TEXTE
161/2022

Coping with the Energy Crisis through Efficiency and Sufficiency

Policy recommendations for easing oil and gas supply tensions in Germany

by:
Eric Fee, Franziska Wehinger, Jens Schuberth, Manuel Hendzlik, Philipp Hölting

Published by:
Umweltbundesamt

German Environment Agency

Umwelt Bundesamt

TEXTE 161/2022

Ukraine Crisis and Sustainability Policy

Coping with the Energy Crisis through Efficiency and Sufficiency

Policy recommendations for easing oil and gas supply tensions in Germany

by

Eric Fee, Franziska Wehinger, Jens Schuberth, Manuel Hendzlik, Philipp Hölting

Imprint

Publisher
German Environment Agency
Wörlitzer Platz 1
06844 Dessau-Roßlau
Phone: +49 340-2103-0
Fax: +49 340-2103-2285
buergerservice@uba.de
Website: www.umweltbundesamt.de

/umweltbundesamt.de
/umweltbundesamt

Completion date:
June 2022

Edited by:
Unit PB 1 Planning and Control, Strategic Controlling, Research Coordination;
Department V 1.1 Climate Change Mitigation
Franziska Wehinger, Eric Fee

Publication as pdf:
http://www.umweltbundesamt.de/publikationen

ISSN 1862-4804

Dessau-Roßlau, October 2022

Abstract: Coping with the Energy Crisis through Efficiency and Sufficiency

This short paper offers practical measures that could help to reduce the consumption of oil and gas as quickly as possible in order to secure the country's energy supply, relieve the burden on consumers and at the same time contribute to combating climate change and enhancing sustainability. Chapter 3 in particular focuses on short-term measures that can easily be carried out within a few weeks and therefore before next winter. This is supplemented by a summary of existing German Environment Agency (UBA) proposals in Chapter 4, which outlines the next steps for accelerating the sustainability transformation.

Abstract: Coping with the Energy Crisis through Efficiency and Sufficiency

This short paper offers practical measures that could help to reduce the consumption of oil and gas as quickly as possible in order to secure the country's energy supply, relieve the burden on consumers and at the same time contribute to combating climate change and enhancing sustainability. Chapter 3 in particular focuses on short-term measures that can easily be carried out within a few weeks and therefore before next winter. This is supplemented by a summary of existing German Environment Agency (UBA) proposals in Chapter 4, which outlines the next steps for accelerating the sustainability transformation.

Table of Contents

1 Germany's energy crisis: with our backs to the wall

Ever since Russia invaded Ukraine and ushered in a new era, Germany's energy policy has been caught between a crisis on the one hand and a spirit of optimism on the other. Alternatives to Russian gas and oil must be found as soon as possible in order to reduce Germany's dependence on imports, while at the same time everything possible must be done to avoid a "coal renaissance"; on the other hand, the prices for heating and fuel have risen very quickly, which is reducing the purchasing power for businesses, industry and consumers. Low-income groups in Germany are finding it increasingly difficult to pay their electricity and heating bills. The cost of heating oil has doubled[1], while the price of natural gas has almost tripled.[2] The Fuel Emissions Trading Act (BEHG) caused the CO_2 price to rise only very slightly (net 0.5 ct/kWh for natural gas, 0.8 ct/kWh for heating oil, 7 ct/litre for petrol, 8 ct/litre for diesel). The price of petrol and diesel jumped to more than two euros per litre and remained at that level for several weeks. Little is likely to change in this regard for the foreseeable future.

In addition to the high costs, there is a looming risk of supply bottlenecks. After the Minister of Economic Affairs announced the emergency plan, the Federal Network Agency then defined what the emergency levels would be in the event of an actual emergency.[3] The oil embargo could result in bottlenecks for drivers, especially in eastern Germany.

