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Energy policy

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Contents

The three fundamental goals of energy policy are known as the policy triangle: security of supply, economic efficiency and environmental protection. To ensure economic efficiency, a well-functioning competitive market is essential, whereas the networks require state regulation. As for environmental protection, CO_2 emissions trading can work against the promotion of renewable energies, and it is also important to weigh these interests against local landscape and nature conservation concerns.

1 Introduction

A well-functioning energy supply system is an important prerequisite for a modern society. This is why energy policy is classed as an essential public service *(▷ Provision of public services)*. At the same time, energy policy can be viewed as a specific sectoral economic policy, which raises the question: to what extent is state intervention necessary and beneficial from an economic perspective? Another area of tension in energy policy arises from the fact that the different political tiers are interlinked, from the global level of climate change and the corresponding need for global agreements on ▷ *Climate protection*, to the European level of the common internal market and emissions trading system, right down to the municipal level of preparatory land-use plans (▷ *Preparatory land-use plan*) and energy strategies. Consideration must also be given to national statutory requirements, for example on the promotion of ▷ *Renewable energies* and the phasing out of nuclear power, as well as federal state specific variations in planning provisions. Accordingly, the next section discusses energy policy goals in general, before moving on to a deeper analysis of selected energy policy measures.

2 Energy policy goals

2.1 The energy policy triangle

At least since the growth of the environmental movement in the 1970s and 1980s, Germany's approach to energy policy and the ▷ *Energy industry* in both the public and private sector has been guided predominantly by the three goals of the policy triangle: *security of supply, economic efficiency and environmental protection*.

Accordingly, the aim of the Energy Industry Act *(Energiewirtschaftsgesetz, EnWG)*, as stated in section 1(1), is 'to provide the general public with a secure, cost-effective, consumer-friendly, efficient and environmentally sustainable grid-based supply of electricity and gas'. The terms *cost-effective* and *efficient* represent the goal of economic efficiency, whilst *secure* and *environmentally sustainable* form the other two sides of the policy triangle. Added to these is the requirement for consumer convenience.

More recently, especially since the Fukushima nuclear disaster and a subsequent reorientation of energy policy in Germany, acceptance is often cited as a further energy policy goal (cf. Hauff/Heider/Arms et al. 2011). Although undoubtedly important, this is not a consideration that actually shapes energy policy, since acceptance is necessary for all energy technologies, whether conventional power stations, wind turbines or high-voltage power lines. Instead of or alongside acceptance, the concept of participation is often referred to as another essential element of a successful energy policy (cf. Schweizer-Ries/Rau/Hildebrand 2011).

Hence the fundamental requirements of energy policy continue to be defined in general terms by the energy policy triangle. As a rule, all three goals are considered to be of equal importance, although any one of them may be given more prominence depending on political preferences. In order to fulfil these goals, the policy needs to be explicitly defined, but two additional questions must also be considered: firstly, how to weigh the objectives against each other in each case and secondly, what role in achieving these objectives should be assigned to state institutions on the one hand, and to the market and private sector on the other. These questions are examined in detail below, as they also have a major bearing on the selection of political instruments and measures.

2.2 Weighing of interests between policy goals and the role of the public and private sector

Although the energy industry and its associated challenges are of crucial importance for society, it is not automatically given any special status. A modern society must also be supplied with food, information, transport facilities and many other essentials besides. In terms of creation of value, the energy industry is actually one of the less significant sectors of the economy. Accordingly, the basic principles and insights that define the economy as a whole are also applied to the energy industry, except where its specific characteristics preclude the use of general concepts.

Any economic discussion of public policy and other objectives should be framed by the concepts of welfare economics. According to the first principle of welfare economics, well-functioning competition in a market economy leads to a so-called Pareto optimal outcome, which means that any state intervention in a market may improve the situation for some participants, but there will always be others that lose out and end up being worse off as a result of state intervention.

State intervention may still be necessary to comply with societal values regarding a fair distribution of income. According to the second principle of welfare economics, however, intervention aimed at income distribution can be organised so as not to impair the functioning of the markets. It follows, then, that specific energy policy measures are not appropriate for the purposes of enabling deprived communities to afford electricity or cooking and heating fuel, an approach adopted in some developing countries. Neither is it enough, from an economic perspective, to justify energy policy measures in terms of their positive effects on jobs. This is because what tends to be forgotten is that the public or private funds in question could also be deployed elsewhere, thus leading to a comparable effect on income and jobs.

