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Tobias Fleiter
Meta Thurid Lotz
Marlene Arens
Barbara Schломann

An overview of implemented and planned
policy instruments to decarbonize basic ma-
terial industries in Germany

Abstract

The policy mix for industry decarbonization in Germany currently undergoes substantial changes. While in the past, it focused strongly on measures supporting and regulating energy efficiency, while in recent years instruments were added that aim at deep decarbonization of industrial production processes and at the long-term transformation of the industry sector.

This report presents a summary of the policy instruments aimed at decarbonizing the basic material industry sector in Germany considering currently implemented and planned policies. We provide detailed fact sheets with the current policy design. There is a particular focus on policies supporting innovation and the market entry of new emerging technologies in the following fields, which are regarded central for industry decarbonisation:

- hydrogen use.
- electrification of industrial heat production,
- carbon capture and storage,
- bio-based materials,
- recycling of materials.

Furthermore, we present a summary of the policy mix and discuss its effectiveness to induce the needed technological change towards CO₂-neutrality in heavy industry. Current gaps in the policy mix are identified and recommendations to reform the policy mix are provided.

Keywords: industry transformation, decarbonisation, policy mix

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1 Summary of the policy mix in Germany: Is it effective to decarbonize the industry sector?

1.1 Introduction

This section provides a summary of the policy mix and discusses the effectiveness of the overall policy mix to induce the needed technological change towards CO₂-neutrality in heavy industry in Germany. A particular focus is placed on the following technology solutions:

- hydrogen for process heating and feedstock (including “blue” and “green” hydrogen),
- electrification of process heating,
- carbon capture and storage,
- bio-based materials,
- recycling of materials (notably metals and plastics).

In the following, we discuss the policy mix in three steps. First, we summarize the overall policy mix. Second, we discuss technology development policies aimed at decarbonizing heavy industries using hydrogen, electrification, and CCS. Third, we discuss material efficiency and recycling policies.

1.2 Summary and recommendations

The summary below builds on the fact sheets in section 2 and the policy overview in Table 1.

Traditionally, the policy mix to decarbonize the industry sector in Germany focused strongly on policies encouraging **energy efficiency** like audit schemes or grants for efficiency improvements. These mostly addressed SMEs and lighter industries. Regulations for **recycling** and the sorted collection of consumer waste formed the second major pillar of the policy mix. This resulted in high recycling rates for products like paper or glass. For a long-time, the EU ETS was the main policy addressing **decarbonization in heavy industry**. However, with very low CO₂-prices below 10 euros/t CO₂ and free allocation of allowances to most industries, this has had basically no effect on investment decisions in energy-intensive industry (this started to change when allowance prices increased to 20 euros and higher in 2018). **Energy taxes** and the EEG-levy are mainly relevant for small companies, while large energy consumers receive large tax exemptions.

GHG reduction targets have also evolved over the past decade. The Climate Action Plan 2050¹, adopted by the German government in November 2016, affirms the Paris Agreement target to achieve CO₂-neutrality by mid-century, contains concrete actions to achieve it, and defines milestones for the year 2030 on a sectoral level. For the industry sector, it sets a target of 49-51% GHG reduction by 2030 compared to 1990. Achieving the sectoral target will require substantial mitigation efforts including large-scale investments in CO₂-neutral production technologies. The targets were further strengthened by the German Climate Protection Law, which went into force in December 2019. This law defines a (linear) path for emission reduction in all sectors towards the 2030 milestone and calls for additional policy action should the monitored emissions fall short of the minimum path in a specific year. Overall, the sectoral target and the clear commitment to GHG neutrality by 2050 have facilitated private and public-sector activities to decarbonize industry, as it has become obvious that the industry sector needs to cut emissions drastically if the overall reduction target is to be met.

Two important milestones for the industrial transition were the publication of the Hydrogen Strategy (June 2020) and the Climate Action Program 2030² (October 2019). Among other things, these have initiated several major **technology development programs** (see section 1.3), providing investment support for the industrial-scale market introduction of CO₂-neutral (or low-carbon) production technologies in heavy industry sectors.

Despite this recent amendment, the policy mix is in several aspects not sufficient to put the industrial transition on the right track towards decarbonization by 2050. These relate - among others - to the lack of a clear and robust perspective for the competitive operation of large-scale, low-carbon plants in the medium term (towards 2025/2030). Here, policy initiatives could address the following issues:

- Technology development programs currently focus on CAPEX support and lack **OPEX support**, which is particularly important for hydrogen-based technologies in the short and medium term. Expanding the pilot CCfD program - if successful - might be a way forward. Alternatively, the supply of hydrogen at lower costs could also reduce this OPEX gap.
- The EUA price in the ETS is too low to make key decarbonization technologies like hydrogen, electrification or CCU/CCS cost-competitive and lacks a clear

1 Climate Action Plan 2050 – Principles and goals of the German government's climate policy (bmu.de)

2 Klimaschutzprogramm 2030 der Bundesregierung zur Umsetzung des Klimaschutzplans 2050

perspective that allows the consideration of steadily increasing CO₂-prices in cost-benefit assessments of new investments. A **minimum CO₂-price path** could solve both issues and provide a clear perspective for low-carbon investments towards cost-competitiveness.

- **Green product lead markets** can support the market-entry of CO₂-neutral products by allowing for a price-premium on products made from CO₂-neutral basic materials like a car made of CO₂-neutral steel or a building made of CO₂-neutral concrete. Public procurement, product labeling or product standards, among other things, could help to close this gap and induce niche markets.

Furthermore, the huge amounts of **CO₂-neutral energy carriers** required to operate CO₂-neutral industrial-scale plants (electricity, hydrogen, green gas) are not yet available. There is still a high level of uncertainty about whether and when such energy carriers will be provided in sufficient quantities at a competitive price. For companies to make investments of several hundred million euros, the supply of such critical energy carriers must be guaranteed. This includes local availability, e.g. of hydrogen, and the **infrastructure** needed for generation/import and transport. Investors in large-scale DRI-steel plants, for example, need to know whether there will be access to a hydrogen network by a certain date in the future, and whether hydrogen will be part of Germany's strategy for industry decarbonization. As a result, the industry policy mix also has strong links to infrastructure planning.

In some sectors, **process emissions** cannot be mitigated by switching energy carriers or process routes. Cement and lime production are the most prominent and relevant examples. Deep decarbonization of these sectors most likely requires carbon capture and storage (**CCS**) or carbon capture and use (**CCU**). While the *Program for CO₂ Avoidance and Use in Basic Industries* is currently being implemented, there is still huge uncertainty for investors due to widespread public opposition to CO₂ storage in Germany. Although this opposition was initially directed at CCS for coal-fired power plants, it is not clear whether the public can distinguish CCS for process-related emissions. For CCU, a major challenge will be to find uses with a long-term storage - substantial R&D is still needed here.

Material efficiency and the circular economy along industrial value chains to end-use sectors is another area where the current policy mix must be adjusted if it is to be aligned with industry decarbonization. CO₂-prices are not included in the prices of most consumer products. Consequently, CO₂ is not factored into investment decisions when materials are used to construct buildings or cars, for example.

Circular economy policies still display a rather traditional focus on the collection and recycling of waste. While some improvements have been made recently (e.g. stricter regulations for commercial waste), particularly materials with very high emission intensity still show very low shares of secondary production routes. Circular economy policies could make a more effective contribution to decarbonization if amended in the following directions:

- Stronger focus on the circularity of **plastic** products in order to close carbon cycles by including chemical recycling and avoiding downgrading.
- Replacing primary **steel** production by secondary production to a greater extent is a very effective decarbonization measure, but would require improved collection of steel scrap and the wider use of secondary steel for high-quality products, e.g. in the automobile industry.
- Development and use of alternative materials to decarbonize the construction sector and especially **concrete** production.
- Across all materials, the current focus on "recycling rates" as collection-centered approach should be amended by a production-centered approach that reports the share of secondary production in total production as it shows the importance of recycled versus primary materials in new production.

These goals require the creation of **markets for recycled products** and the implementation of uniform product standards at national and European level.

1.3 Policy area: Technology development towards decarbonization

In recent years, the German policy mix has been extended by several instruments aiming at the development and large-scale market introduction of decarbonization technologies in heavy industries. Five instruments in particular can be mentioned in this category:

- e) National Decarbonization Program
- f) Program CO₂ Avoidance and Use in Basic Industries: Under preparation (as of 1.2.2021)
- g) National Hydrogen Strategy: CCfD pilot
- h) National Hydrogen Strategy: IPCEI "Hydrogen for industrial production"
- i) EU ETS Innovation Fund: further development of the NER300 program

Summaries of the individual instruments are available in section 0. While all the instruments aim at decarbonizing heavy industry, their technology focus differs substantially (see Table 2). The *EU Innovation Fund* shows the broadest technology focus and even includes the switch to new low-carbon products. While the *Decarbonization Program* was first planned to only address process-related emissions, it was finally published with a broader technology scope. However, downstream activities like material efficiency or recycling are still beyond its scope. The *Program for CO₂ avoidance* is still under preparation and had not yet been published in January 2021. It is currently planned to address carbon capture, use, and storage as well as transport technologies. The *IPCEI for hydrogen* and the *CCfD Pilot* both aim at constructing large-scale industrial installations that replace fossil fuels with hydrogen (green or blue). Overall, the programs show a relatively complete technology coverage for the major decarbonization options of hydrogen, electrification and CCS/CCU.