Germany is also subject to legal obligations to protect the climate, first among which is that the country must meet its international commitments under the Paris Climate Agreement on achieving the 1.5-degree Celsius target. Secondly, Germany is committed to helping the EU to meet its 2030 GHG emissions target as defined in the EU Effort Sharing Regulation. Countries that fail to meet their EU mitigation targets must purchase surplus emission permits from other countries, which can lead to substantial burdens on the national budget. Thirdly, Germany has set itself binding sector targets through its own climate protection legislation, which were not met in the building sector for the second year in a row or in the transport sector in 2021. Given that projected emissions are not falling quickly enough under existing climate policies, the latest calculations indicate that the target achievement gap in the respective sectors will grow steadily until 2030 unless drastic countermeasures are taken. If the building sector continues on its current path, according to the 2021 projection report it will miss its climate targets by 11 percentage points by the time 2030 comes around.[4]

With its Emergency Energy Measures Package of April 2022 ("Easter Package"), the Federal Government was endeavouring to ensure that the targets of the Climate Protection Act (amended in 2021) can still be met. The necessary regulations, laws and measures are due to be introduced before the end of 2022. However, even if the Easter Package is implemented consistently, time delays of sometimes several years are to be expected and sector targets will be missed repeatedly.

There are solutions, however: cutting gas and oil consumption while remaining competitive would solve all three problems at the same time. It would reduce dependence on imports, protect consumers and also help to mitigate climate change.

Germany does not have a good track record of saving energy. Primary energy consumption in Germany urgently needs to be reduced – by 37% by 2030 compared to 2008 according to the

[1] Relative to the long-term average of around 7 ct/kWh, the cost of heating oil in April 2022 was around 13 ct/kWh.
[2] The price of natural gas rose to 14 ct/kWh as compared to the long-term average of around 6 ct/kWh.
[3] BMWK 2022 a.
[4] Öko-institut et al. 2021

Energy Efficiency Directive. Final energy consumption only fell by a total of 2% (0.3% on average) in the period from 2008 to 2018.

Every reduction in energy and resource consumption not only contributes to the sustainability transformation, but also strengthens the resilience of society and the economy and will therefore help the country to overcome future crises better. That is why the low hanging fruits offered by efficiency and sufficiency measures should be picked with resolve.

Sufficiency strategies are often mistakenly associated with economic downturns and making sacrifices. Instead, they actually boost Germany's competitiveness. Savings in heating and fuel costs can make industries even more export-oriented. The right conditions can help companies reduce their operating costs, for instance by using low-cost public transport instead of company cars, lower energy consumption as a result of lower workshop, factory and office temperatures, and more working from home. The positive correlation between sufficiency and competitiveness must be clearly communicated in the context of the energy-saving campaign. The UBA will assist with this in its dialogue with the public.

About one third of final energy consumption is for heating buildings and providing hot water. This means that the building stock is also responsible for around 20% of energy-related CO_2 emissions in Germany every year. The savings potential in this sector is enormous. The transport sector is also responsible for around 20% of the country's energy-related emissions. While the construction sector has been able to achieve substantial greenhouse gas savings through increases in efficiency over the past 30 years, greenhouse gas (GHG) emissions in the transport sector have barely fallen since 1990[5].

Heating using renewable sources, for example heat pumps and solar panels, and thermal insulation reduce GHG emissions, heating costs and dependence on oil and natural gas. However, severe shortages of raw materials as well as limited numbers of skilled workers and reduced capacity in the building materials industry currently stand in the way of progress. Heat pumps are also only suitable for insulated houses; complete home insulation, on the other hand, is suffering from the stagnating rate of refurbishment. The accelerated scaling up of electromobility and the expansion of public transport (especially rail transport) will also reduce GHG emissions and dependence on oil in the medium term. While both measures must be progressed successively, in light of its complexity the timeframe for such a transformation must also be taken into account here.

Nevertheless, there are measures that can be implemented immediately and without the need for skilled labour, building supplies or other materials. These are simple energy efficiency and sufficiency measures that can have a timely effect and thus alleviate the skyrocketing prices of natural gas and oil, relieve the burden on households and reduce GHG emissions.

[5] German Environment Agency 2022

2 Avoiding lock-ins and pseudo-solutions

In the face of rising prices and fears of shortages, politicians must offer consumers ways out of this situation. However, there is a considerable risk that, due to the urgency of the crisis, popular but ultimately ineffective measures will be implemented. As a result, any hard-won consensus could be called into question again and climate change mitigation could fall victim to hasty decisions. Such decisions are often not only bad for the environment, but also expensive and do not increase the resilience of the national economy or of society.