And yet from the point of view of welfare economics, there are good reasons for policy-based intervention in the energy industry, even though state intervention in a market must always be fully justified. This is because there are two prerequisites underlying the principles of welfare economics that are not fulfilled in the energy market: (1) the absence of external effects and (2) the absence of natural monopolies or subadditive costs. Wherever there are subadditive cost structures, the distribution of output volume across several companies would lead to higher production costs compared with production by a single company. The ideal solution under these circumstances is therefore is to concentrate the entire production in one company.

Environmental impacts in connection with the energy transition are a typical example of a so-called negative external effect: the perpetrator harms others, and yet an unregulated market does not oblige the responsible party to bear the costs of the environmental damage caused. This is where there is a need for state intervention in order to prevent the environment from being overexploited.

Another reason for state intervention is when the market fails because of natural monopolies. This situation arises when competition between several suppliers does not allow a service to be offered more cheaply; on the contrary, overall costs are higher than when there is only one supplier. A natural monopoly of this kind occurs in the case of energy networks.

It follows, then, that there are four basic requirements for state energy policy, including in the context of urban and spatial development: (1) When weighing the interests between the three goals of the energy policy triangle, the welfare of society overall should be considered wherever possible, in other words, costs and benefits for the whole of society, taking into account external effects such as environmental damage. (2) Energy policy should rely as far as possible on market forces and private initiatives in order to guarantee a secure, cost-effective energy supply. (3) Any environmental damage associated with the energy transition and energy use in general should be limited through energy policy measures, or alternatively the corresponding costs should be internalised. (4) When it comes to energy networks, state regulation should ensure that overall costs are kept to a minimum – this includes preventing monopoly profits.

2.3 The goal of security of supply

Generally speaking, it should be noted that security of supply can be interpreted in different ways. It is often used in a political context, where it is instrumentalised for the purpose of legitimising certain political demands. From an economic perspective, it is argued that markets can be capable of safeguarding security of supply: if there is a demand for it, there will also be suppliers to provide it. Attempts to preserve or acquire a certain degree of national or regional autonomy in the energy supply sector also tend to be problematic from an economic point of view – international trade theory generally shows that protectionist behaviour aimed at protecting domestic industry does not boost national prosperity in the long run, but actually diminishes it.

Among the various definitions of security of supply (cf. Weber 2010), in many cases only a pragmatic definition is viable. According to this definition, security of supply occurs when, from a present-day perspective, there will be no energy supply interruptions with unacceptable consequences in the foreseeable future. This is certainly a somewhat vague definition. For the sake of clarity, it is particularly important to define what is meant by unacceptable consequences. But at least this attempt to define the concept clearly indicates where measures should be targeted in order to enhance security of supply.

Another point to note is that some aspects of security of supply are more important than others, depending on the energy carrier in question. When it comes to electricity, for example, supply disruptions are often caused by a failure of power plants and/or power lines, coupled with insufficient reserve capacities. Here it is mainly a question of technical uncertainties on a domestic level. For fossil fuels like oil, gas and coal, on the other hand, the biggest unknown is a potential interruption of supplies from abroad. The corresponding risks can only really be described in verbal terms; they are virtually impossible to quantify statistically. Since short-term supply disruptions can be offset at least partially though storage solutions, the emphasis in this sector is on long-term security of supply.

2.4 The goal of economic efficiency

In well-functioning competitive markets, all suppliers will strive to produce and sell their services to the customer as cost-effectively as possible. Otherwise, they will not survive the competition. Bearing this in mind, there is a need to establish whether it is possible to ensure effective competition in the energy industry, and if so, how this is to be done.

Transmission networks for electricity, gas and district heating are characterised by considerable economies of density, and are thus classed as a special type of economy of scale. Additional costs generated by supplying another customer in a given catchment area are much lower than the average costs incurred by the construction of the grid up to that point. This situation gives rise to a natural monopoly characterised by a subadditive cost function. A natural monopoly requires state intervention particularly when some of the costs involved are so-called *sunk costs*, i.e. costs that can never be recovered. Most costs incurred by power lines and grids are (quite literally) sunk costs: even if grid operation was discontinued, selling the power lines to another region would hardly recoup the costs.