The three programs *CO₂ Avoidance and Use*, *Hydrogen CCfDs* and *IPCEI for Hydrogen* mainly aim at building large-scale industrial plants, while the *Decarbonization Program* and the *EU Innovation Fund* are also more open to smaller demonstration projects.

Table 2: Overview of the technology scope of technology development policies

(dark green= high relevance; light green = relevant; white = out of scope)

Policy Instrument	Industry type		Mitigation technologies							TRL
	Heavy industry	Light industry	Hydrogen	Electrification	CCS / CCU	Bio-based materials	Circularity	Material efficiency	Energy efficiency	
Technology development										
e) Decarbonization Program	Dark Green	White	Dark Green	Dark Green	Light Green	Light Green	White	White	White	4-9
f) CO2 Avoidance and Use	Dark Green	White	White	White	Dark Green	White	White	White	White	8-9
g) Hydrogen CfDs	Dark Green	White	Dark Green	White	White	White	White	White	White	8-9
h) IPCEI Hydrogen	Dark Green	White	Dark Green	White	White	White	White	White	White	8-9
i) EU ETS Innovation Fund (EU)	Dark Green	White	Dark Green	Dark Green	Dark Green	Dark Green	Dark Green	Dark Green	Dark Green	6-9

The potential impact of these programs can be estimated based on the available budget. This is summarized in Table 3 for the time horizon foreseen in the programs' current planning. However, it is likely that the programs will be continued beyond the currently planned time horizon, which will substantially increase the total budgets available until 2030. The budget of the *EU Innovation Fund* was estimated based on the total projected available budget of ~10 billion euros in the EU, the population share of Germany in the EU, and the assumption that 50% of the projects address the industry sector. The budget included for the *IPCEI for Hydrogen* only covers the share addressing the industry sector.

The total budget of the programs amounts to about 5 billion euros, cumulated over the respective planned time horizon of the individual programs, which ends between 2025 and 2030. The first programs started to accept applications in 2020 (*EU Innovation Fund* and *Decarbonization Program*). However, it is likely that most of the programs will run longer than today's budget plans indicate. More specifically, continuing the programs on the currently planned level to 2030 would increase the total cumulated budget to 12 billion euros.

From the total budget of 5 billion euros, about 4 billion are directed exclusively towards CAPEX funding, 550 million address OPEX (CCfDs), and 800 million are more flexible (EU Innovation Fund). The total CAPEX funding seems sufficient when compared to the costs of industrial-scale projects, such as a new DRI steel plant (0.4 bn euros investment for DRI+EAF plant of 1 Mtpa crude steel production), or a cement clinker kiln equipped with carbon capture (0.15 billion euros investment for 1 Mtpa clinker production). Thus, the estimated budgets are sufficient to support financing of several industrial-scale installations.

However, while the CAPEX funding seems substantial, the funding available for OPEX does not seem sufficient to close the gap between traditional fossil-based processes and low-carbon production processes. The operational costs of low-carbon production processes can outweigh the capital expenditures for these technologies within a few years, especially under low carbon prices or if these processes are exempt from carbon taxes. However, companies can only invest in new plants if there is a business case for doing so, even with increased OPEX. Hydrogen-based technologies, in particular, have very high OPEX costs compared to fossil-fuel alternatives. Assuming the EUA price increases to about 30 euros on average and hydrogen costs of 150 euros/MWh, the OPEX cost gap is often several times higher than CAPEX costs for technologies like DRI steelmaking or the use of hydrogen for methanol/ethylene production. On the other hand, assuming electricity costs of 40 euros/MWh (today's tariff for very large electricity consumers), direct electrification options like electric glass melting might become cost-competitive without additional OPEX funding. CCS also requires only comparably little OPEX funding.

Table 3: Estimated planned budgets for the technology development programs

Budgets show only the share addressing industry decarbonization in broader programs

Programme	CAPEX/OPEX?	2020	2021	2022	2023	2024	2025 > 2025	Total	
e) Decarbonization Programme	CAPEX	80	310	500	500	500		1,890	
f) CO2 Avoidance and Use	CAPEX	-	120	120	100	80	80	500	
g) Hydrogen CfDs	OPEX	-	-	250	300			550	
h) IPCEI Hydrogen	CAPEX	-	250	250	250	250	250	1,500	
i) EU ETS Innovation Fund	CAPEX & OPEX	-	80	80	80	80	80	400	
Total		80	760	1,200	1,230	910	410	650	5,240
CAPEX		80	680	870	850	830	330	250	3,890
OPEX		-	-	250	300	-	-	-	550
CAPEX & OPEX		-	80	80	80	80	80	400	800

In summary, the recent introduction of specific programs aimed at the development and industrial upscaling of key technology solutions for industry decarbonization can be regarded as central milestones in establishing a policy mix for the transformation of the industry sector towards GHG neutrality. The total planned budgets are significant, and the technology scope covers important relevant options. However, under the current regulatory framework (energy prices, hydrogen production costs and EU ETS), the budgets are most likely not sufficient to close the OPEX gap and make hydrogen-based technologies cost-competitive with today's fossil fuel-based technologies. Possible approaches to closing this gap include an ambitious minimum price path in the EU-ETS, higher budgets for CCfDs

- if the instrument works - or a supply-side approach that makes (green) hydrogen available at lower prices to industrial consumers. In addition, the creation of lead markets could generate higher product prices.

1.4 Policy area: Material efficiency and circular economy

The relevance of material efficiency and circular economy for achieving the national and EU climate goals is well established. In 2020, the International Resource Panel (IRP) published a report assessing the relevance of material-based strategies for selected sectors, which determined their high relevance and hence the importance of related policies³. Chapter 2.6 outlined the relevant policy mix addressing this technology field in Germany and the following section evaluates its effectiveness in triggering the decarbonization of the industrial sector. In this context, increased material efficiency is considered desirable, even though implementing material-based strategies does not necessarily lead to a reduction in emissions, for example, due to the higher energy required. Consequently, these strategies and the related policies need further assessment and evaluation beyond the scope of this report.

The German policy mix addressing material efficiency and circular economy is framed by the *German Resource Efficiency Program ProgRess III* and comprises legislative as well as financing instruments. The legislation implemented in Germany is mostly a one-to-one implementation of the *EU Waste Framework Directive* and hence, the *EU Circular Economy Action Plan*. In a few aspects, the national legislation goes beyond EU requirements. The financing instruments with a total budget of €490 million from 2018 to 2024 are mostly focused on the funding of R&D projects in construction and plastics. An exception is the *r+Impuls funding guideline*, which facilitates the market entry of technologies.

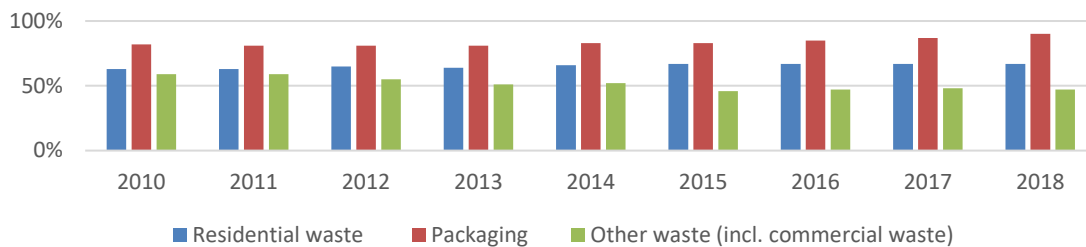
In general, the effectiveness of these policies is questionable since the aim of the *German Resource Efficiency Program Progress II* to double resource productivity from 1994 to 2020 is expected to be missed. Nevertheless, the recycling quota defined by the relevant legislation has been adhered to.

The Circular Economy Act defines recycling as the recovery of waste for the original or other purposes excluding energetic recovery. The preparation for recycling and the temporary storage of waste is therefore also considered recycling. The calculation of the recycling rates uses an input-based method, which compares

³ Resource Efficiency and Climate Change | Resource Panel

the input of the recycling processes with the total waste quantity. In practice, only 10% to 90% of this input is actually recycled. In particular, incorrect sorting leads to the energetic recovery and disposal of the remaining quantities. The relevant waste types and the associated recycling rates are shown in Figure 1. While packaging stands out due to its high and increasing recycling rate, the rate for other waste is actually decreasing.

Figure 1: Comparison of recycling rates of residential waste, packaging and other waste⁴



An examination of the much-discussed plastic waste determined a recycling rate of about 47% in 2017 and 2019⁵. Even though this information is frequently cited e.g. by the Parliament, the Federal Environment Agency or the plastic packaging industry association⁶, the values are criticized. As described, the input-based calculation method does not consider losses during recycling. Additionally, exported waste is considered to be recycled even though its actual implementation is not tracked⁷. To overcome these challenges, it is proposed to use the recyclate share of plastic processing as an indicator. This key figure compares plastic products from recyclate with the total amount of processed plastics in Germany. Consequently, it excludes exported recyclate and quality losses during recycling. In Germany, recyclate is typically used in the construction sector, in agriculture, and for the production of packaging. The recyclate share was about 12% in 2017, and about 14% in 2019. Historical data before 2017 are not available for comparison⁸.