In the second relief package, for example, the federal government decided on a temporary reduction of the energy tax on fuels for three months (net: 29.55 ct/litre for petrol and 14.04 ct/litre for diesel). This blanket subsidy will undermine the urgently needed reduction in fossil fuel consumption. Instead, this measure perpetuates dependence on fossil fuels and hinders the necessary transformation in the transport sector. Financial support for low-income households would have been a more appropriate measure here and should be taken into account in future deliberations on energy prices (climate income/mobility subsidy or similar). Unfortunately, this so-called *Tankrabatt* (lit. 'fuel discount') also risks completely negating the effect of the promotional *Sonderticket* scheme for local public transport (9-Euro-Ticket), which will be valid at the same time from June onwards. Making public and private transport artificially cheaper at the same time creates a contradictory policy that discourages people from switching from cars to public transport in the long run. The fuel tax discount is a major step backwards as far as the urgently needed transport turnaround is concerned. We can already assume that the fuel discount will mainly be claimed by the mineral oil companies and refineries, because the increase in the prices of petrol and diesel at the pumps is not reflecting the growth in the price of crude oil at present. This double subsidisation means that the allocated funds will not be used for the urgently needed expansion of public transport and pedestrian and bicycle traffic.

Further lock-in measures would include, for example, suspending the CO_2 price path in national emissions trading, even though its share of the energy price increase is negligible – its long-term signalling effect for decarbonisation would then be lost. If the energy tax were not raised to the normal level again after the energy price crisis, the price incentive to use energy sparingly would be permanently reduced. There are many other and more effective instruments to help vulnerable income groups with these high energy and electricity bills (e.g. climate income).

Consumers can also fall into the trap of pseudo-solutions: they may use electric heaters due to the fear of supply shortages or with the intention of saving money. This would not only be very expensive and inefficient, but would also increase electricity consumption and possibly lead to electricity shortages in the industrial sector. Another pseudo-solution would be to use more wood-burning stoves for heating, which would increase air pollutant emissions, worsen air quality and reduce the carbon sink effect provided by forests.

3 A short-term package of measures: making buildings and transport fit for the coming winter

Instead of risking lock-ins, the crisis in the building and transport sector must be seen as an opportunity. A realistic scenario for this would be to run a nationwide initiative to reduce the temperature in buildings by two degrees during the heating season, and by winter all heating systems will have been adjusted so that they waste as little gas and oil as possible and heat up the rooms to a lesser extent. The federal, state and local governments are setting a good example with all the public buildings in their ownership. Instead of the flat-rate subsidisation of fossil fuels through the energy tax rebate, low-income households would receive targeted support. At the same time, a temporary speed limit of 100 km/h on motorways, 80 km/h outside built-up areas and a standard speed of 30 km/h in built-up areas would be introduced. An obligation on the part of employers to provide support for home working would also reduce the number of journeys to and from work. All available reserves in local public transport will be used to increase capacities in the short term and pop-up infrastructures for bus and bicycle traffic will be created. This could save around 10% of the annual final energy consumption of buildings and at least 7 to 9% of fuel consumption in the transport sector.

The UBA proposes the following measures, which could be implemented within a very short period of time and can bring about considerable savings to the energy budget:

3.1 Buildings

3.1.1 Starting point and opportunities

While politicians appeal to consumers and demand changes in behaviour, many of these behavioural changes can be facilitated and achieved through policy measures. Significant energy savings can be made in the short term: 15 TWh of natural gas can be saved by reducing room temperature by 1 degree (30 TWh by reducing room temperature by 2 degrees) and 11 TWh of natural gas can be saved by using energy-saving shower heads (less than 7 litres/minute) or flow limiters. The operating modes of heating systems will come into their own here, since most heating systems are not adjusted to the optimal settings and therefore waste energy. The savings in heating energy achieved by optimising heating systems (hydraulic balancing; adjustment of the temperature control) amount to up to 30% in some cases, and 8 kWh/m^{2}a on average (4 -11 kWh/m^{2}a); electricity consumption can be reduced by up to 80% through the use of a high-efficiency circulator pump compared to a conventional circulator pump. The potential savings amount to around 9.5 (4.5 - 13) TWh of natural gas if heating optimisation is carried out in half of all residential buildings that are heated using natural gas. Automated or even AI solutions can simplify the process of optimising heating systems. There is potential for economising on water heating by limiting temperatures to the minimum required to protect against legionella. Adjustable radiator thermostats allow for more precise control of room temperature.