In the absence of regulation, a natural monopoly with sunk costs constitutes a monopolistic bottleneck which also obstructs competition in upstream and downstream markets, because it is impossible to compete for customers in the electricity and gas sector if the energy cannot be transported via the transmission lines of the existing grid.

For this reason, one of the fundamental goals of energy policy in terms of ensuring a cost-effective energy supply is to boost competition in areas where there is no natural monopoly. The monopolistic bottleneck of energy networks, on the other hand, calls for clear state regulation in order to prevent grid operators (whether private or public) from unlawfully exploiting their dominant position. Wherever public authorities set mandatory provisions for planning and operating networks, however, they must also duly weigh the advantages and disadvantages to society as a whole, taking into account the three dimensions of the energy policy triangle.

2.5 The goal of environmental protection

In Germany and Europe as a whole, the current debate on energy-related environmental damage mainly revolves around the anthropogenic greenhouse gas effect. Although this is not exclusively energy-induced, the CO_2 generated worldwide by the combustion of fossil fuels accounts for around 60% of the anthropogenic greenhouse gas effect (cf. IPCC 2014).

CO_2 is not really an air pollutant, since it is present in the natural atmosphere. And yet CO_2 is the main cause of the greenhouse gas effect, which is why emissions must be reduced. More than 90% of CO_2 emissions are energy-related, so a cap on CO_2 emissions has far-reaching implications for the energy industry. The remaining CO_2 emissions can be attributed primarily to industrial processes, such as cement production.

The key consequence of sustained greenhouse gas emissions is global warming, although the extent of the projected temperature rise and associated damage and risks is still a matter of considerable uncertainty. With a doubling of CO_2 equivalent concentrations in the atmosphere, the Intergovernmental Panel on Climate Change (IPCC) anticipates a rise of 1.5 to 4.5°C in average global temperatures (cf. IPCC 2014). The associated risks include an increased frequency of storms, flooding, periods of severe heat and other extreme weather events, the melting of the polar ice caps and a rise in sea levels. These, in turn, result in systemic risks to infrastructure, the security of food and drinking water supplies, ecosystems (▷ *Ecosystem services*) and ▷ *Biodiversity*.

Since the green house gas effect is a global phenomenon, any national or regional measures taken in isolation will have only a limited effect. Germany accounts for less than 3% of global greenhouse gas emissions. International agreements are thus essential in order to limit global warming, while national and regional efforts are required to achieve the overarching goals.

In addition to the greenhouse gas effect, energy policy requirements for environmental protection must also take into account conventional atmospheric pollutants, any negative impact on the landscape and the risks of nuclear power. The latter, however, are mitigated by statutory provisions for a nuclear energy phase-out by 2022, even though the question of the storage and disposal of radioactive waste awaits clarification.

As for conventional atmospheric pollutants, such as dust and other particulate matter, sulphur dioxide and nitrogen dioxide, these have been substantially reduced in the last few decades thanks to statutory requirements including the mandatory use of three-way catalytic converters in vehicles. There are still challenges that must be addressed here, particularly in connection with so-called summer smog, though this is primarily caused by transport emissions. And although in principle there has been a reduction in particulate emissions from wood-fired heating systems following an amendment to the First Federal Immission Control Ordinance *(Bundesimmissionsschutzverordnung, 1. BImSchV),* there are transitional periods and exemptions for open fireplaces.

Landscape conservation and the aesthetic impact of power plants on the landscape have increasingly become a focus of debate in Germany. These issues are hard to quantify in economic terms, since they are also heavily influenced by subjective perceptions. A nuanced consideration of these concerns in connection with urban and spatial development measures will be essential if plans to restructure the energy system in Germany are to succeed.

3 Energy policy instruments

Energy policy measures often pursue several goals at the same time. For urban and spatial development measures in particular, various objectives have to be weighed against each other. Nevertheless, the next section examines individual measures separately for each of the three fundamental energy policy goals as previously discussed. It pinpoints the areas in which even general provisions take effect and defines the framework for urban and spatial planning measures.