⁴ Abfallbilanz - 2018 - Statistisches Bundesamt (destatis.de)

⁵ PowerPoint-Präsentation (conversio-gmbh.com) PowerPoint-Präsentation (conversio-gmbh.com)

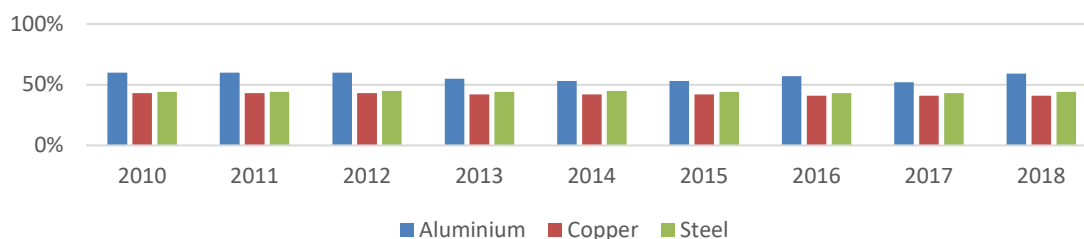
⁶ Drucksache 19/4634 (bundestag.de) Kunststoffabfälle|Umweltbundesamt IK-Jahresbericht-2020-online.pdf (kunststoffverpackungen.de)

⁷ Deutschland ist nicht Recyclingweltmeister: Grüne im Bundestag (gruene-bundestag.de) Deutschland betrügt sich selbst beim Plastikmüll - Wirtschaft - SZ.de (sueddeutsche.de) Export von Plastikabfällen - NABU

⁸ PowerPoint-Präsentation (conversio-gmbh.com)

A similar approach to calculating the share of secondary pre-materials is used for aluminum, copper and steel recycling as shown in Figure 2. The shares of secondary aluminum, copper and steel scrap are more or less constant over time. The highest share of recycled material is used for aluminum production.

Figure 2: Comparison of secondary pre-material share for aluminum, copper and steel⁹



The problems with the input-based calculation method of recycling rates were considered in the amendment of the EU Waste Framework Directive in 2018¹⁰. Consequently, the described related acts now require an output-based calculation method. The output of the recycling plants is used for the calculation, which takes losses into account. The required recycling quotas were lowered accordingly in the *Circular Economy Act*. Due to the newly introduced output-based calculation method, the recycling rates shown in the preceding sections cannot be directly compared with the recycling quotas. However, transferring the input-based recycling rates for residential waste in 2015 showed that the output-based recycling rates are significantly lower (input-based recycling rate for residential waste in 2015: 67%; output-based recycling rate for residential waste in 2015: 36-40%). In practice, a share depending on the specific waste type of the input material is used for energetic recovery¹¹. As a consequence, the quotas given in the current legislation would not be fulfilled. The actual recycling rates are not yet available for the relevant time period. Hence, it is not possible at present to assess the effectiveness of the policy mix from this perspective.

A recent publication by Gandenberger¹² evaluates the ability of the policy mix to facilitate the circular economy innovation system in Germany. The conclusion is

⁹ BGR - Produkte (bund.de)

¹⁰ Indikator: Recycling von Siedlungsabfällen | Umweltbundesamt

¹¹ 2018_EaA_059-078_Obermeier (vivis.de)

¹² Innovationen für die Circular Economy - Aktueller Stand und Perspektiven: Ein Beitrag zur Weiterentwicklung der deutschen Umweltinnovationspolitik (umweltbundesamt.de)

that ProgRess III does not enable the transformation from a linear to a circular economy for two reasons: non-existent markets for secondary products and insufficient financial resources for innovations. Accordingly, ProgRess III does not obtain the desired effects of acting as a framework for the circular economy. However, this evaluation did not consider the recent amendments to the legislative framework, especially the Packaging Act and other emerging technologies and innovations. Two major approaches in this context are the chemical recycling of plastics and the transformation to a bioeconomy. The National Bioeconomy Strategy was published by the German government in 2020. This includes general objectives and action fields focusing on the bioeconomy potential assessment and (inter-)national collaboration. The use of biogenic materials in industry is also mentioned, but this is limited by land availability¹³. The topic was additionally mentioned in *ProgRess III*, part of *FONA4*, and considered in funding guidelines to a smaller extent. Nevertheless, the topic is less present in the societal and political discourse about industry decarbonization - in contrast to the chemical recycling of plastics.

Chemical recycling is mentioned in the European Strategy for Plastics (2018) and thought to be a promising option for recycling plastic waste. Chemical recycling summarizes different technology options for the depolymerization of plastic as preparation for recovery¹⁴. In accordance with the *EU Waste Framework Directive* and the German *Circular Economy Act*, chemical recycling contributes to achieving the recycling quota. In contrast, according to the German Packaging Act, chemical recycling is classified as recovery and not as recycling - in the same way as energetic recovery. Consequently, it can contribute to the recovery quota defined in the Packaging Act (90 %) but not to the recycling quota (65 %). Chemical recycling could therefore substitute the energetic use of plastic waste.

The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety currently supports this definition of chemical recycling. On the one hand, chemical recycling is perceived as less environmentally-friendly due its high demand for process energy. On the other hand, the incentives for recycling induced by the Packaging Act shall be assured. Through this risks for establishing sorting and recycling capacities shall be avoided. Thus, chemical recycling is assessed exclusively as an alternative to the energetic recovery of contaminated

¹³ Nationale Bioökonomiestrategie – Zusammenfassung (bmbf.de)

¹⁴ Chemisches Recycling von gemischten Kunststoffabfällen als ergänzender Recyclingpfad zur Erhöhung der Recyclingquote | SpringerLink

plastic waste if this is economically and ecologically feasible¹⁵. A comparable position is taken by the Federal Environment Agency. However, it emphasizes the need for further research to assess the economic and ecological advantages of chemical recycling¹⁶. Especially the liberal opposition party, FDP, challenges the chemical recycling position of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and thereby the Federal Government against the backdrop of the intensification of recycling quotas and technology openness¹⁷.

While environmental organizations, such as the Nature and Biodiversity Conservation Union and Greenpeace, support the current position of the Federal Government¹⁸, the national and European chemical industry associations point to the barriers to technology development¹⁹. The legislative demands of the environmental organizations include restricting chemical recycling to processes which again produce plastic and integrating chemical recycling in the waste hierarchy between recycling and energetic recovery. The chemical industry associations, on the other hand, demand that chemical recycling is fully classified as recycling. How this discourse develops will influence the decarbonization of the industry - even if the direction has not yet been determined.

To summarize the previous sections, at present, the German policy mix in the field of material efficiency and circular economy does not seem to have a strong impact on industry decarbonization. In his evaluation of the innovation system for the circular economy, Gandenberger proposes dynamic standards for the use of secondary materials to create markets as well as product design standards that foster repair and recycling. He underlines the importance of accompanying measures to establish new business models²⁰. Similar aspects were also identified by the IRP for the international level in the above-mentioned publication. Steel and cement, but also plastics, paper, glass and metals are particularly relevant materials and should be targeted directly²¹. Technologies such as the

15 2020_EaA_065-070_Janz.pdf (vivis.de)

16 Chemisches Recycling (umweltbundesamt.de)

17 Drucksache 19/20175 (bundestag.de) Drucksache 19/21432 (bundestag.de)

18 Chemisches Recycling von Kunststoffen - NABU Das Wegwerf-Prinzip | Greenpeace

19 VCI-Vorlage (bayerische-chemieverbaende.de)

20 Innovationen für die Circular Economy - Aktueller Stand und Perspektiven: Ein Beitrag zur Weiterentwicklung der deutschen Umweltinnovationspolitik (umweltbundesamt.de)

21 Resource Efficiency and Climate Change | Resource Panel

chemical recycling of plastics, but also an increased share of secondary steel as well as increased cement/concrete recycling are key solutions for the decarbonization of industry. Downgrading the materials should be widely avoided. Using alternative or bio-based materials in the construction sector can also have a significant impact, which is one reason why the implementation of product standards should not be limited to the design phase. Additionally, an overall policy strategy focusing on decarbonization via material efficiency and the circular economy could bundle the efforts being made at national and EU level.

2 Fact sheets of implemented and planned policy instruments in Germany

2.1 Introduction

The complete list of policies included in this analysis is given below. These include policies that directly address the industry sector, which is the focus of this analysis. Obviously, the industrial transition also depends on related policy fields like decarbonization of electricity supply and cross-cutting policies and targets. these are, however, not the focus of this report.