3.1.2 Measures and instruments

The German Environment Agency proposes the following measures in order to tap into this potential in the short term:

Measure: **Reduce room temperature in all public buildings by 2 degrees and set heaters correctly.** The public sector, from the federal government to the *Länder* and local authorities, should live up to its role model status by lowering the room temperature in all public buildings and, if heating systems cannot be optimised, at least checking and adjusting the settings of

heating control systems. Berlin set a good example by lowering the water temperature of all outdoor pools.[6] 50/50 projects should be rolled out in all schools and further education institutions from the new school year onwards, with pupils looking for ways to save energy and receiving half of the cost savings for school projects as a reward; this approach is tried and tested and enables multiplier effects into households.
Instrument: A directive from the Ministry for Housing, Urban Development and Building on lowering room temperatures and optimising heating. Commitment of *Länder* and local authorities through the Energy Efficiency Act. Voluntary commitment on the part of municipal umbrella organisations and other school authorities for school projects, if applicable.

Measure: **Provide clear and easy-to-understand information about heating.** Successful behavioural change, be it through ventilation, lowering the room temperature or saving water, requires clearly understandable information. The Heating Costs Regulation started providing monthly information in 2022, but does not give much more detail on how behavioural change is to be achieved. The elements proposed in the UBA guidelines for easy-to-understand heating information (including cost estimation)[7] should be reinforced in the Heating Costs Regulation; transitional periods for the installation of remotely readable metering devices should be shortened. Tenants should also have the right to access information about the building/heating efficiency measures implemented by their landlords.
Instrument: Alterations to the Heating Costs Regulation

Measure: **Ensure widespread impact with regulations on heating optimisation.** The first step is for all building owners to demonstrate that their heating controls are configured correctly by the end of the year; if tools are provided, this can be done with little effort and basic knowledge. The second step should involve providing evidence of complete heating optimisation by the end of 2024; this is more time-consuming/technically complex and requires more expertise. Both can be checked by the municipal chimney sweep. For landlords, only having to ensure lower room temperatures depending on the gas warning level can be beneficial.[8]
Instrument: Alterations to the Buildings Energy Act

Measure: **Swift roll-out of energy-saving campaign:** instead of passive contributions (television/posters/cinema advertisements), the public must be addressed directly. The federal government (chancellor/minister) should write to all households individually; existing, simple online tools[9] should be used for providing initial advice and "energy accounting", as energy advisors are already very busy; energy-saving competitions should be launched; tools such as video tutorials should be offered to help people implement energy-saving measures such as adjusting their heating systems. The campaign must be prominent (for instance in the format of "Energy Saving at Eight" instead of "The Stock Exchanges at Eight"), low-threshold (easily accessible), enabling (i.e. motivating and creating a personal connection) and engaging (i.e. not an unwanted obligation on the part of the target group). Easily communicable goals must be formulated as part of this campaign (finding "1 million energy-saving households" in 1 week).

[6] Ferstl 2022
[7] Brischke et al. 2021
[8] Various court decisions interpreting room temperatures below 20-22°C as inadequate, cf. https://www.dahag.de/c/ratgeber/mietrecht/mietmaengelanzeige/raumtemperatur
[9] Interactive, easy-to-use online advice (https://www.co2online.de/service/energiesparchecks), monitoring of savings successes with the http://energiesparkonto.de tool

Instrument: enabling, engaging outreach communication campaign run by the Ministry for Economic Affairs and Climate Action (BMWK)

Measure: **Boost workforce and skilled labour for the *Gebäudewende* (lit. 'building revolution').** The shortage of skilled workers in the construction sector is already causing a significant bottleneck in the rapid implementation of the 'building revolution'.[10] If the refurbishment rate doubled, the shortage of skilled workers would grow by an additional 100,000 jobs.[11] This is why the Skilled Workers Strategy should be revised promptly and the Skilled Workers Immigration Act should be implemented with resolve. To achieve this, professional recognition procedures and the processing time for work visas must be accelerated. Most urgently, it must be made possible for refugees from crisis regions to enter the country quickly. Some aspects of providing energy advice for buildings can be taken over by artificial intelligence and digital programmes (smart meters), if these programmes are promoted and made marketable.
Instrument: Immigration Act for Skilled Workers, Skilled Workers Strategy, Ministry of Labour and Social Affairs (BMAS)

3.2 Transport

Measure: The introduction of a **speed limit** of 100 km/h on motorways and 80 km/h on extra-urban roads could save up to 2 billion litres of fossil fuels, which corresponds to 3.8% of Germany's total fossil fuel consumption in 2020. This could eliminate around 5.3 million tonnes of CO_2 equivalents per year. A speed limit of 120 km/h on motorways would still save around 800 million litres (1.5%) or 2.0 million tonnes of CO_2 equivalents.
Instrument: Amendments to the Road Traffic Regulations and Motorway Speed Limit Act (in accordance with Section 1 (1), (3) of the Energy Security Act).

