of this magnitude on German energy policy inevitably have an impact far beyond the country's borders and have to be taken within the context of a broader European energy policy framework and in close consultation with its neighbours.

### STEADY PROGRESS

Over the last two decades, Germany has successfully decoupled greenhouse gas (GHG) emissions from economic growth and is well on track to meet its Kyoto target, without recourse to flexibility mechanisms. It also remains on course to meet its target under the EU Effort Sharing Decision with existing measures. In the context of the Energy Concept (*Energiewende*), the German government has confirmed a GHG reduction target of 40%

below 1990 levels by 2020 and set additional reduction targets of 55% by 2030, 70% by 2040 and 80% to 95% by 2050, each relative to 1990. Additional measures, however, may be required to meet the 40% reduction target by 2020 in the absence of a sustainable Europe-wide emissions trading scheme.

Energy efficiency is an important pillar of the *Energiewende* and the country has set a target of 20% reduction in primary energy consumption by 2020 and 50% by 2050 when compared to 2008. To date Germany has made good progress and has implemented a broad sweep of programmes across all sectors. Nonetheless, there is much to be done if Germany wishes to meet its 2020 targets and a comprehensive assessment of the energy saving potentials and targets for the individual sectors is needed, notably, in the industry and transport sectors.

Together with energy efficiency improvements, large-scale deployment of renewable energy is at the heart of the *Energiewende*. Since its inception in 2000, the Renewable Energy Sources Act (EEG) has proven very effective in introducing renewable energies; notably electricity generation from biomass, wind energy and solar photovoltaics (PV). This policy instrument has also proven successful in bringing costs down, as reflected in particular in the decrease in feed-in tariffs (FITs) for PV as a response to the rapid growth in take up of the technology over the past four years.

Germany is at the heart of European natural gas trade and enjoys robust supply and storage infrastructure and benefits from strong domestic utilities. The market has seen a number of positive developments, which have resulted in increased competition over the five years since the previous review: the Federal Network Agency has implemented an entry-exit system, reformed the balancing rules and rationalised the number of market areas, from more than 20 in 2006 to six in 2009 and only two today. Diversification of gas supply routes into Germany has also improved, notably with the opening of the Nord Stream pipeline, which added 55 billion cubic metres (bcm) annually to import capacity. The transmission system operators (TSOs) developed a national ten-year gas grid development plan in 2012, which has been approved with a request for changes by the Federal Network Agency. Germany's natural gas data, however, have become a source of uncertainty and there is a need to establish a consistent national data base of German gas market information.

Oil remains a main source of energy in Germany although its use has declined over the past decade. The country has few domestic oil resources and relies largely on imports to meet demand. It has well-diversified and flexible oil supply infrastructure, which consists of pipelines and import terminals. The domestic market is liberalised and characterised by a large number of market participants. Oil supply is secure and the country consistently meets its 90-day International Energy Agency (IEA) stock-holding obligation and generally holds storage well in excess of the prescribed amount. In 2011, the amount of stock held in excess of the 90-day obligation was the equivalent of 50 days of consumption.

Regarding coal production, a decision has been taken since the last review was conducted in 2007, to phase-out subsidies for domestic production of hard coal and to decommission all hard coal mines by 2018. Furthermore, substantial volumes of coal-fired capacity are likely to be decommissioned following the implementation of the EU Large Combustion Plant Directive. On the other hand, currently several large new coal-fired power plants are under construction, representing one of the biggest investment waves into domestic coal capacities since the post-war reconstruction. These new coal-fired power plants will have a technical lifetime at least until 2050 and are likely to

remain a cornerstone of Germany's electricity production well into the medium term. The Energy Concept supports the testing and, where appropriate, the use of carbon capture and storage (CCS) technology. Despite some setbacks, a regulatory framework for CCS has been established although progress to date has been slow and some planned projects cancelled. More efforts are needed to encourage CCS demonstration and testing in new coal-fired power plants and to explore and test CCS storage options, especially in the North and Baltic Seas, together with neighbouring countries.

Electricity is at the core of the *Energiewende* and Germany has a large diversified electricity system which benefits from strong interconnections with neighbouring countries. Owing to its sufficient domestic thermal power generation capacities and strong interconnections, the system has coped to date with the shutdown of 8.4 gigawatts (GW) in nuclear capacity without major energy security concerns although the situation in winter 2011/12 was severely strained. The Federal Network Agency is monitoring the situation and regularly reports its findings.