3.1 Measures to promote security of supply

Short-term security of supply is particularly relevant for the electricity sector and is ensured primarily by means of technical measures. A key element is the so-called N-1 principle. According to this principle, electrical supply systems are designed and operated in such a way as to ensure that if one of the components in the system (a power line or power station) fails, a sufficient supply of electricity can still be guaranteed.

An important strategy for safeguarding the long-term security of supply is to promote free trade. However, if free trade is not promoted or is insufficiently promoted in a given region and this leads to a scarcer supply and correspondingly higher prices, there are no serious adverse effects for the consumer. This in turn reduces the strategic incentive for suppliers to stop production as a way of exerting pressure on purchasers. However, the use of global trade as a type of insurance for safeguarding supplies presupposes not only that the commodity in question is internationally tradable but also that there is no excessive concentration of resources in a given state or region.

In the case of natural gas, that first prerequisite is as yet hardly fulfilled. Around 75% of the natural gas traded internationally is transported via pipelines and, as a consequence, cannot readily be replaced by gas originating from other states. The second premise mentioned above applies neither to petroleum nor to natural gas. Around 70% of global reserves are concentrated in the so-called strategic ellipse, which encompasses the Arab nations, Iran, the Central Asian Republics and Russia (cf. *BGR* [Federal Institute for Geosciences and Raw Materials] 2013). If several suppliers in this area stop operations, security of supply may be jeopardised.

For this reason, in addition to geographical diversification via a functioning global trade system, a policy-based strategy is also needed to safeguard oil and gas supplies. One component of this strategy is energy storage as a way of bridging short-term supply gaps. This is why Germany holds oil, petroleum products and semi-finished petroleum products in storage, in line with the Petroleum Stockholding Act *(Erdölbevorratungsgesetz, ErdölBevG).* To date, there are no internationally agreed requirements for keeping natural gas reserves. In Germany, however, there is considerable underground storage capacity for natural gas, and these reserves are usually drawn on to offset fluctuating demand between summer and winter months.

Tapping into domestic resources can also play a role in safeguarding the security of supply in the longer term. This aspect should also be taken into account when weighing the interests of statutory and spatial planning requirements for what is known as fracking, i.e. the use of unconventional methods for extracting gas and oil.

For coal, but also for electricity generated from renewable energies, security of supply is a less relevant objective: global coal reserves are widely distributed geographically, and the international trade system works. This means that the political risks associated with this sector are correspondingly low. Electricity production, however, involves various technologies that use different primary energy carriers, and so even without the use of renewable energies, risks can be mitigated through diversification.

3.2 Measures to promote economic efficiency

The European Union began to introduce competition into the electricity and gas markets as of 1996, via various EU Directives. Germany transposed these into national law through the amendment to the Energy Industry Act in 1998 and subsequent amendments in 2005 and 2011. The idea is to ensure that the efficiency-enhancing effects of competition also benefit the energy industry. Specific measures are required, however, in order to appropriately regulate the monopolistic bottleneck of the energy networks.

Non-discriminatory access to the grid is a prerequisite for ensuring competition for grid-based energy carriers outside the networks, in other words on the wholesale and retail markets. Grid access has been regulated in Germany since the Energy Industry Act entered into force in 2005, which means that the rules for grid use are set by the relevant authorities.

This legislation regulates the following aspects:

- the organisation of energy companies as far as grid-based energy carriers are concerned,
- the conditions for grid use by third parties,
- the structure and level of grid charges.

In Germany, essential regulatory tasks are carried out by the Federal Network Agency *(Bundesnetzagentur, BNetzA)*, and the ministries of agriculture in the federal states are also responsible for certain aspects, such as regulating charges. The legal foundations underpinning the work of the regulatory authorities and the basic principles of regulation are set down in the Energy Industry Act of 2005. These provisions are further defined by various ordinances, the most important of which are the Electricity Grid Access Ordinance *(Stromnetzzugangsverordnung, StromNZV)*, the Gas Grid Access Ordinance (G*asnetzzugangsverordnung, GasNZV),* the Electricity Grid Charges Ordinance (S*tromnetzentgeltverordnung, StromNEV)* and the Gas Grid Charges Ordinance *(Gasnetzentgeltverordnung,GasNEV)*.

