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Germany's Energy Efficiency Strategy 2050

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Germany's Energy Efficiency Strategy 2050 sets out a long-term pathway for strengthening German energy efficiency policy. In this way, it also makes an appropriate contribution to achieving the EU energy efficiency target (of reducing primary and final energy consumption by least 32.5% by 2030). The Strategy sets a new energy efficiency target for 2030, brings together the necessary measures in a new National Energy Efficiency Action Plan (NAPE 2.0) and contains guidelines on how the dialogue process on the Energy Efficiency Roadmap 2050 should be designed.

1. Introduction

How sustainable an economy really is depends to a large extent on how efficiently it uses energy. Energy efficiency improves companies' competitiveness, strengthens the purchasing power of consumers, reduces dependence on energy imports, and is not least the key to achieving climate targets.

The Federal Government has set itself the goal of making Germany the most energy-efficient economy in the world. The guiding principle underlying German energy and climate policy en route towards this goal is 'efficiency first'. This means that the priority is on reducing energy consumption, wherever it makes economic sense to do so. Remaining energy demand is then to be covered primarily through the direct use of renewables. Once these approaches have been pursued as far as possible, electricity from renewable energy is to be used efficiently in sector coupling, in order to meet the energy needs of industry, transport and heating.

Energy efficiency means using less energy even as value added increases. This reduces energy costs and gives companies a valuable cost advantage. Investments in efficiency measures strengthen domestic value creation, secure jobs, and increase security of supply because dependence on oil and gas imports is lessened. In addition, placing a focus on energy efficiency opens up new export and growth markets for German companies producing efficiency technologies 'made in Germany'. The German market serves as a showcase for their plant and machinery, products and services.

Better energy efficiency also means that private consumers have more money in their household budget. By placing minimum standards on electrical appliances, for example, consumers' energy costs are kept as low as possible – serving to protect them in the same way as energy-efficiency retrofits and consumption specifications for car manufacturers do. This means that raising energy efficiency also takes on an important social function.

In adopting its Energy Efficiency Strategy 2050 at the end of 2019, the Federal Government has placed even greater weight on efficiency policy for the future. The strategy comprises three elements: it defines an efficiency target for 2030, sets out the different Federal Government measures necessary for achieving this target in a new National Energy Efficiency Action Plan (NAPE 2.0), and sets out how the dialogue process on the Energy Efficiency 2050 Roadmap will be implemented. As part of this dialogue, representatives of civil society and business, consumers, scientists and the Federal Government will discuss ways in which cross-sector cooperation can be used to help achieve the reduction target for 2050, and will also develop proposals for specific measures.