The federal government published its new Energy Research Programme in August 2011 which promotes research and development activities to achieve the policy targets contained in the Energy Concept. Accordingly, the federal government has been increasing its research and development, and the budget funding will increase from EUR 1.9 billion over the period 2006-09 to EUR 3.5 billion for the period 2011-14. This commitment to energy-related research, development and deployment (RD&D) activities and encouragement of the federal government to further increase in spending on energy RD&D is very welcome.

## CONTROLLING THE COSTS

A robust German electricity market, fully integrated in the EU internal market for energy, can provide one of the most cost-effective solutions to achieve the ambitious energy transformation set out in the *Energiewende*. The aim of the German government is to support efficient wholesale and retail markets, which can provide households and industries with a secure, competitive and environment friendly supply of energy while providing adequate investment signals for the market.

While the energy transformation will bring with it significant long-term benefits, the costs of meeting the *Energiewende* are large and include the EEG and other supporting measures such as the costs of the transmission and distribution grid expansion programmes, research and development in energy-related technologies. Additional costs of electricity generation from renewable sources will be recovered from final customers via the EEG surcharge, which has increased significantly over the past three years and depending on a number of factors such as on the rate of renewables expansion, weather conditions and the wholesale electricity price, might increase again in 2014.

The EEG has come under renewed criticism because of the high costs for consumers owing to the fixed FIT payments to operators of renewable power plants and a decreasing amount of chargeable energy consumption to which costs can be allocated. In February 2013, the Federal Minister of Economics and Technology and the Federal Environment Minister presented a joint proposal for a short-term amendment of the EEG to claw back the rising EEG surcharge and expressed their will to fundamentally alter the EEG in the long term.

Despite its success in attracting investment in renewable energy, the federal government has been less successful in controlling the volumes of renewable energy connecting to

the system each year. The question remains, therefore, whether steering deployment volumes via a per kilowatt hour (kWh) remuneration will remain effective over the medium to long term. To date, German consumers have absorbed the costs of the EEG but the growing burden on households has ignited a political debate in Germany about the costs of the *Energiewende*.

Developing renewable energy in locations where it is needed most, in terms of system stability, and where the costs of connecting to the system are optimal, requires a carefully designed connection policy. In the case of wind energy this could mean those places where wind coverage is highest or in the case of solar PV where radiation levels are greatest. Furthermore, the costs of connecting to, and reinforcing the grid, also need to be taken into account in the process for connecting new capacity to the grid. Network charges should provide an incentive for new capacity to connect where the system needs it most. A further concern in this regard is competition between the Länder for renewable energy developments, which provide a source of revenue to the host area. Discussions between the Länder and the federal government should aim to eliminate this concern and develop a mechanism to ensure that the fiscal benefits of renewable energy location do not have a distortionary impact on development. Creating a regulatory environment to allow variable renewables to provide system services, such as participating on the balancing markets, is an important element in this regard.

German energy policy goals are long term and in order to realise their targets, a predictable political and regulatory framework is necessary. Sudden changes to the support regime while reducing costs in the short term can undermine investor confidence and will drive up costs over the long term as a result of higher risk premiums. Retroactive tariff cuts in any form or for any length of time will send the wrong signal to the market. Reforms of the EEG will need to realise the benefits of competition, locate and pace new deployment in line with the required infrastructure and provide sufficient certainty for investors while meeting demand for energy.

There is also debate regarding the allocation of the costs of the *Energiewende* with some arguing that household consumers carry a disproportionate share of the burden. Under existing arrangements, large consumers of electricity that use more than 10 gigawatt hours (GWh) of electricity per year pay a reduced surcharge (EUR 0.0005 per kWh) on 90% of the electricity they consume with the full surcharge payable on the remaining 10%. Electricity-intensive industries that consume more than 100 GWh, and whose electricity bills represent more than 20% of total costs, may pay the lower surcharge on all of their consumption. These large energy users also benefit from lower wholesale electricity prices brought about by the growth in renewables. Large numbers of producers, who have erected solar PV systems and connected to the distribution system, receive a revenue stream via the EEG. While these producers deliver significant benefits in terms of energy output, they also impose costs on the system, in terms of developing the distribution system and may sometimes act as a disincentive to reduce energy consumption. The federal government should ensure that the regulatory system captures these costs and allocates them appropriately among producers and consumers.

A further concern is the exemption of network charges applied to large consumers, which was introduced in 2011. It could be argued that the exemption of these charges, which are recovered from smaller users of electricity via a special Section 19 of the regulation on network charges (*Netzentgeltverordnung*), distorts electricity prices and trade and imposes an unnecessary burden on small consumers. The federal government

intends to revise the regulation and has to this end initiated the interdepartmental co-ordination on its draft amendment in March 2013.