There are no regional or local exceptions to these provisions, and so-called closed distribution networks, to which some of the rules do not apply, can only be formed under strictly limited circumstances (cf. *BNetzA* [Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway]/*Regulierungsbehörden der Länder* [Federal States Regulatory Authorities] 2012). Consequently, there is little room for manoeuvre for municipal and regional stakeholders in relation to urban and spatial development measures. In particular, municipal ownership of the electricity and gas grid can barely be used to pursue local energy policy goals because all municipal networks are subject to the general provisions on non-discrimination and the structuring of grid charges. Municipal energy companies can invest in their own power plants outside their network in areas such as renewable energies, combined heat and power generation (CHP or co-generation) or conventional power plants, and they can also support energy efficiency measures. In so doing, however, they are subject to the same economic opportunities and risks as other stakeholders in the energy market.

3.3 Measures to promote environmental protection

The essential conditions for fulfilling the goals relating to security of supply and economic efficiency are set at European and national level. When it comes to certain aspects of environmental protection, however, the local and regional level plays a much more important role. Because although global objectives for climate protection call for comprehensive measures on a large scale, it is only in a local spatial context that they can be implemented, particularly when, as is the case in Germany, the use of nuclear power and technologies for CO_2 capture and storage (CCS) is excluded for political reasons. Most renewable energies, however, are characterised by comparably decentralised, small-scale production structures (the exception being offshore wind) and, as such, are reliant on local consent and approval. At the same time, owing to fluctuations in the availability of solar and wind-based power, there is a need for increased flexibility on the demand side as well as an expansion of the electric grid.

On the European level, the most important tool for implementing climate protection goals is the CO_2 Emissions Trading System (ETS). This is complemented on the national level by the Renewable Energy Act *(Erneuerbare-Energien-Gesetz, EEG),* the Renewable Thermal Energy Act *(Erneuerbare-Energien-Wärmegesetz, EEWärmeG)*, the Energy Saving Ordinance *(Energieeinsparverordnung)* and other measures including mandatory labelling for electrical appliances.

The European Emissions Trading System was launched in 2005, and covers CO_2 emissions from energy-intensive industries, such as electricity generation, iron and steel production and the cement industry. The system is based on the economic principle that emissions can only be prevented in a cost-effective manner if all emission-reducing measures are subject to a uniform price. This is why the Emissions Trading System – along with a tax that is commensurate with any marginal damage caused by environmental pollution – is seen as the instrument of choice from an economic point of view. The reason for this is that it helps to achieve climate protection goals at the lowest possible cost to society (static efficiency) whilst offering the best possible incentives for developing environmentally sound processes (dynamic efficiency).

As a consequence of the EEG and preceding legislation, there has been an upsurge in the number of renewable energy power plants built over the last 20 years in Germany. This can be ascribed in particular to the fixed feed-in tariff, which considerably reduces the economic risk to investors. In 2017, the EEG is to switch to a tendering system for all plants with an installed capacity of more than 100 kW. This will address a fundamental shortcoming of the feed-in tariff, namely the absence of any quantity control. This problem resulted in an unexpectedly high growth in photovoltaic installations, particularly from 2009 to 2011, which in turn led to a rapid rise in the EEG levy. That still leaves another problem, however: since the European Emissions Trading System already curbs emissions from electricity production, the promotion of renewable energies does not lead to a further reduction in emissions, but instead to a reduction in the cost of CO_2 allowances – which, in turn, partially explains why old coal-fired power stations can still be operated at a profit.

In order to achieve longer-term German and European climate policy goals, a further expansion in renewable energies will undoubtedly be necessary if the use of other CO_2-free technologies is to be excluded. As a consequence, however, it is crucial that spatial and preparatory land-use planning allocate sufficient space to the use of renewable energies. The ▷ *Weighing of interests* to take account of local landscape and nature conservation as well as visual pollution of the landscape can only be done on the ground – this is where urban and spatial development has a vital role to play.

Similar interests must also be weighed when it comes to installing new power line routes. With the Power Grid Expansion Act *(Energieleitungsausbaugesetz, EnLAG)* and the Grid Expansion Acceleration Act *(Netzausbaubeschleunigungsgesetz, NABEG)*, however, legislators in Germany have established specific procedural rules for building new ultra-high voltage power lines with the aim of accelerating the expansion of the transmission network. Here, for the first time, provision has been made to paying compensation to municipalities affected by an expansion of the grid.

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