Targets: National and sectoral GHG reduction targets

Carbon and energy pricing

- a) EU emissions trading
- b) National emissions trading scheme - CO₂-price for transport and heating
- c) Energy taxes and exemptions ("Spitzenausgleich")
- d) EEG-levy and compensation scheme ("Besondere Ausgleichsregelung")

Technology development, demonstration and market introduction programs aimed at decarbonizing industry

- e) National Decarbonization Program
- f) Program CO₂ Avoidance and Use in Basic Industries
- g) National Hydrogen Strategy: CCfD pilot
- h) National Hydrogen Strategy: IPCEI "Hydrogen for industrial production"
- i) EU ETS Innovation Fund: further development of the NER300 program

Research and innovation

- j) 7th Energy Research Program
- k) FONA - Research for Sustainability
- l) progres.nrw - Research

Downstream: Material efficiency and circular economy

- m) Circular Economy Act, related acts and ordinances and current amendments
- n) German Resource Efficiency Program ProgRess III

- o) Technology Transfer Program Lightweight Construction (TTP LB)
- p) Funding directive and research concept "Ressourceneffiziente Kreislaufwirtschaft"
- q) EU Circular Economy Action Plan (EU)

Energy efficiency

- r) Federal support for energy efficiency in the economy - grants and loans
- s) Energy audits in SMEs
- t) KfW Energy Efficiency Program: Low-interest loans for energy efficiency projects
- u) Pilot program "Einsparzähler" (Savings meter)
- v) Federal funding for energy efficiency in the economy - funding competition
- w) Energy efficiency networks for businesses
- x) Energy audit obligation for large companies (implementation of Art. 8 EU Energy Efficiency Directive)
- y) Minimum energy performance standards – EU Ecodesign Directive

Other related policies

- z) IN4climate.NRW
- aa) SME Initiative Energy System Transformation and Climate Protection

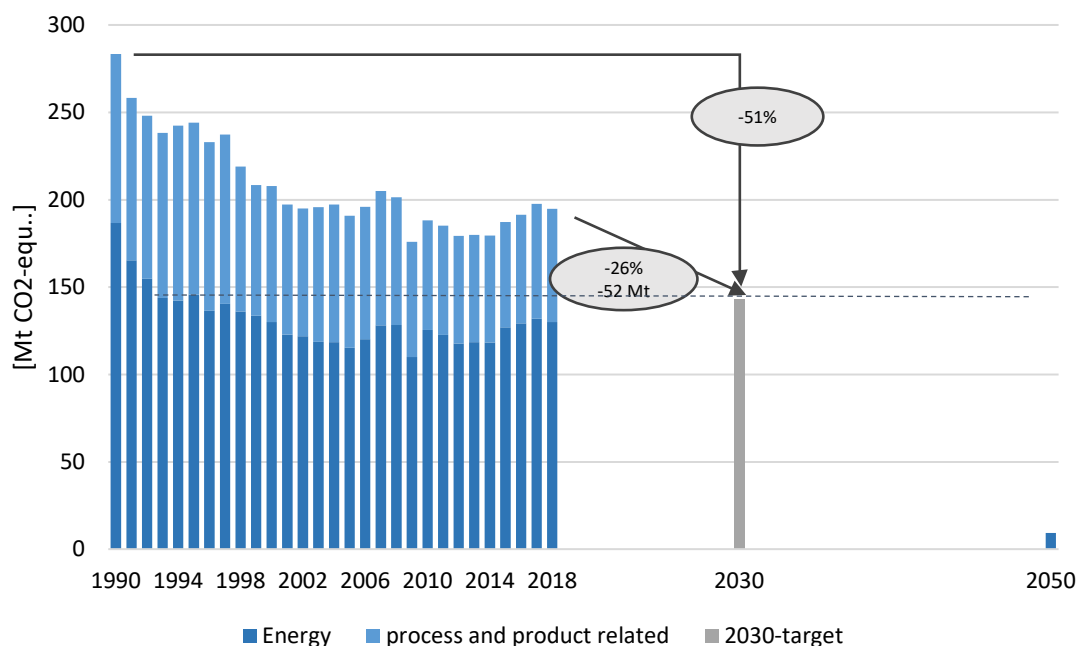
2.2 Targets

The Climate Action Plan 2050²², adopted by the German government in November 2016, affirms the target of the Paris Agreement to achieve CO₂-neutrality by mid-century, contains concrete actions to achieve the target, and defines milestones for 2030 on a sectoral level. For the industry sector, it sets a target of 49-51% GHG reduction compared to 1990. To achieve the sectoral target, substantial mitigation efforts are needed including large-scale investment in decarbonization technologies. The targets were further strengthened by the German Climate Protection Law, which went into force in December 2019. This defines a (linear) path for emission reduction in all sectors towards the 2030 milestone and

²² Climate Action Plan 2050 – Principles and goals of the German government's climate policy (bmu.de)

requires additional policy action should the monitored emissions fall short of the minimum path in a specific year.

Figure 3: Historic development of GHG emissions in the German industry and target in the year 2030



2.3 Carbon and energy pricing

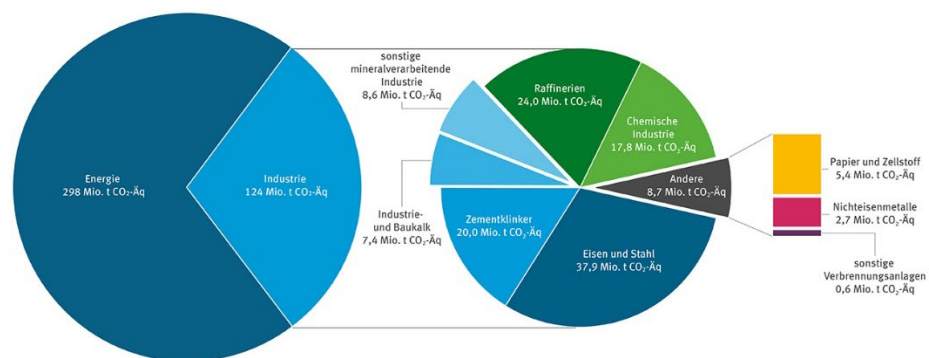
a) EU Emissions Trading Scheme (ETS)

Description The amendments to the Emissions Trading Directive came into force on 8 April 2018 for the fourth trading period 2021-2030. The amended directive contains important innovations to strengthen EU emissions trading and its price signal. The total quantity of emission certificates auctioned and allocated free of charge will decrease by 2.2 percent p.a. from 2021 (in relation to the reference value in 2010). 24 percent instead of 12 percent of surplus certificates will be withdrawn from the market each year from 2019 to 2023 with the Market Stability Reserve (MSR). From 2023, the maximum size of the market stability reserve is limited to the auction volume of the previous year. Surpluses exceeding this amount will be deleted from the MSR. In addition, member states

have the option of reducing the number of certificates in circulation if fossil power plants are decommissioned as a result of additional national climate protection instruments.

In Germany, about one quarter (124 million t CO₂) of the total emissions that fall under the EU ETS are from industry installations. Refineries, chemicals, iron and steel, and cement are major emitting sectors.

Figure 4: Emissions in the EU Emissions Trading Scheme in Germany by sector in 2019 (Source: DEhSt)



The ETS sets a CO₂-price for large emitters and an overall emissions cap and is, thus, a central element of the EU policy mix addressing the decarbonization of industry. However, industrial companies in energy-intensive trade-exposed sectors receive a substantial number of emission permits for free via the benchmarking procedure and electricity price compensation (EPC).

Production and heat generation installations receive a proportion of free permits, which fell from 80% of allocated certificates in 2013 to 30% in 2020, according to EU rules. However, to compensate for disadvantages in international competition, most industry installations receive nearly 100% free allocation, defined by a product-specific carbon leakage list published by the European Commission.

The electricity price compensation (EPC) is intended to reduce the burden on sectors facing international competition by (partly) compensating EU allowance (EUA)-induced increases in the electricity price. EPC is defined according to EU guidelines. How-

ever, CO₂ costs for the purchase of one gigawatt-hour of electricity per year per installation are subtracted from the EPC. In 2018, the EPC in Germany amounted to 219 million euros in total, with the largest share requested by the chemical industry. A substantially higher EPC was expected for 2019 (500-600 million euros), because the higher EUA price from 2018 was considered for the calculation.

Sources

Beihilfen für indirekte CO₂-Kosten des Emissionshandels (Strompreiskompensation) in Deutschland für das Jahr 2018 (SPK-Bericht 2018) (dehst.de)

State aid for indirect CO₂ costs of emissions trading (electricity price compensation) in Germany for 2017 (EPC report 2017) (dehst.de)

b) National Emissions Trading Scheme - CO₂-price for transport and heating**Description**

In its Climate Protection Program 2030, the German government advocates the introduction of CO₂ pricing for the transport and heating sectors (non-ETS sectors) from 2021 onwards. The Bundestag decided to introduce such a CO₂ pricing system as early as December 2019 by implementing the national emissions trading scheme (nETS). The nETS is an upstream system and covers emissions from the combustion of fossil fuels, in particular heating oil, liquid gas, natural gas, coal, petroleum, and diesel. Until 2025, fuel or heat suppliers will need to buy certificates at a fixed price. From 2026 onwards, the system becomes a cap-and-trade one with a predefined price corridor. This should create a reliable price path that enables private households and companies to anticipate and adapt to the development. The sectors affected by this law are mainly buildings, transport, and industry. Industry installations that participate in the EU ETS are exempt from the nETS. Either the industry companies can apply for compensation, or the upstream sellers of fossil fuels can reduce their obligation to render emission allowances by the respective amount sold

to an EU ETS installation. The total quantity of emissions under the nETS can be estimated as follows. In 2019, the total industry sector emissions (according to the German sectoral target definition) accounted for about 195 Mt CO₂-equivalent. Of these, about 100 Mt CO₂ fall under the scope of the EU ETS and are thus excluded from the nETS. Thus, less than 50% of all industry emissions fall under the nETS, probably substantially less, as these emissions include product-related fluorinated GHG emissions, which are also outside the scope of the nETS. Thus, a realistic estimate is that 20-40% of industry sector emissions fall exclusively under the nETS.