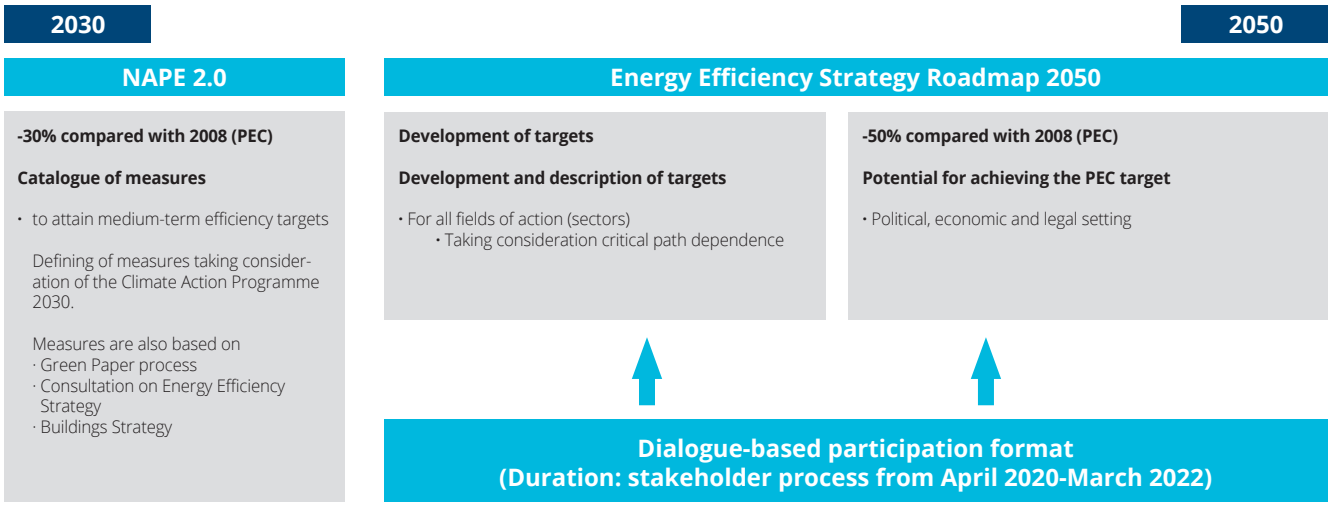
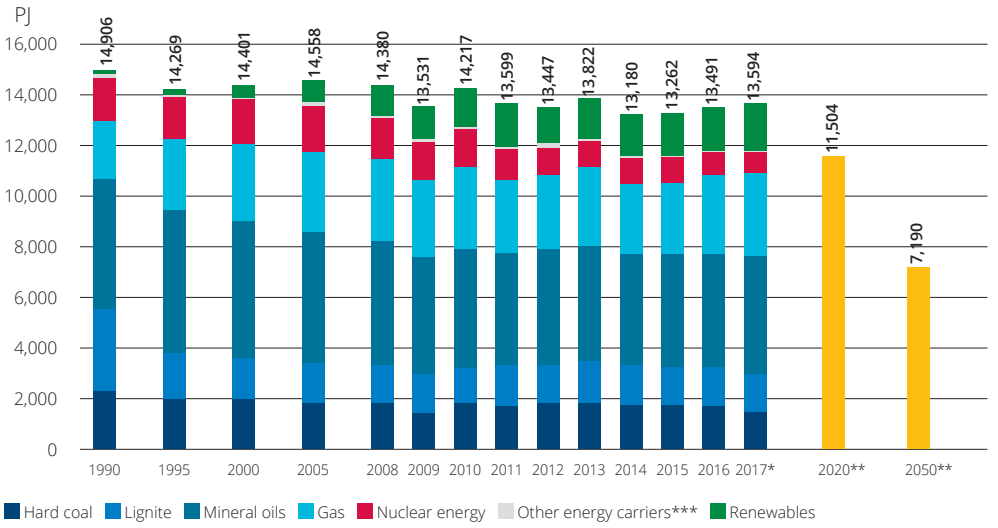


Figure 1: Diagram depicting the Federal Government's Energy Efficiency Strategy 2050
(Source: Federal Ministry for Economic Affairs and Energy, 2019)

2. Energy efficiency target for 2030



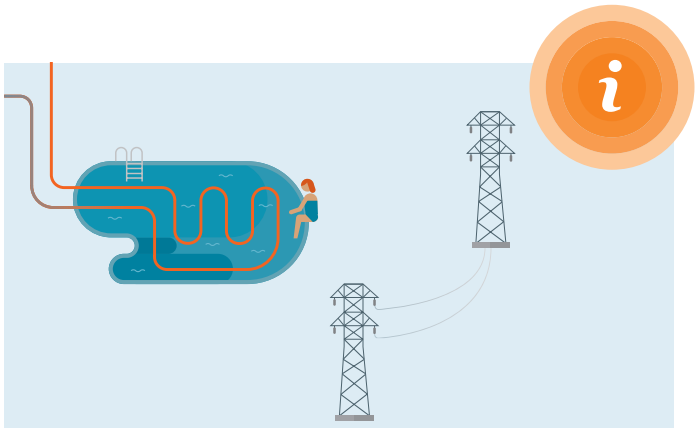
*Preliminary data
**Targets of the Federal Government's energy concepts: reduction of PEC by 20% by 2020 and by 50% by 2050 (base year: 2008)
***Other energy sources: non-renewable waste, waste heat, electricity and heat exchange balance