The household electricity bill in Germany is relatively complex and contains a number of components unrelated to the supply of electricity to final users. To the extent that these charges are independent of the supply of electricity they should be eliminated and recovered via more appropriate mechanisms.

The cost impact of the EEG needs to be assessed in the context of overall energy sector developments. Recent increases in electricity costs have put low-income households, in particular, under pressure, while large consumers have been shielded from the surcharge while benefitting from the renewable-induced reduction of wholesale prices. In addition, energy poverty is equally driven by the steep increase in fossil fuel costs. The costs, but also the benefits, of renewables need to be allocated in a fair and transparent way.

## GETTING THE GRIDS RIGHT

The expansion of the transmission and distribution networks is seen in Germany as the most important means of moving energy supply away from nuclear power and coal towards greater levels of renewable energy. The forecast growth in renewable electricity generation capacity, and the need to bring the electricity output to market, must be complemented by timely, large-scale, cost-efficient investments in the electricity transmission and distribution systems. At present, transmission infrastructure carrying power from northern Germany to the south is increasingly congested, and likely to become more so. The geographic concentration of large volumes of wind power, as much as 25 GW by 2030, in northern Germany, a region with low electricity demand, and the need to transport it to the industrial south where demand is will place further strain on the networks. Major power flows in Central Europe, including loop flows, originating in Germany, in the north-south direction through the Czech Republic and Poland, are among the drivers of the need for enhanced operational co-ordination, financial settlement and infrastructure investment in Central Europe.

As a result of changes to the German Energy Act (EnWG), the four TSOs are required to prepare a joint network development ten-year plan. The first such plan – the Electricity Grid Development Plan 2012 (NEP 2012) – which was subject to public consultation before examination and approval by the Federal Network Agency in November 2012, contains plans for the reinforcement of approximately 2 900 km of lines and construction of 2 800 km of new power lines. The approval supported 51 of the 74 projects proposed by the TSOs. Cost estimates for this work vary but are somewhere in the region of EUR 20 billion to EUR 30 billion over the next ten years.

As most renewable electricity generation is connected to the distribution system, rather than the transmission system, large investments are also required in the country's 870 distribution systems. Once more, estimates of the scale of investment and works vary but a study published by the German Energy Agency forecasts that capital investments of between EUR 27.5 billion and EUR 42.5 billion are required over the next ten years. So far, strong focus has been given to development of the transmission system which is commendable; however, as the greater share of investment will take place in the distribution networks, the focus of future policy by the government and Federal Network Authority needs to be on distribution.

To date, Germany's record with regard to the construction of new grid infrastructure is patchy and planning and consenting procedures present a major stumbling block. Increased and effective co-operation between the Länder and between the federal government and the Länder is also necessary to make possible the *Energiewende*. Accordingly, a welcome measure is the Network Expansion Acceleration Act (NABEG), which was introduced in order to facilitate network expansion; this will link the north with large centres of consumption in the south. A welcome component of this measure is the comprehensive and timely participation by the general public as well as industry stakeholders.

To date, many grid projects have been delayed or stopped at Länder borders. NABEG intends to streamline and accelerate the permitting procedure by mandating that a federal planning procedure be carried out that determines corridors for the power lines, which are binding for the subsequent plan determination procedure. At present, the procedures for individual power line projects are conducted by the respective authorities of the Länder. This can lead to delays when two or more jurisdictions are involved and NABEG may confer this competence to the Federal Network Agency, a measure that could accelerate the permitting process without compromising the integrity of the process.

Further implementation measures must be considered, which aim at more transparency and public involvement in the decision process of grid extension. The NABEG provides part of the solution, as does the appointment of the network regulator as one-stop shop for projects of national interest. The preparation of the first joint Network Development Plan by the four electricity TSOs is a welcome step in this regard. Similarly, in response to the growth in variable renewable energy, investing in electricity storage capacity and improving energy efficiency in electricity transmission and distribution must be considered. Furthermore, a stable regulatory system is required to ensure the availability of long-term finance to network operators.

## GENERATION ADEQUACY

The German electricity system is regarded as a secure system and over the past 20 years, the country has enjoyed the benefits of reserve capacity, both in generation and transportation networks, most notably in the distribution grid.

Generating capacities are sufficient to cover peak demand under existing market conditions. Notwithstanding the nuclear phase-out starting with the closure of 8.4 MW of capacity in 2011, reserve margins are satisfactory until 2015 at least. Nonetheless, concerns remain as to the extent to which the current electricity market arrangements can deliver the necessary investments to maintain secure and reliable electricity services. At present, as a result of weak carbon prices and high gas prices in Europe, existing gas-fired plants have lost competitiveness and evidence suggests that some are being taken off-line. The average load factor of combined-cycle gas turbine plants (CCGTs) in Germany is around 3 000 hours and they struggle to make a return despite the flexibility they offer to the market. The growth in renewable energy forecast for the medium term may compress the wholesale market further and make it more difficult to recover fixed capital costs. This has led to a discussion on the need for capacity mechanisms and other investment incentives in Germany.