The CO₂ price is set initially at 25 €/t in 2021 and will increase gradually to 55 €/t in 2025. For the year 2026, a price corridor of at least 55 and at most 65 €/t applies. After that, the price will be formed on the market. The CO₂ prices in the EU ETS and the nETS are independent and are likely to differ substantially, because mitigation measures in the nETS are expected to have higher marginal abatement costs.

The basis for the nETS is the "Law on a national certificate trade for fuel emissions (Fuel Emission Trading Act - BEHG)".

CAPEX/OPEX	n.a.
Technology maturity	n.a.
Target group/ sector/technology	Upstream energy suppliers in entire non-EU ETS heating and transport sectors
Typical grant/ project size	n.a.
Eligibility	n.a.
Budget available	n.a.
Evaluation	n.a.

Sources

Hintergrundpapier - Nationales Emissionshandelssystem (dehst.de)

Law on a national certificate trade for fuel emissions (Fuel Emission Trading Act - BEHG)

c) Energy taxes and exemptions ("Spitzenausgleich")

Description

With the law on the introduction of the ecological tax reform of 24 March 1999 (BGBl. I p. 378) and the corresponding follow-up laws, the taxation of various fossil fuels and electricity was increased to incentivize energy efficiency improvements. At the same time, the tax revenues were used to decrease non-wage labor costs. The Electricity Tax Act and the Energy Tax Act differentiate tax rates according to energy source. Some energy consumers are fully exempt from energy taxation, including most of the large consumers from heavy industries, as they receive exemptions for energy use in specifically defined energy-intensive processes and the tax reliefs discussed under the heading "Spitzenausgleich" below.

Current discussions about reforming energy taxes are directed towards the high price of electricity, which is a major barrier to the diffusion of sector-coupling technologies like heat pumps. One option currently on the table is to lower taxes on electricity and the EEG-levy (see separate fact sheet below), financed by higher taxes on fossil fuels according to their CO₂-intensity.²³²⁴

Energy tax reliefs ("Spitzenausgleich"):

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- 23 Winkler, Jenny; George, Jan F.; Held, Anne; Eßer, Anke; Ragwitz, Mario; Maurer, Christoph; Tersteegen, Bernd; Bangert, Luise; Kahl, Hartmut; Kahles, Markus (2020): Auswirkungen klima- und energiepolitischer Instrumente mit Fokus auf EEG-Umlage, Stromsteuer und CO₂-Preis: Finanzierungsmechanismus für erneuerbare Energien: Einnahmen- und Refinanzierungsseite; available at: Auswirkungen klima- und energiepolitischer Instrumente mit Fokus auf EEG-Umlage, Stromsteuer und CO₂-Preis (fraunhofer.de)
- 24 Christoph Maurer, Bernd Tersteegen, Anke Bekk, Anne Held, Marian Klobasa, Dominik Greinacher, Reinald Günther (2020): Effiziente Ausgestaltung der Integration erneuerbarer Energien durch Sektorkopplung; CLIMATE CHANGE 25/2020, Umweltbundesamt, Dessau-Roßlau

Under the so-called "Spitzenausgleich", companies in the manufacturing sector receive reliefs of energy taxes. The currently valid law first came into force in 2013 to amend the Energy Tax Act and the Electricity Tax Act as well as the Air Traffic Tax Act. With this law, the "Spitzenausgleich" was re-adjusted and continued beyond 2012 for another 10 years. Companies must meet two conditions to receive tax discounts:

- ▶ The company applying must prove it has introduced an energy management system in accordance with DIN EN ISO 50001 or an environmental management system in accordance with EMAS at the latest by the end of the application year 2015, and that it will operate this system from the end of 2015.

- ▶ The energy intensity of manufacturing industry in Germany must decrease overall by a legally defined target value. This target value is 1.3% per year for the reference years 2013 to 2015 (application years 2015 to 2017) and 1.35% per year for the reference years from 2016 (application years 2018 to 2022). The new peak balancing regulation is designed for a period of 10 years.

d) The EEG levy and compensation scheme ("Besondere Ausgleichsregelung")

Description

In order to finance the support (feed-in tariffs and permits) of renewable energy technologies for electricity generation, a levy was introduced as a mark-up on the electricity tariff for all electricity consumers in Germany (Regulated in Germany's Renewable Energies Act, EEG). In recent years, this mark-up reached up to 6 eurocents per kWh for typical household consumers (large industrial companies receive major discounts).

A sharp increase in the so called EEG levy is expected for 2021. The main reason for this is the decline in economic output and the associated fall in the wholesale price of elec-

tricity. In order to make the state electricity price components more reliable, a subsidy from federal budget funds is planned for the "gradual and reliable reduction" of the EEG levy, so that this will be 6.5 ct/KWh in 2021 and 6.0 ct/KWh in 2022. This measure will also be financed by government revenue from the new national emissions trading scheme. After 2022, revenues from emissions trading will continue to be used to reduce the EEG levy. The necessary adjustments to the Renewable Energies Act were already implemented in its amendment of 15 July 2020. The EEG, which has also been amended, was due to come into force on January 1, 2021 ("EEG 2021").

The high mark-up on the electricity price provides substantial incentives for energy-efficiency improvements on the one hand, and, on the other hand, hinders electrification and sector coupling technologies (e.g. heat pumps, electric industrial furnaces, and electric cars).

Compensation scheme (BesAR) of the Renewable Energy Sources Act (EEG):

Under BesAR, companies in trade-intensive industries with high electricity consumption are given discounts on the EEG levy. The aim of BesAR is, among other things, to protect the international competitiveness of the beneficiaries. To receive discounts, companies have to apply and belong to electricity- and trade-intensive industries. They must also prove that their electricity costs account for a high proportion of their gross value added. Furthermore, in order to qualify for the corresponding benefits, applicants must exceed an electricity consumption threshold of 1 GWh/yr. and provide evidence of a certified energy or environmental management system. Companies with an annual electricity consumption of more than 5 GWh have to prove they operate an energy or environmental management system (ISO 50001 or EMAS), companies with 1-5 GWh can also prove they operate an alternative system to improve energy efficiency in the sense of the Peak Energy Efficiency System Ordinance (SpaEfV). As a result of these requirements, the compensation scheme has contributed strongly to the

spread of ISO 50001 energy management schemes in Germany.

2.4 Technology development, demonstration and market introduction programs aiming at decarbonizing industry

e) National Decarbonization Program

Description

The national Decarbonization Program is currently being implemented as part of the Climate Protection Program 2030. It is a support program addressing technology development, demonstration and market uptake. The program is particularly aimed at the reduction of process-related emissions in hard-to-abate sectors and addresses key production facilities in these sectors. For this purpose, projects in emission-intensive industries with process-related emissions are supported via grants. The projects range from application-oriented R&D and industrial-scale testing to the broad market introduction of mature or emerging technologies.

The program does not have a narrow definition of process-related emissions only, but also aims at reducing hard-to-abate emissions from fossil fuel combustion. The program will provide grants to finance a share of the upfront costs of investing in new plants, developing climate-neutral processes, switching from fossil to electricity-based fuels, using innovative combinations of processes, developing climate-neutral product substitutes and bridging technologies. Applications are evaluated in technical and economic terms. The current program design focuses on capital expenditures only and does not plan to finance operational costs. However, in order to add OPEX support, it is possible to combine the grants with support from the EU Innovation Fund or the CCfD pilot from the German Hydrogen Strategy.

In total, the program aims to reduce annual GHG emissions in industry by about 2.5 million tonnes by the year 2030.