Figure 2: Development of PEC in Germany and energy efficiency targets
(Source: Federal Ministry for Economic Affairs and Energy, 2019 based on German Environment Agency and AG Energiebilanzen, 2018)

Germany has set itself the goal of reducing greenhouse gas emissions by at least 55% by 2030 (compared to 1990 levels). To achieve its overall climate target for 2030, the country will have to both massively expand renewables and significantly reduce its energy consumption. This two-pronged approach is the only way to ensure the target is met in the most cost-effective and sustainable way possible.

The climate targets are therefore accompanied by ambitious efficiency targets: by 2050, Germany aims to halve its primary energy consumption compared to 2008. In the last decade, energy demand has already been noticeably reduced. However, it is already apparent that Germany will have to make much faster progress on saving energy in all of the relevant areas if it wants to meet this efficiency target on time.

This is also true in view of Germany's goal of increasing the share of renewable energy in its electricity mix to a total of 65% by 2030. This goal is ambitious, especially since energy demand for heating, transport and industry is to be covered by a growing share of renewables-based electricity instead of fossil fuels. In order to keep the need for new photovoltaic and wind energy capacity within reasonable limits, the energy demand in these sectors must therefore be significantly reduced.

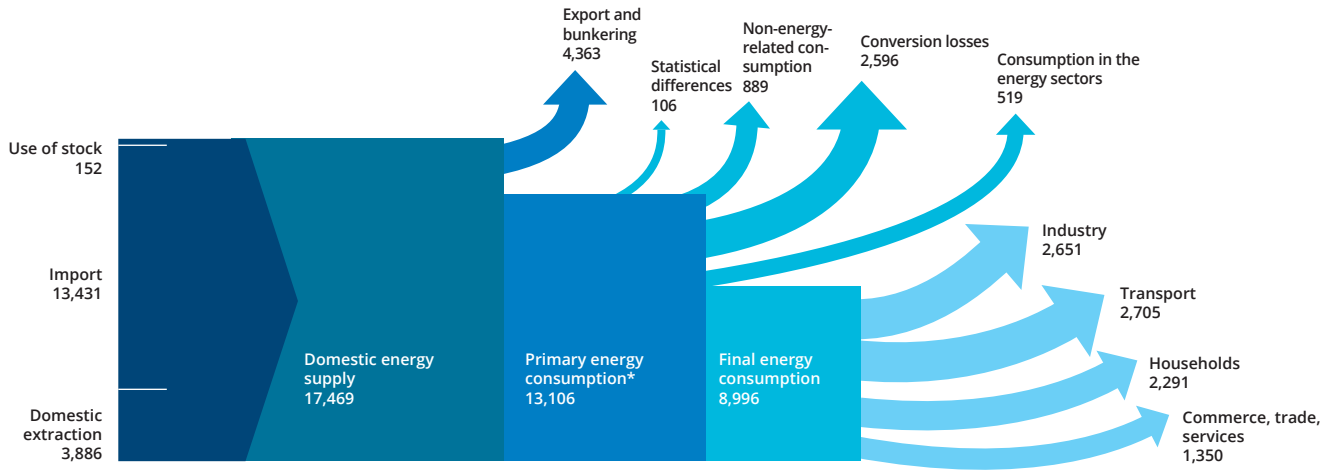


What does primary energy consumption consist of?
Primary energy is the energy that is directly available in naturally occurring energy sources. It is obtained from primary energy sources such as hard coal and lignite, mineral oil, natural gas, wind, water and solar radiation. Primary energy consumption thus comprises the energy content of all primary energy sources that are used in Germany. This also includes secondary energy sources such as electrical and thermal energy, fuels and coal briquettes. Primary energy consumption is calculated by adding together all energy sources procured in Germany with the balance of imported quantities, taking into account changes in stocks minus the stocks bunkered at sea. In contrast to primary energy consumption, final energy consumption is used to describe the amount of energy that is available to consumers after deduction of conversion and transmission losses.