Measure: The potential for saving fuel through having **car-free Sundays** was recognised as long ago as 1973. It is also an appropriate measure for reducing fuel consumption in the present situation. Making every second Sunday car-free could save up to 3% of the annual fuel consumption of passenger cars and light commercial vehicles. Ideally, streets and squares would be opened to pedestrians and cyclists on Sundays and public transport would be free of charge.
Instrument: Regulation under Section 1 Paragraphs 1, 3 of the Energy Security Act.

Measure: During the coronavirus pandemic, **working from home** increased and around 3.7 million tonnes of CO2 were saved as a result of fewer commuter journeys. This measure is also pertinent for the energy savings that are now needed, because the savings potential of multi-site working, even after the pandemic, is around 1.0 to 3.7 million t CO2-eq.[12] This corresponds to an annual fuel saving of between 0.6 and 2.3%. The UBA suggests that employers must allow employees to work from home where work profiles and business processes permit. This would allow the potential described above to be exploited in the short term. During the coronavirus pandemic, this obligation was imposed as part of the Infection Protection Act.
Instrument: Regulation under Section 1 Paragraph 1 of the Energy Security Act.

Measure: **Improvements in local and long-distance public transport services** through a short-term, temporary expansion of services (increased frequency) by activating reserves

[10] BMAS 2021
[11] Bauer et al. 2021
[12] Öko-Institut 2022

(personnel and material) and accelerating public transport (e.g. bus lanes, express routes). This requires the provision of financial resources in the short term and the prospect of adequate funding in the long term. Every kilometre travelled by public transport saves 27% (local bus) to 82% (long-distance bus) of greenhouse gas emissions and a comparable amount of fuel compared to using a car[13]. The overall reduction depends on the actual expansion of capacity that can be achieved in the short term and is difficult to estimate.

Instrument: Amendment to the Regionalisation Act, as well as to the Road Traffic Regulations

Measure: The strong demand for the 9-Euro-Ticket and the large number of passengers on public transport at the beginning of the promotional period show that a simple and inexpensive local transport fare is very attractive to passengers and that people are making the most of this offering. The UBA therefore proposes the introduction of a **discounted annual ticket for the entire public transport system (*Deutschlandticket*)**.
The funding would come from passenger revenue and subsidies from the federal government and is separate from the increase in funding for public transport that is fundamentally necessary in the long term. On the contrary, further financial resources should be made available to improve services in the short term (increased frequency, service, comfort).
This initiative should most certainly be accompanied by other measures in order to reduce the number of passengers at peak times and to avoid congestion that exceeds capacity limits. These include: more home working or more flexible working hours; boosting cycling (e.g. pop-up cycle lanes on main commuting routes); short-term, temporary expansion of services (increasing frequency) by activating reserves (personnel and material) and speeding up public transport (e.g. bus lanes; express routes).

Instrument: e.g. Regionalisation Act, Road Traffic Regulations (for cycle paths and bus lanes) (BMF / BMDV)

[13] Based on average emissions of the means of transport:
uba_emissionstabelle_personenverkehr_2020.pdf (umweltbundesamt.de)

4 Beyond next winter: accelerating the sustainability transformation and strengthening resilience against future crises

In addition to short-term measures to overcome the current crisis, the federal government must now implement further measures to build resilience to future crises and accelerate the sustainability transformation. The heat pump campaign will make such heating systems commonplace in a few years, meaning that new boilers will only be installed in exceptional cases. More than 1 million heat pumps should be installed by 2025, which will accelerate the transition of the heating market.[14] The announced *Solardachpflicht*, literally meaning 'solar roof obligation', must now be swiftly put into practice.[15] The envisaged energy standards for new buildings are both appropriate and useful; however, the focus of the building revolution urgently needs to be extended to existing buildings.