	<p>The program is overseen by the German Federal Ministry for the Environment (BMU), and the official funding directive was published on December 16, 2020 and went into force on January 1st 2021. In anticipation of this, the Environmental Innovation Program (UIP) set up a funding window "Decarbonization in Industry" for a transitional period until the new directive came into force to provide a basis for project proposals throughout 2020. The program is implemented by the Competence Center Climate Protection in Energy-intensive Industries (KEI) based in Cottbus.</p>
CAPEX/OPEX	Only CAPEX support (but combination with other programs possible to add OPEX support)
Technology maturity	From applied research to demonstration and industrial-scale market introduction of emerging technologies (TRL 4-9)
Target group/ sector/technology	CO ₂ -intensive processes in the basic materials industries (steel, cement, chemicals, others)
Typical grant/ project size	Up to January 2021, one project had been selected for a grant: Salzgitter AG has been given a grant of 5 million euros for the construction of a small-scale demonstrator DRI plant that can flexibly use natural gas or hydrogen as fuel. ²⁵
Eligibility	All companies located in Germany with process-related emissions that fall under the scope of the EU ETS
Budget available	2 bn euros for 2020-2024, 0.5 bn euros/year expected afterwards. The program was announced in advance, so that companies could prepare proposals in time.
Evaluation	No evaluations available - program only starts in 2021

²⁵ <https://www.bing.com/search?q=salzgitter+dri&form=ANNT11&refid=96e052cc32a146af9fcc5e076d36346c&sp=1&pq=salzgitter+dr&sc=8-13&qs=n&sk=&cvid=96e052cc32a146af9fcc5e076d36346c>

Sources	<p>Directive for the support of research, development and investment projects targeting greenhouse gas neutrality in the industry sector²⁶</p> <p>Press release BMU²⁷</p> <p>Temporary funding guidelines²⁸</p>
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f) CO₂ avoidance and use in basic industries

Description	<p>The focus of this program, which is part of the Climate Protection Program 2030, is on the reduction of process-related GHG emissions in the basic materials industry. The main objective is to further develop central components of the process chain in the field of CO₂ capture, storage and utilization (Carbon Capture and Storage - CCS and Carbon Capture and Utilization - CCU) towards market maturity and thus to create the necessary technical prerequisites for a permanent reduction of process-related greenhouse gas emissions. This involves the entire value chain covering CO₂ capture, transport and storage.</p> <p>The program is administered by the German Federal Ministry for Economic Affairs and Energy (BMWi). The related support directive is currently under development and has not yet been published.</p>
CAPEX/OPEX	Focus on CAPEX (OPEX support might also be possible but only for CCS)
Technology maturity	Starting from TRL 5-6 with goal to achieve industrial-scale market introduction
Target group/ sector/technology	All sectors with process-related emissions, however, strong focus on cement, lime and chemicals

²⁶ <https://www.bundesanzeiger.de/pub/publication/sPdNMCSOJMQRsv4qr/content/sPdNMCSOJMQRsv4qr/BAAnz%20AT%2015.01.2021%20B5.pdf?inline>

²⁷ <https://www.bmu.de/themen/forschung-foerderung/foerderung/foerdermoeglichkeiten/details/31/>

²⁸ https://www.klimaschutz-industrie.de/fileadmin/user_upload/KEI_download_pdf/20200709_Hinweisblatt_Foerderprogramm_Foerderfenster.pdf

Typical grant/ project size	Projects are expected to be very large / only a few projects will be financed (grant size probably >100 million euros per project)
Eligibility	n.a.
Budget available	~0.5 bn euros total budget (2021-2025), ~0.1 bn annually
Evaluation	n.a.
Sources	German climate protection program 2030 Exchange with BMWi

g) National Hydrogen Strategy: Pilot program Carbon Contracts for Difference

Description	<p>The German government's National Hydrogen Strategy (NWS) was adopted by the Federal Cabinet on June 10, 2020. A flexible and result-oriented governance structure is planned for the consistent implementation and further development of the strategy. The central component is the establishment of a National Hydrogen Council, which held its constituent meeting on July 9, 2020.</p> <p>While there is strong commitment to hydrogen produced from renewable energy sources ("green hydrogen"), the NWS acknowledges the role of CO₂-neutral hydrogen produced within a European hydrogen market. As Germany is closely connected to the European energy market, CO₂-neutral (blue/turquoise) hydrogen is likely to be used on an interim basis. However, it is stated that only green hydrogen is sustainable in the long term.</p> <p>The German government's economic stimulus package of June 3, 2020 massively expanded the promotion of hydrogen and fuel cell technology. The economic stimulus package thus fully supports the measures defined in the NWS. A total of €7 billion has been earmarked for national measures, of which roughly €2 billion are for the use of hydrogen to decarbonize industry. Several individual</p>
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measures can be assigned to the industry sector. For example, the introduction of a pilot program for Carbon Contracts for Difference (CCfD) is scheduled for 2021.

An important instrument for the implementation of the NWS is the Important Project of Common European Interest (IPCEI) Hydrogen. Here the German government plans to promote integrated projects along the entire hydrogen value chain. Currently, the German expression of interest procedure is being prepared, in which companies can submit appropriate proposals.

A pilot program for carbon contracts for difference (CCfD) is planned as part of the National Hydrogen Strategy published in June 2020. The program is dedicated to the steel and chemical industries and allocated around €500 million in the national budget. Companies are to sign contracts with the government for low-carbon industrial production, and in return the government assures a fixed carbon price, a so-called strike price. As long as the ETS price is lower than the strike price, the difference will be covered by the government. If the ETS price is higher than the strike price, then companies must pay back the difference between the two prices. Other cost components such as higher costs for different raw materials or higher capital expenditures (CAPEX) could be included in the design.

CCfDs are designed to offset the higher operating costs of low-carbon production processes compared to the fossil fuel-based reference process. They address operating costs, while investment costs can be covered by other programs, such as the National Decarbonization Program.

CCfDs are to be selected through a tender. However, this and other issues still need to be clarified such as conflicts with European state aid law or how to determine reference costs. A first draft is due to be published in early 2021.

CAPEX/OPEX

OPEX (CAPEX)

Technology maturity

All

Target group/ sector/technology	Steel and chemicals industry
Typical grant/ project size	(not specified)
Eligibility	
Budget available	~0.5 bn. euros in total until 2023
Evaluation	n.a.
Sources	National Hydrogen Strategy Deutscher Bundestag (2020): Antwort der Bundesregierung auf die Kleine Anfrage zu Pilotprogramm Carbon Contracts for Differences. ²⁹

²⁹ <https://dipbt.bundestag.de/dip21/btd/19/236/1923624.pdf> (2020-01-13)

h) National Hydrogen Strategy: IPCEI "Hydrogen in industrial production"

Description	<p>As part of the National Hydrogen Strategy, a support program was agreed on to develop hydrogen technologies in the form of an IPCEI (Important Project of Common European Interest). The expression-of-interest procedure was published on January 11th 2021 and also covers the support of projects for hydrogen use in industry.</p> <p>While the entire IPCEI addresses all parts of the hydrogen value chain, the German Federal Ministry for Economic Affairs and Energy (BMWi) administers the part that specifically addresses the industrial application of hydrogen. About 1.5 bn. euros are expected to be available as funding for this part for the period until 2026. This includes the use of hydrogen in industry as well as the development and production of fuel cell systems.</p> <p>Support is only available to cover the differential costs, i.e. the additional costs for a low-CO₂ process compared to the conventional CO₂-intensive process. Funding is for CAPEX, while OPEX can be funded in exceptional cases if the plant is needed for research purposes.</p> <p>Important Projects of Common European Interest (IPCEI) are transnational projects partly funded by governments to achieve European strategic objectives and improve European competitiveness. These projects are also expected to have a spillover effect on other countries, other companies and/or other sectors. Nine strategic fields have been identified, including hydrogen technologies and systems and low-carbon industry, as well as microelectronics and battery manufacturing.</p>
CAPEX/OPEX	CAPEX (OPEX only for research projects)
Technology maturity	Starting from TRL 5-6 with the goal to achieve industrial-scale market introduction
Target group/sector/technology	Hydrogen use in all sectors, but a focus on steel and chemicals.

	Technologies to make industrial processes "hydrogen ready"
Typical grant/ project size	Large-scale projects (>10 million euros)
Eligibility	Particular requirements of IPCEI projects
Budget available	~ € 1.5 bn. total for period 2021-2026 (only industry-sector funding)
Evaluation	n.a.
Sources	"Expression of interest for the planned support in the field of hydrogen technologies and systems" (Bekanntmachung des Interessenbekundungsverfahrens zur geplanten Förderung im Bereich Wasserstofftechnologien und -systeme) ³⁰ BMWi (2020): Häufig gestellte Fragen zum "Important Project of Common European Interest (IPCEI)". ³¹ National Hydrogen Strategy

³⁰ BAnz AT_IPCEI_Interessenkundgebungsverfahren_ 14.01.2021 B1.pdf

³¹ Available at: <https://www.bmwi.de/Redaktion/DE/FAQ/IPCEI/faq-ipcei.html> (2020-01-13)

i) EU ETS Innovation Fund: further development of the NER300 program

Description	<p>Within the framework of the European Emissions Trading Scheme, the Innovation Fund supports the commercial demonstration of innovative low-carbon technologies. It is a continuation of the former NER300 program, but extends the funding scope to technologies addressing the reduction of GHG emissions in energy-intensive industries. Additionally, it covers the following technologies, similar to the NER300 program: carbon capture and utilization (CCU), construction and operation of carbon capture and storage (CCS), innovative renewable energy generation, and energy storage.</p> <p>The Innovation Fund is part of the Emissions Trading System (EU-ETS) and is financed by revenues from auctioning CO₂ allowances. In the period 2020 to 2030, a total of 450 million allowances will be used to finance the Innovation Fund. Currently, a total budget of about €10 bn is expected, but this depends on the allowance price in the EU ETS.</p> <p>The first call of the EU Innovation Fund was published by the European Commission on July 3, 2020. This call for proposals addresses large projects with capital costs of > €7.5 million. For large-scale projects, funding is available for capital and operational costs. Small-scale projects will receive funding for capital costs only.</p>
CAPEX/OPEX	<p>CAPEX and OPEX (funding up to 60% of the additional capital and operational costs)</p>
Technology maturity	<p>6-9 ("commercial demonstration")</p>
Target group/sector/technology	<p>Energy-intensive industries, CCS, CCU, renewable energies and energy storage</p>
Typical grant/project size	<p>Large-scale projects: > €7.5 million capital costs Small-scale projects: < €7.5 million capital costs</p>
Eligibility	