30% less primary energy consumption by 2030

Against this background, the Federal Government has set a national efficiency target for 2030 to reduce primary energy consumption by 30% compared to 2008. This will also contribute to Germany's efforts towards meeting its national target to raise the share of renewable energy in Germany's total gross final energy consumption to 30% by 2030.

At the same time, by reducing consumption by 30%, Germany wants to make an appropriate contribution to meeting the efficiency targets set for the EU. These targets are laid down in the amendment to the European Energy Efficiency Directive (EED) adopted in 2018. The Directive provides for primary and final energy consumption to be reduced within the EU by 32.5% by 2030 compared with a reference scenario. In addition, the EED obligates EU Member States to reduce their final energy consumption by at least 0.8% each year in real terms. In 2023, the EU will consider whether the Europe-wide reduction targets need to be increased. There are also plans to draft a monitoring report in Germany by mid 2022 at the latest. The report will look at whether the efficiency target for 2030 is still appropriate in view of the long-term goal of achieving greenhouse gas neutrality or whether it needs to be tightened. The appraisal will also take future EU requirements into account.



The share of renewable energy sources in primary energy consumption is 13.8%. Differences in the totals are due to rounding. *All figures provisional/estimated
29,308 Petajoule (PJ) ≙ 1 Mio. t SKE

Figure 3: Shares of primary and final energy consumption in Germany (2018)
Federal Ministry for Economic Affairs and Energy, 2019 based on AG Energiebilanzen, 2019)

NAPE 2.0 closes energy-savings gap

Reducing primary energy consumption by 30% over the next decade means cutting down by 1200 terawatt hours by 2030 compared to 2008. More than half of these savings are to be made in power generation – mainly by replacing coal-fired and nuclear power stations with renewable energy plants. Since renewable energy plants are considerably more efficient, the shift towards using greater shares of green electricity will – in itself – cause primary energy consumption to drop by an estimated 700 terawatt hours by 2030 compared to 2008.

The final 500 terawatt hours of energy consumption reductions need to be made by private households, industry, commercial, trade and service enterprises, and transport. According to estimates, the measures which were already adopted before the Climate Action Programme 2030 was adopted will in themselves reduce consumption in these sectors by around 200 terawatt hours.

This leaves a gap in the reduction target that is now being closed by the Energy Efficiency Strategy 2050: the NAPE 2.0 – which forms the centre of this Strategy – is to lead to additional primary energy savings of around 300 terawatt hours by 2030. To put this figure into perspective, this target reduction is equivalent to approximately twice the amount of energy that is currently generated in Germany through wind energy and photovoltaic systems.

3. Measures

The centrepiece of the Energy Efficiency Strategy 2050 is the new National Energy Efficiency Action Plan (NAPE 2.0). The aim of the Action Plan is to reduce final energy consumption in all relevant sectors, i.e. buildings, industry and commerce, transport. Across these sectors, particular importance is attached to reducing energy demand in heating and cooling, which accounts for almost 50% of total final energy consumption in Germany.

The majority of the measures and instruments listed in NAPE 2.0 reduce not only energy consumption but also carbon emissions as a direct result. This is why NAPE 2.0 and the ongoing efforts to achieve the national climate targets for 2030 are closely linked. For example, the Action Plan takes up the same energy efficiency measures that are set out in German government's Climate Action Programme 2030. However, it also includes other efficiency measures that are designed to help reduce final energy demand.

The Energy Efficiency Strategy 2050 addresses challenges, fields of action and instruments that are sector-specific as well as those that are of importance across different sectors.