Public transport services must be continuously improved and expanded. The promotion of electromobility should be supported by means of polluter-pays pricing, the reduction of fossil fuel subsidies and a reform of vehicle taxation towards a bonus-malus system. A reduction of 24% of the annual final energy consumption of buildings and 28% in transport (even 48% of the final fossil energy demand) compared to 2018 could be achieved by 2030[16]. This would signal an end to energy imports from Russia.

The medium- and long-term recommendations for policy action are only outlined here in summary form, as they are already described in detail in other UBA publications.[17]

4.1 Buildings

The first mechanisms for the transformation of the building stock are already being refined[18], partly in connection with the Climate Protection Emergency Programme and partly in light of the war in Ukraine. Other projects listed in the coalition agreement must be tackled soon, such as better funding for heating networks, mandatory municipal heating planning and the decarbonisation of district heating. The UBA has also identified further opportunities for climate protection instruments in the medium to long term. They could reduce **final energy consumption by 24% (167 TWh)** by 2030 relative to 2018, instead of the 13% that is currently projected, and reduce **greenhouse gas emissions by 42% (39 Mt)** instead of 22%.[19]

Improving the financing of heat pumps – shaping the roll-out. In addition to conventional funding, alternative approaches such as tendering heat pump heating systems as an energy

[14] 150,000 heat pumps were installed in 2021. The BMWK has set a target of installing a total of 6 million heat pumps by 2030.
[15] BMWK 2022 b.
[16] Based on previously unpublished research report (see: UBA, not yet published).
[17] See e.g.: Purr et al. 2021; Rother et al. 2020; UBA 2022
[18] For example: the 'solar roof obligation', stricter standards for new buildings in line with the 'Effizienzhaus 55' goals from 2023 onwards and those of 'Effizienzhaus 40' from 2025, minimum proportion of 65% renewable energy sources for new heating systems from 2024.
[19] See: UBA, not yet published. It is likely that these potentials are still valid to an extent, as both construction prices and energy prices have risen; cf. Hinz & Enseling 2022

service (bundled micro-contracting) should be pursued in order to mobilise new actors such as energy service providers and municipal utilities. Given that even after deducting the subsidy, these systems still require substantial investments, complementary financing options must be developed so that more households can afford climate protection measures. [20]

Uphold quotas of renewable energy sources. The minimum quota of 65% renewable energy sources for new heating systems should be increasingly supplemented in subsequent years in order to make the future direction clear to the market. At the same time, the federal government should agree on an end to the installation of gas-powered heating systems by 2026.

Improve energy standards. Energy standards will permanently reduce energy use in existing buildings and contribute to reducing reliance on natural gas and heating oil in the medium term. In addition to the requirements for new buildings, those for existing buildings in particular should be strengthened and the requirements should gradually be raised to at least the level of the 'Effizienzhaus 55' by 2025.

Make better use of living space. Municipalities (or agencies) should encourage the shared use of flats and houses with low occupancy rates (e.g. once children have moved out). To do this, they will offer a housing exchange service that can arrange everything from subletting to full rental management. This would also be a good option for Ukrainian refugees.

Promote small-scale, low-threshold conversions. A co-benefit for housing sufficiency could be created here: on the one hand, existing buildings can be used instead of developing new areas, and on the other hand, accommodation for Ukrainian refugees can be provided.[21]

4.2 Transport

UBA is pursuing a complete reorientation of transport policy in the transport sector. The transport revolution towards climate protection-oriented, environmentally, health and socially compatible mobility is – in contrast to the energy revolution in Germany – still in its infancy. We must not only strive for a massive expansion of public transport, but also for sufficiency in personal transport and the consumption of fossil fuels. The necessary measures can be assigned to eight core building blocks, which include regulatory, economic and infrastructural instruments[22]. The measures that need to be implemented include, in particular, pricing transport according to the 'polluter pays principle', boosting rail transport and ecomobility, developing a suitable energy infrastructure (overhead lines), as well as electrifying and improving the efficiency of cars, light and heavy commercial vehicles. These or comparable measures could reduce **final energy consumption by 28% (fossil EEV as much as 48%)** by 2030 relative to 2018, instead of 10% as is currently projected, and **GHG emissions by 48% (78 Mt CO_2 equivalent)** instead of 22%.[23]