Budget available	~10 billion euros estimated in total until 2030 (EU-wide, all technologies)
Evaluation	n.a.
Sources	https://ec.europa.eu/clima/policies/innovation-fund_en

2.5 Research and innovation

j) 7th Energy Research Program (7. Energieforschungsprogramm)

Description	<p>In 2018, the Federal Ministry for Economic Affairs and Energy (BMWi) published the "7. Energieforschungsprogramm" (7th Energy Research Program) of the German federal government under the heading "Innovationen für die Energiewende" (Innovations for the Energy Transition). Fundamental aim of the research program is technology and innovation transfer facilitating the energy transition. Besides institutional research funding and project funding in areas such as energy generation, system integration and system-wide research topics, there is a focus on the energy transition in energy demand sectors. In total, a budget of about €6.4 billion is provided in the period 2018 to 2022. The major part of this - about €4.2 billion - is assigned to funding projects. In the energy demand sector, which comprises industry as well as trade, commerce and services, the following research topics are supported:</p> <ul style="list-style-type: none"> energy-intensive basic materials industry (e.g. efficiency, electrification), sector-specific measures (e.g. circular economy, efficiency) and cross-cutting topics (e.g. digitalization, process heat).
CAPEX/OPEX	More details on the funding modalities are published in specific funding guidelines and funding announcements
Technology maturity	TRL 1-9

Target group/ sector/technology	SMEs, enterprises, higher education, and research institutions
Typical grant/ project size	Depends on the individual funding guideline and funding announcement
Eligibility	More details on the funding modalities are published in specific funding guidelines and announcements
Budget available	€4.2 billion in total for the period 2018 to 2022, about €0.9 billion annually
Evaluation	The Energy Research Program is evaluated in retrospect, so the evaluation of the 5 th version is currently available
Sources	<p>BMWi - 7. Energieforschungsprogramm der Bundesregierung</p> <p>7. Energieforschungsprogramm (bmwi.de)</p> <p>Evaluation des 5. Energieforschungsprogrammes_- Zusammenfassung</p>

k) FONA: Research for sustainability

Description	<p>Based on the UN Sustainable Development Goals, the German Federal Ministry of Education and Research (BMBF) developed a research strategy called "Forschung für Nachhaltigkeit" (FONA, research for sustainability) in 2005. The 4th Framework Program (FONA4) is effective from 2020 to 2024 and has a budget of €4 billion in total. Research projects in the fields of green hydrogen, circular economy, climate protection, and bioeconomy are funded in specific funding guidelines and funding announcements. Besides a funding directive and research concept for a resource-efficient circular economy (described in a separate policy fact sheet), individual projects and funding guidelines are very relevant for the decarbonization of the industrial sector.</p>
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The funding guideline "Impulse für industrielle Ressourceneffizienz" (r+Impuls, impulses for industrial resource efficiency) is supported by the prior FONA3 program. Between 2016 and 2021, 26 joint projects have been funded with €22.3 million in the field of industrial resource efficiency. The funding is exclusively applicable from TRL 5 and thereby closes the gap between R&D projects and broad market introduction.

The funding guidelines "Epigenetik - Chancen für die Pflanzenforschung" (Epigenetics - opportunities for plant research) and "Zukunftstechnologien für die industrielle Bioökonomie" (Future technologies for the industrial bioeconomy) are supported by FONA4. While the first guideline focuses on food production, the second supports technologies in the field of bioeconomy in general.

The research project "Carbon2Chem" tests the capture and utilization of CO₂-emissions (CCU) from metallurgical gases from the steel industry. The captured CO₂ will be used to produce precursors for fuels, plastics or fertilizers. €60 million were provided by the German Federal Ministry of Education and Research as part of FONA3 during the first phase (2016-2020), and about €75 million will be provided in the second phase (2020-2024).

The funding guideline "Vermeidung von klimarelevanten Prozessemissionen in der Industrie" (Klim-Pro-Industrie, avoiding climate-relevant process emissions in industry) contributes to implementing the Klimaschutzplan 2050 (Climate Action Plan 2050), Hightech-Strategie 2025 (Hightech Strategy 2025) and FONA3 and focuses on carbon direct avoidance (CDA), carbon capture and utilization (CCU) and carbon capture and storage (CCS). In total up to €80 million will be provided until 2025.

CAPEX/OPEX

Technology maturity

More details on the modalities are published in the funding guidelines and funding announcements

Target group/ sector/technology	
Typical grant/ project size	
Eligibility	
Budget available	€4 billion in total for the years 2020 to 2024
Evaluation	The FONA Framework Program is evaluated in retrospect, so the evaluations of phases 1 and 2 (2005-2009 and 2010-2014) are available
Sources	<p>Forschung für Nachhaltigkeit (bmbf.de)</p> <p>FONA Strategie – FONA</p> <p>Evaluation der BMBF-Rahmenprogramme Forschung für die Nachhaltigkeit FONA 1 (2005-2009) & Forschung für Nachhaltige Entwicklungen FONA 2 (2010-2014) (fraunhofer.de)</p> <p>Projektmappe_rplus_impuls_2020_0.pdf (fona.de)</p> <p>Epigenetik- Chancen für die Pflanzenforschung – FONA</p> <p>Zukunftstechnologien für die industrielle Bioökonomie – FONA</p> <p>Carbon2Chem – FONA</p> <p>Vermeidung von klimarelevanten Prozessemissionen in der Industrie (KlimPro-Industrie) – FONA</p>

I) progress.nrw - Research

Description	<p>progress.nrw - Research is a funding instrument established by the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia as part of the Energieforschungsoffensive.NRW. It supports the transition from basic to applied research for new products, processes or services in the field of energy system transformation and carbon-neutral industry.</p>
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CAPEX/OPEX	Purchase of research equipment (/)/ use of research equipment, personnel expenses, material expenses, travel expenses, overhead expenses (OPEX)
Technology maturity	Transition from basic to applied research (TRL 2-4)
Target group/ sector/technology	Higher education and research institutions
Typical grant/ project size	€2 thousand to €70 thousand
Eligibility	Non-economic projects with a duration up to six months
Budget available	No information available
Evaluation	No evaluation available
Sources	Flyer_progresNRW_V03.indd (ptj.de) RL_progres_nrw_research.pdf (ptj.de)

2.6 Material efficiency and circularity

m) Circular Economy Act, related acts and ordinances and current amendments

Description

The current version of the Circular Economy Act including the amendment from October 2020 is the legal framework for waste management in Germany and implements one-to-one the EU Waste Framework Directive. The national regulation goes beyond the EU regulation by implementing a duty of care and by determining preferences for sustainable public procurement. Furthermore, German waste management is shaped by the definition of the terms waste and by-product, the determined waste hierarchy and the extended producer responsibility. Consequently, separated waste collection and recycling quotas are introduced.

or specific waste streams (packaging, end-of-life vehicles, batteries, electrical devices, reclaimed wood, waste oil etc.), additional acts and ordinances have been implemented similar to the EU waste-specific directives. The new Packaging Act from 2019 and the Commercial Waste Ordinance from 2017 are of particular importance. Both laws are intended to increase recycling.

The Packaging Act introduces stricter quota requirements and a consistent concept for their monitoring and further development, which should lead to increases in the recycled volumes of plastics and metals. Additionally, current amendments from November 2020 and January 2021 ban all plastic bags by 2022 and define a minimum recycle share for PET bottles by 2025. Furthermore, a mandatory deposit for all non-refillable plastic bottles will be implemented by 2022 and reusable options must be offered for takeaway drinks by 2023.

The new Commercial Waste Ordinance will have similar effects through its requirements for stricter separate collection and the sorting and recycling of mixed commercial waste. Several studies show that this will save an additional one million t CO₂e compared to current practice. This reduction is supported by waste prevention and resource

conservation measures (e.g. increasing reuse), as described in the national Waste Prevention Program (AVP) and the German Resource Efficiency Program (ProgRes III).