A. Sectors

Buildings

The buildings sector accounts for around 35% of total final energy consumption in Germany. This means that it has a key role to play in the energy transition and in mitigating climate change. The potential for reducing energy demand and generating heating and cooling from renewables rather than fossil fuels is high. The German Government has taken account of this fact in NAPE 2.0, placing a particular focus on ensuring that energy consumption in the building sector is reduced in an affordable, economic, sustainable and socially equitable manner. This process is being carried out as part of the Long-Term Renovation Strategies (LTRS) measure, whereby each European Member State must submit a national strategy to the EU.

NAPE 2.0 also aims to leverage the potential of using local and district heating networks to decarbonise the heating and cooling supply. Such networks are good for increasing the share of renewable energy in heat generation as they can be fed by solar thermal systems or large heat pumps, for example. Heat pumps are also a good example of how sector coupling helps raise energy efficiency in the buildings sector in a significant way: heat pumps are very efficient because they generate three to four kilowatt hours of heat with one kilowatt hour of electricity. For this reason, sector coupling is given a high priority in NAPE 2.0. However even here, the priority is still to reduce consumption.

i. **Tax incentives for the energy-efficient refurbishment of buildings**

ii. **Federal support for efficient buildings (BEG)** including a replacement premium for oil heating systems

iii. **Promotion of serial renovation** in the building sector (planned)

iv. Further development of **energy-related urban renewal** based on new funding tables (planned from 2020)

v. Further development of **energy consulting and** more specific design of **public relations** structure

vi. **Role model function of Federal buildings** will be developed for and extended to new buildings and existing buildings

vii. **Further development of the energy standard**

viii. **Further development of urban development funding (StBaufF)** (planned from 2020)

ix. **Further development of the innovation programme 'Zukunft Bau' [Future of Construction]**

x. **Conversion and expansion of heating networks** towards making them more efficient and based to an increasing extent on renewables (under 'Energy Industry' in the Climate Action Programme) (planned)

xi. **Replacement of small storage tanks** with electrical flow heaters

xii. **Supporting energy performance contracting** as an instrument for increasing energy efficiency at all levels of the public sector

xiii. **Climate control/ventilation** package incorporating efficiency tools for non-residential buildings

xiv. Minimum specification of **meters** and sensors **for new heating and air conditioning/ventilation systems**

xv. Efficiency-optimised modelling within the framework of **Building Information Modelling (BIM)**

xvi. **Amendment of the Heating Costs Ordinance**

xvii. **Heating suitability check** for consumers

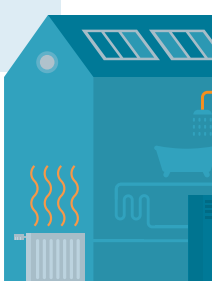


Figure 4: Efficiency measures for the buildings sector
(Source: Federal Ministry for Economic Affairs and Energy, 2019)

In its Climate Action Programme 2030, the Federal Government has adopted numerous, wide-reaching measures to improve energy efficiency in the building sector. These include, among other things, the tax deductibility of energy-related building refurbishment measures, the bundling of subsidy offers in the federal subsidy scheme for efficient buildings (BEG), including the increase and expansion of subsidy rates, and the planned subsidy for serial refurbishment. Energy consulting and public relations work are being further developed, as are energy standards and urban development promotion. The carbon pricing for the heating and transport sectors agreed in the Climate Action Programme 2030 will also provide incentives for saving energy.

Industry, commerce, trade, services

Industry, commerce, trade and services account for a total of 45% of German final energy consumption. Although final energy productivity has increased by more than 10% since 2008, absolute energy consumption has remained constant. It is therefore crucial to intensify efforts to significantly increase energy efficiency in this sector. The Climate Action Programme 2030 is preparing the ground for this.

In industry too, the Energy Efficiency Strategy 2050 is based on the guiding principle of 'efficiency first'. Efficiency measures are considered as part of investment cycles in the business – investments in efficiency must fit corporate strategy and planning and strengthen companies' competitiveness. When designing instruments and incentives, consideration is given to how great an impact these will have on systems or processes at the plant.