A **polluter-pays pricing system** includes a CO_2 price that is significantly higher than the current BEHG (Fuel Emissions Trading Act) price path, and also dismantles environmentally harmful

[20] e.g. Green Finance Institute 2022; Somper 2021;
[21] The *Raumteiler* ('room sharer') initiative run by the state of Baden-Württemberg, which aims to make the most of under-occupancy or vacancies for refugees in search of accommodation, was established in 2015 and is currently aimed at Ukrainian refugees: https://www.raumteiler-bw.de/raumteiler
[22] German Environment Agency 2022
[23] Based on previously unpublished research report (see: UBA, not yet published).

subsidies in air transport, company cars, diesel and commuting allowances. A mileage-based passenger car toll should be introduced on all roads by 2030. This must be based on the external (environmental) costs of transport and would be a strong instrument for environmental protection, which could also compensate for falling tax revenues as electromobility increases.[24] With regard to freight transport, it is essential to extend the HGV toll to all HGVs, all roads and to internalise all external costs at an early stage.

Another focus for the transport revolution should be on strengthening ecomobility, which consists of public transport, cycling and walking, as well as sharing services. Sufficient funds must be available to make public transport attractive, the range of services must be expanded, and the frequency and quality must be increased. An additional 11 to 15 billion euros of funding will be needed per year. Then there is the expansion of the rail infrastructure, for which a further 3 billion euros per year will be required[25]. Furthermore, digital solutions (e.g. Mobility as a Service (MaaS)) and more flexible forms of service are needed, especially in rural areas (e.g. ridepooling)[26]. Cycling and walking should also be promoted more strongly and considered from the outset in transport planning. The funding requirement for cycling is set by the federal government with a lower limit of 30 euros per person per year[27], while Baden-Württemberg estimates a minimum of 10 euros per person for the development of a base network of paths.[28]

When it comes to vehicles, the focus of the revolution is on **greater efficiency and electrification**. The European CO_2 standards for passenger cars and light commercial vehicles are key factors in boosting the market for electric vehicles and also improve the efficiency of new vehicles.

This instrument can be supported at the national level by an e-quota and a **bonus-malus system for newly registered passenger vehicles**. The latter promotes the buying of environmentally-friendly cars with low CO_2 emissions by means of a subsidy and makes the buying of particularly high-emission cars more expensive by means of a surcharge. If structured in the right way, a system will be created in which buyers of cars that are more harmful to the climate will co-finance the purchase of more environmentally-friendly models without the need to spend taxpayers' money on them. For heavy-duty vehicles, electrification should be accelerated, if possible, by expanding the EU CO_2 fleet target for 2030 to -50% relative to 2021 (currently -30%) and by developing an overhead power line infrastructure on motorways[29]. The instruments for polluter-pays pricing also promote greater efficiency and electrification of vehicles.

[24] Friedel & Blank 2021
[25] Naumann et al. 2019; UBA 2022
[26] German Environment Agency 2022
[27] BMDV (2022): National Cycling Plan 3.0, p. 24.
[28] Ministry of Transport Baden-Württemberg (2022): *Auf die Füße, fertig, los! Erfolgreiche Wege zu mehr Fußgängerfreundlichkeit*, p. 32.
[29] German Environment Agency 2022

5 List of sources

Bauer S., Lehr U., Thobe I., Ulrich P., Wolter M. (2021): *Konjunktureller Beitrag des Baugewerbes- in der Corona-krise und darüber hinaus. Umwelt, Innovation, Beschäftigung 02/2021, Umweltbundesamt, Dessau-Roßlau.*

BMAS- Federal Ministry of Labour and Social Affairs (2021): *Fachkräftemonitoring- Arbeitsdynamik in den nächsten fünf bis zwanzig Jahren.* https://www.bmas.de/DE/Arbeit/Fachkraeftesicherung-und-Integration/Fachkraeftemonitoring/fachkraeftemonitoring.html (31.05.2022)

BMWK - Federal Ministry for Economic Affairs and Climate Action (2022a): *Notfallplan Gas für die Bundesrepublik Deutschland.*https://www.bmwk.de/Redaktion/DE/Downloads/M-O/notfallplan-gas-bundesrepublik-deutschland.pdf?__blob=publicationFile&v=17 (31.05.2022)

BMWK - Federal Ministry for Economic Affairs and Climate Action (2022b): *Energie sparen für mehr Unabhängigkeit – Arbeitsplan Energieeffizienz.* https://www.bmwk.de/Redaktion/DE/Downloads/Energie/20220517-arbeitsplan-energieeffizienz-energiesparen-fuer-mehr-unabhaengigkeit.pdf?__blob=publicationFile&v=6 (17.05.2022).