Present reserve margins, the measure of available capacity over and above the capacity needed to meet normal peak demand levels, suggest that there is no urgent need to develop some form of capacity mechanism; nonetheless, there is a need to adapt

existing markets arrangements. Changes can help defer, or potentially avoid the implementation of further regulations and maintain efficient energy-only markets. For example, Germany should utilise existing mechanisms to seek to harmonise security of supply rules, procedures and reserves similar to, for example, arrangements in Nord Pool, the Nordic power exchange.

To the extent that the federal government must contract for capacity as a short-term measure for maintaining network reliability, as already happens, such contracting should be done on a transparent and open basis, for example, by public tender. Such measures should be supported by network-based incentives on generators to optimise their location decisions from a system-wide reliability and cost perspective. Furthermore, there is a need for transparent and widely understood triggers — response mechanisms which are linked to the fundamentals of demand and supply rather than price — in order to minimise the risk of crowding out incremental capacity. These triggers should be seen as a transitional measure to assist with the potentially difficult medium-term adjustment.

Germany has time to adjust its energy-only market design; it runs a sufficiently high reserve margin and is well interconnected with neighbouring countries. Close monitoring is required and should continue in the medium term. Germany should strengthen its energy-only market by improving demand elasticity, establishing targets for reserve margins, introducing cost-reflective reimbursement for network services, applying market price-sensitive renewables and introducing price caps, and enhancing EU co-ordination. Examples from other regions exist, such as Texas or the National Electricity Market in Australia. Germany should take advantage of this collective experience.

In unexpected cases, the reserve margins could fall below what is desired; when this happens Germany should start looking into options to complement its liquid and efficient energy-only market with market-based instruments. A targeted and temporary capacity mechanism, with the phase-out timed around managing the peak period of uncertainty while the nuclear capacity is being replaced, should be the aim. Germany should also monitor network-related aspects of reliability to better balance the overall electricity system.

## A FUTURE FOR GAS

The strategic role of natural gas in the *Energiewende* needs further clarification and greater thought should be given to its use and place in the electricity supply mix of the future. Natural gas can provide a flexible source of electricity supply in the medium term and, as nuclear capacity is phased-out, can help smooth the path to a low-carbon power sector. The nature of Germany's energy supply over the coming decade suggests that there is a need for more mid-merit electricity capacity to offset variations in output from wind and solar PV. Furthermore, if Germany is to meet its 2020 GHG emissions reduction target of 40% without much of its nuclear fleet, a cleaner alternative to coal use needs to be found. Furthermore, as coal use in North America falls as a result of the boom in unconventional gas, the region's exports are driving greater use of relatively cheap coal in Europe. Recent evidence suggests that German utilities are consuming larger volumes of coal and displacing natural gas from the generation mix. In the absence of an effective carbon price in Europe, this will drive up Germany's GHG emissions while capping investment in cleaner gas-fired technologies.

## KEY RECOMMENDATIONS

*The government of Germany should:*

- Ensure that the large-scale transmission and distribution developments, including investments that are necessary if the Energy Concept (Energiewende) is to succeed, are put in place in a timely manner and maintain a regulatory system that provides sufficient financial incentives and investment security for mobilising the necessary investments in distribution.*
- Develop suitable mechanisms to manage the cost of incremental renewable energy capacity via cost-effective market-based approaches, which will support the forecast growth of variable renewable electricity generation that brings new capacity closer to market needs, supports investments in appropriate locations and complements planned network expansion.*
- Assess, in co-ordination with all relevant stakeholders, the extent to which the present market arrangements enable the financing of economically viable investments in new flexible gas-fired generation and cost-effective electricity storage. Part of this assessment is the need to examine the suitability of capacity markets as a transitional measure to support the adjustment to a post-nuclear power system.*
- Take strong measures to ensure that the costs of the Energiewende are minimised and allocated fairly and equitably across customer categories and limit the growth of the Renewable Energy Sources Act (EEG) surcharge attributable to the deployment of additional renewable energy capacities, while drawing all benefits from the rapid decrease in technology costs that has occurred.*
- Develop policies that convey a clear understanding of the role of gas in the Energiewende and ensure that the short-term boom in coal use by the electricity sector does not crowd out investment in flexible gas-fired capacity.*