Based upon these and other principles, the Federal Government has developed seven strategic fields of action for NAPE 2.0:

- Process heat accounts for two thirds of the final energy demand in industry. The Federal Government will therefore expand its initiative for the use of waste heat through such measures as increasing its funding.
- Industrial companies today generally generate heat for processes and heating needs using fossil fuels. These should be replaced by renewable energy as far as possible.
- The Federal Government seeks to promote the use of highly efficient cross-cutting technologies – pumps, conveyor systems, compressed air systems, etc. – in order to reduce the electricity demand in industry. It plans, for example, to provide stronger incentives for the systematic optimisation of plant and machinery.
- Primary industries are not only very energy-intensive, but also material and resource-intensive. Increasing efficiency in this area also saves costs and energy.
- Using digital technologies makes it possible to analyse energy conditions in a device-specific manner and to perform efficient monitoring, control and regulation of entire production processes, even remotely. This opens up broad new potential for savings. The Federal Government is supporting the transfer of innovative approaches to the cross-system networking of plants, processes and parts of buildings.
- Key leverage for mitigating climate change can be derived from the decarbonisation of processes in primary industries, for example through the use of green hydrogen. New funding programmes are to promote pioneering projects in this area.
- In order to establish energy efficiency as a return on investment and business model, the Federal Government will close gaps in information and strengthen the market for energy services.

The Federal Government is working to address these fields of action through a large number of programmes, instruments and measures. These include, for example, investment programmes targeted at improving energy efficiency and generating process heat from renewable energy in industry, as well as competitive tendering for efficiency measures and a National Decarbonisation Programme. Many measures have already been implemented, others are still being developed.

i. **Investment programme – energy efficiency and process heat from renewable energy in the economy**

ii. **Competitive tendering for energy efficiency**

iii. The Federal Government will examine on a case-by-case basis to what extent the existing **energy tax** breaks for fossil fuels can be more closely aligned with the government's climate policy goals.

iv. By promoting advisory services, investment measures and further training courses on **resource efficiency and substitution**, the Federal Government seeks to firmly establish the principle of the circular economy at German companies.

v. Industry commitment to speeding up implementation

vi. **EU Ecodesign Directive – broadening of minimum standards**

vii. **EU ETS Innovation Fund:** Further development of the NER300 programme, which supports investments in innovative low-carbon and energy-efficient demonstration projects in the energy sector

viii. **The National Decarbonisation Programme** is intended to promote low-carbon and energy-saving technologies for energy-intensive industries as they progress towards market maturity (including, in particular, the optimisation of process chains, the conversion of processes towards the use of renewable energy sources, etc.).

ix. **Programme for preventing carbon emissions from arising and implementation of this in primary industries**

x. **Further development of the Energy Efficiency Network initiative**

xi. **Efficiency analysis tools for energy audits**

xii. **Promotion of process heat efficiency and the potential for using waste heat**

xiii. **Training drive for energy consultants** on the efficient use of renewable energy for process heat supply

Figure 5: Measures for raising energy efficiency in industry
(Source: Federal Ministry for Economic Affairs and Energy, 2019)

Transport

There is a particularly urgent for action in the transport sector, where final energy consumption has risen by 7% since 2008. The main reason for this is the growth in transport services, which has cancelled out any technology-related advances in improving efficiency. Both passenger and freight transport are expected to rise in the time up to 2030. This will represent an additional challenge for reducing energy consumption.

The key starting points for stepping up energy efficiency and climate action in transport are to raise the efficiency of combustion engines, to utilise electrified drives, to use renewable energy for producing fuel and, not least, to restructure the transport system.