Brischke L., Over M., Parnow H., Barth J., Walter S. (2021): *Verständliche monatliche Heizinformation als Schlüssel zur Verbrauchsreduktion*, Climate Change 69/2021, German Environment Agency, Dessau-Roßlau.

Ferstl, C. (2022): *Freibadsaison startet mit unangenehmer Überraschung.* From: Frankfurter Allgemeine Zeitung 30.04.2022. https://www.faz.net/aktuell/wirtschaft/wegen-gaspreisen-schwimmbaeder-senken-temperaturen-17993337.html (23.05.2022)

Friedel C & Blank R (2021): *Mobilität neu Steuern – Ein Steuer- und Abgabekonzept für klimaschonenden und sozial gerechten Verkehr bis 2050.* German Environment Agency, Dessau-Roßlau.

Green Finance Institut (2022): *Billionen mobilisieren - Öffentlich-private Innovation, die das EU-Ziel der Renovierungswelle ermöglicht.* https://www.greenfinanceinstitute.co.uk/programmes/ceeb-europe/ (31.05.2022)

Hinz E., Enseling A. (2021): *Gutachten für den Verbraucherzentrale Bundesverband: Spezifische Kosten für die energietechnische Modernisierung im Gebäudebestand in Abhängigkeit des Effizienzstrandards,* Ingenierbüro Hinz, Darmstadt.

Naumann R., Pasold S., Fröhlicher J. (2019): *Finanzierung des ÖPNV. Status quo und Finanzierungsoptionen für die Mehrbedarfe durch Angebotsausweitungen. Gutachten im Auftrag des Umweltbundesamtes.* KCW GmbH, Berlin.

Öko-Institut (2022): *Arbeiten im Homeoffice – gut für die Umwelt und die Mitarbeiter:innen? Analyse der potenziellen ökologischen und sozialen Auswirkungen mobilen Arbeitens.* Page 21

Öko-Institut; Fraunhofer ISI; IREES GmbH; Thünen-Institut (2021): Projection Report 2021 for Germany, Pursuant to Article 18 of Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the governance system for the Energy Union and climate change, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, and §10 (2) of the Federal Climate Change Act. With the collaboration of Repenning, J.; Harthan, R. O.; Blanck, R.; Böttcher, H.; Braungardt, S. et al, 2021.

Purr K., Wehnemann K., Balzer F., Erxleben F., Hendzlik M., Kahrl A., Lange M., Lünebürger B., Steinbrenner J., Weyland M. (2021): *Treibhausgasminderung um 70 Prozent bis 2030: So kann es gehen!;* Position paper, German Environment Agency, Dessau-Roßlau.

Rother S., Schuberth J., Steinbrenner J., Bade M., Bertram A., Herda I., Herbstritt C., Lüneberger B., Mohr L., Purr K., Rau C., von Schlippenbach U., Sieck L., Unnerstall H. (2020): *13 Thesen für einen treibhausgasneutralen*

Gebäudebestand- Drängende Herausforderungen der Wärmewende. Position paper, German Environment Agency, Dessau-Roßlau.

Stomper A. (2021): *Zur Finanzierung der Energetischen Gebäudemodernisierung: EGM-Kapital. Skizze eines Vorschlags*, Institute for Financial Economics, HU Berlin, Climate Change Center Berlin Brandenburg.

UBA – German Environment Agency (2022): *Klimaschutz im Verkehr*. https://www.umweltbundesamt.de/themen/verkehr-laerm/klimaschutz-im-verkehr#undefined (31.05.2022)

UBA – German Environment Agency (not yet published): „*Klimaschutzinstrumente-Szenario 2030 (KIS-2030) zur Erreichung der Klimaschutzziele 2030" im laufenden Forschungsvorhaben „Politikszenarien für den Klimaschutz X*" (FKZ 3720415010), Dessau-Roßlau.