The promotion of electric mobility is a central pillar of the Climate Action Programme 2030, which will also strengthen rail transport. A National Hydrogen Strategy has been set up to advance the development and use of fuel cells. However, the transport system as a whole will also have to be redesigned as this is the only way that a sustainable reduction in energy consumption will be achieved despite the continual growth in transport services. The Climate Action Programme 2030 and NAPE 2.0 therefore also aim to change current traffic distribution towards greater shares of rail transport, public transport, cycling and pedestrians. Specific measures here include, for example, the expansion of cycling infrastructure and an increase in funding for public transport and rail transport. In addition, low-carbon cars and trucks are to be more strongly promoted.

B. Cross-cutting topics affecting various sectors

Carbon pricing

In Germany, from 2021, carbon emissions generated by the combustion of heating and motor fuels will carry a price tag. The pricing applies to the entire heating and transport sector with the exception of those sectors that are already subject to EU emissions trading. Initially, a fixed price will apply that will rise year by year. Parallel to this, a platform for trading of allowances will be created. Carbon pricing provides a strong additional incentive for investments in energy efficiency and climate protection.

Digitalisation

Digital technologies offer a powerful leverage for reducing energy consumption. Smart meters provide valuable information on savings potential, smart control enables plant and machinery to be operated more efficiently, and big data and AI solutions provide new insights into consumption. The Federal Government has already taken a number of measures to make optimum use of the opportunities offered by digitalisation. These include a funding programme for energy-saving meters which supports the development of digitally-aided business models for increasing energy efficiency, the funding of measurement and control technology and energy management software, and research funding.

However, digitalisation also leads to the emergence of new ways of using information and communication technology. The Federal Government has responded to this by establishing a Green IT Initiative.

i. **Bolstering rail passenger transport** in order to increase its attractiveness as an energy-saving transport alternative

ii. Increasing the **attractiveness of public transport** to take advantage of its high level of energy efficiency and high degree of electrification

iii. **Development of cycling infrastructure and improvement of the conditions for cycling**

iv. **Bolstering rail freight transport**

v. **Modernisation of inland shipping and use of shore-side electricity in ports** should be promoted by speeding up the adaptation of infrastructure and promoting progressive technologies

vi. **Promotion of low-carbon passenger cars** through purchase premiums for e-vehicles and tax relief for low-carbon passenger cars

vii. **Expansion of the refuelling and charging infrastructure** to support the market ramp-up of alternative drive systems

viii. **Promotion of low-carbon trucks**

ix. **Expand refuelling, charging and overhead line infrastructure** for alternative truck drive systems

x. **Automation and networking of traffic, measures to make traffic more fluid; facilitating innovative forms of mobility**

xi. **Tax incentives for electric mobility and alternative means of transport**

xii. **Energy efficiency standards for electric vehicles** at EU level

Figure 6: Efficiency measures for the field of transport
(Source: Federal Ministry for Economic Affairs and Energy, 2019)

Strategy for promoting energy efficiency and heat from renewable energy

The advisory and support programmes operated by the Federal Ministry for Economic Affairs and Energy in the field of energy efficiency and heat from renewable energies are central instruments of Germany's climate strategy. In its Climate Action Programme 2030, the Federal Government has brought together the different strands of funding for the buildings sector under the Federal Funding for Energy-Efficient Buildings (BEG). Offering higher funding rates, new support measures and better financial resources, the BEG now gives building constructors and property owners stronger incentives for constructing energy-efficient buildings and carrying out energy-efficiency retrofits. In addition, the application procedure has been simplified.

Innovative financing methods

Not all of the potential for making efficiency gains is being used because there is not enough investment funding available. The Federal Government is addressing this issue by providing a series of target group-specific measures. For example, it is drawing up a sustainable finance strategy that is to help financial market players take sustainability aspects better into account in their financing decisions. By issuing environmental bonds (Green Bonds), the Federal Government is supporting the development of sustainable financial markets. As a promotional bank, KfW is to support efforts to transform the financial market and individual economic sectors to make them climate-compatible.

Product efficiency

The two EU instruments of eco-design and energy labelling aim to encourage manufacturers to improve the energy efficiency of their products for household and commercial use. The Federal Government is supporting the continued development these instruments by promoting the use of ambitious standards and running an information drive for the new energy label (scale A to G), for example.

Communication and advice

A core element in all strategies for increasing energy efficiency is the provision of information about energy savings potential, instruments and technologies as well as about support and financing measures. Communication and advice are therefore important pillars of German efficiency policy.

Energy research

Energy efficiency is also a top priority in energy research. One area of focus for research funding is energy-efficiency retrofits for existing buildings with a view to developing technical solutions and exploring the social implications of such retrofits. The research concentrates on both individual buildings and their relationship with one another in the neighbourhood. Another central field of energy research is production processes in industry. In large parts of the corporate landscape, which is dominated by small and medium-sized enterprises, there is still great potential for making efficiency gains. In energy-intensive industry, on the other hand, the focus is on shifting from fossils to renewable energy sources, waste heat recovery and the coupling of different processes. In addition, energy efficiency is also an issue in research projects, for example on grids, storage facilities or sector coupling.

International cooperation

Raising energy efficiency is a global challenge. The Federal Government operates a series of energy partnerships with selected countries which provides a framework for long-term, structured cooperation with these. Energy efficiency forms a core area of cooperation here. In addition, Germany contributes its experience and expertise to the work of many international institutions, including the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA), and the energy committees of the G7 and G20. In addition, the Federal Government organises the 'Berlin Energy Transition Dialogue' (BETD), an annual global conference at which energy and foreign ministers from all over the world discuss key issues of the global energy transformation. Germany is also pressing ahead with the establishment of the Energy Efficiency Hub, which is to continue the activities and successes of the International Partnership for Energy Efficiency Collaboration in a more intensive and effective form in the future.

4. Dialogue process on the Energy Efficiency Roadmap 2050

Figure 7: Structure of participation format
(Source: Federal Ministry for Economic Affairs and Energy, 2019)

In order to halve primary energy consumption by 2050 compared to 2008 as planned, new medium and long-term solutions are needed. The Federal Government is therefore launching a Dialogue process on the Energy Efficiency Roadmap 2050 involving broad participation by the affected sectors, by consumers, representatives of civil society and scientists. As part of this process, the various actors are to discuss ways of working cross-sector in order to achieve the energy consumption reduction target for 2050 and will develop proposals for implementing them. Their job will also be to consider the impact of the identified methods of cooperation on various groups of actors, including consumers, suppliers and policymakers. At the end of the process, a final paper is to be produced that identifies political, economic and legal challenges as well as solutions and specific options for action for achieving the 2050 target.

The dialogue process is also to spawn concepts for specific energy efficiency measures. The new measures can be used en route towards achieving the targets for both 2030 and 2050. The focal points of the roadmap process will be defined taking into account the other specialist dialogues that will be held on ways to implement the climate package or on specific aspects such as the development of a hydrogen strategy.

The participation process will take place at two levels. At a higher first level, regular plenary meetings will be held. At a further level, the topics of the plenary sessions are to be prepared and processed in working groups subdivided according to fields of action.

Long-term importance of energy efficiency

In the short and medium term, higher energy efficiency directly contributes to reducing carbon emissions by reducing the need for fossil fuels. However, as the share of renewable energy used increases, the importance of this role decreases. Instead, energy efficiency becomes increasingly important in order to conserve scarce resources. For example, it limits the need for land for renewable energy plants and power grids, as well as the need for biomass and synthetic fuels. This not only reduces costs, but also boosts public acceptance for the energy transition. If energy is not used efficiently, there is a risk that the public will not accept the necessary expansion of networks and renewable energy, or that technologies will have to be used that are more expensive than the public is willing to pay. Energy efficiency is therefore also an essential element in limiting energy demand and keeping it at a level for which the necessary generation and infrastructure can be provided.

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