An overview of the recycling quotas in force as well as the target values up to 2035 from the described legislation is given in the following table:

	Current	2022	2025	2030	2035
Residential waste	50%	n/a	55%	60%	65%
Packaging	55%	n/a	65%	70%	n/a
Glass	80%	90%	n/a	n/a	n/a
Paper	85%	90%	n/a	n/a	n/a
Ferrous metals	80%	90%	n/a	n/a	n/a
Aluminum	80%	90%	n/a	n/a	n/a
Beverage cartons	75%	80%	n/a	n/a	n/a
Other composite	55%	70%	n/a	n/a	n/a
Commercial waste	30%	n/a	n/a	n/a	n/a

CAPEX/OPEX

No financial support

Technology maturity

Not technology-specific

Target group/ sector/technology

Industry, waste management

Typical grant/ project size

No financial support

Eligibility

Producers and owners of waste, operators of waste pre-treatment and processing plants

Budget available

No financial support

Evaluation

No evaluation available for recycling measures

Sources

KrWG - nichtamtliches Inhaltsverzeichnis (gesetze-im-internet.de)

Startseite - Das neue Verpackungsgesetz (VerpackG) 2021

GewAbfV - Verordnung über die Bewirtschaftung von gewerblichen Siedlungsabfällen und von bestimmten Bau- und Abbruchabfällen (gesetze-im-internet.de)

Abfallrecht | Umweltbundesamt

n) German Resource Efficiency Program ProgRess III**Description**

The German Resource Efficiency Program ProgRess III updates the previous ProgRess II from 2020 to 2023. The update is based on an evaluation of ProgRess II as well as current environmental policy challenges. Despite this, it is expected that the objective of ProgRess II to double raw material productivity between 1994 and 2020 will be missed by a wide margin. In contrast to its predecessor, ProgRess III specifically mentions the relevance of resource efficiency to achieve climate goals and the relevance of digitalization for resource efficiency in particular.

ProgRess III includes 118 measures to improve resource efficiency in Germany. These measures cover the action fields:

- resource protection in value chains and material cycles,
- cross-cutting instruments,
- resource protection at international level,
- resource protection at municipal and regional level and
- resource protection in everyday life.

A set of indicators is defined to monitor the impact of ProgRess II that consider total raw material productivity, raw material consumption, secondary raw material use, and material stock changes.

The German Resource Efficiency Program and its current version ProgRess III set the framework for goals, ideas and approaches to protect natural resources. Hence, diverse

	policy instruments addressing material efficiency and the circular economy are based on this program.
CAPEX/OPEX	
Technology maturity	
Target group/sector/technology	The modalities depend on the respective policy design
Typical grant/project size	
Eligibility	
Budget available	
Evaluation	Evaluation of ProgRess II included in ProgRess III
Sources	Deutsches Ressourceneffizienzprogramm III 2020 – 2023 - Programm zur nachhaltigen Nutzung und zum Schutz der natürlichen Ressourcen (bmu.de)

o) Technology Transfer Program Lightweight Construction (TTP LB)

Description	Based on the German Sustainability Strategy and the Industry Strategy 2030, the TTP LB focuses on lightweight construction as a game changer to improve growth and competitiveness as well as climate protection and sustainability. The German Federal Ministry for Economic Affairs and Energy is providing funding of around €300 million for this. Within the framework of the TTP LB, particularly R&D projects relating to lightweight construction are funded in five program lines. The first three program lines have a thematic focus, while the final two consider technology readiness (demonstration project or standardization phase). The thematic focuses consider the following three topics, of which the second and the third are relevant for industry decarbonization:
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	<ol style="list-style-type: none"> 1. Technology development to strengthen the economy, 2. New design techniques and materials 3. Resource efficiency and substitution. <p>The second program line aims to develop and promote material-related GHG reduction options. This is a very broad measure covering material efficiency, material substitution and product design with regard to new construction techniques. Between 2020 and 2024, the Energy and Climate Fund has earmarked funds of around €0.15 billion, which will be continued in subsequent years. After the deadline in June 2020 24 joint projects with more than 137 project partners are funded with €49 million in the next 3 years.</p> <p>The third program line is an accompanying anchoring of material efficiency issues rather than a new measure. The measure builds on the approaches mentioned in the German Resource Efficiency Program. The aim of increased resource efficiency and substitution is to anchor the principle of recycling in production processes and thus exploit previously untapped potentials for reducing emissions. SMEs are the priority target group. In this program line 19 joint projects with more than 107 project participants are funded following the application deadline in June 2020. The funding volume amounts to €31.6 million and is also drawn on over the next 3 years. The next cut-off date for both program lines on October 1, 2020 was similarly well received.</p>
CAPEX/OPEX	Research infrastructure (CAPEX)/ project-related costs (OPEX)
Technology maturity	R&D (TRL 3-8)
Target group/ sector/technology	Enterprises, higher education and research institutions, non-profit organizations, public institutions/ lightweight construction
Typical grant/ project size	€2 million

Eligibility	Projects with a duration up to three years, up to 50% funding for enterprises and up to 100% for higher education and research institutions
Budget available	€60 million in 2020 and €70 million from 2021 onwards (financed via Energy and Climate Fund)
Evaluation	Based on ex ante evaluation, which identified the economic and environmental relevance of lightweight construction
Sources	810287_01 1..13 (bmwi.de) BMW - Technologietransfer-Programm Leichtbau (TTP LB) ex-ante-evaluation-technologietransfer-programm-leichtbau.pdf (bmwi.de)

p) Funding directive and research concept "Ressourceneffiziente Kreislaufwirtschaft"

Description	<p>Based on the second German Resource Efficiency Program (ProgRess II) and funded by the Framework Program to promote Research for Sustainability (FONA3), the German Federal Ministry of Education and Research published the research concept "Ressourceneffiziente Kreislaufwirtschaft" (Resource-efficient circular economy). This supports R&D in the field of resource efficiency considering eco-design, digitalization, innovative product cycles and business models as well as specific relevant products (plastics, economically critical raw materials, mineral materials). Since 2017, three funding directives have been announced covering the following topics:</p> <p>Innovative product cycles (ReziProK, pub. 2017), Construction and mineral material cycles (ReMin, pub. 2018) and Plastics recycling technologies (KuRT, pub. 2020).</p> <p>The funding measure ReziProK started in 2019 with 25 joint projects and a transfer and networking platform hosted by</p>
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	<p>the chemical industry association (DECHEMA). The funding period ends in December 2022 and has a total budget of about €30 million.</p> <p>The funding phase of ReMin started in February 2021. Consequently, information about the number of projects and budget is not yet available. Even though the KuRT measure was announced subsequently, its funding phase already started in November 2020. Nevertheless, information about projects and budget is not yet available either.</p>
CAPEX/OPEX	Purchase of research equipment (CAPEX)/ personnel expenses, travel expenses, material expenses, subcontracts, services (OPEX)
Technology maturity	R&D (TRL 3-8)
Target group/ sector/technology	Enterprises, higher education and research institutions, non-profit organizations, public institutions
Typical grant/ project size	ReziProK: €1,2 million
Eligibility	Projects with a duration up to three or five years, up to 50% funding for enterprises and up to 100% for higher education and research institutions
Budget available	€150 million in total from 2018 to 2023
Evaluation	No evaluation available
Sources	<p>Ressourceneffiziente Kreislaufwirtschaft (bmbf.de)</p> <p>PtJ: Ressourceneffiziente Kreislaufwirtschaft – Innovative Produktkreisläufe</p> <p>PtJ: Ressourceneffiziente Kreislaufwirtschaft – Bauen und Mineralische Stoffkreisläufe (ReMin)</p> <p>PtJ: Ressourceneffiziente Kreislaufwirtschaft – Kunststoffrecyclingtechnologien (KuRT)</p> <p>Bundesbericht Forschung und Innovation 2020 - Forschungs- und innovationspolitische Ziele und Maßnahmen (bmbf.de)</p>

DECHEMA | 36/2019 RessWin

Ressourceneffiziente Kreislaufwirtschaft – Innovative Produktkreisläufe – FONA

Ressourceneffiziente Kreislaufwirtschaft – Bauen und Mineralische Stoffkreisläufe (ReMin) – FONA

Ressourceneffiziente Kreislaufwirtschaft – Kunststoffrecyclingtechnologien (KuRT) – FONA

q) Circular Economy Action Plan (EU)

Description

As part of the European Green Deal, the European Commission adopted the new Circular Economy Action Plan in March 2020 to promote sustainable economic growth. The plan includes 35 actions until 2022 in the fields of sustainable products, value chains, waste and crosscutting activities at regional, national and global level. Most of the proposed activities aim at the adaption of the legislative framework to foster the transformation to a circular economy. Additionally, a monitoring system (Circular Economy Monitoring Framework) is part of the proposed action plan.

A first milestone was the proposed modernization of the EU legislation on batteries in November 2020. Further proposals in 2021/22 are intended to focus on the waste management of electronic devices, end-of-life vehicles, packaging, plastics, textiles, and construction materials. Additionally, legislation will be proposed for sustainable design and prolonged product lifetime. The planned launch of an industrial symbiosis reporting and certification system by 2022 is especially relevant for industry decarbonization

The circular economy is not a new topic at EU level and was implemented via an initial Circular Economy Action Plan in 2015. All 54 measures proposed in the plan have been adopted or are currently being implemented. These efforts included the establishment of a Circular Economy Stakeholder Platform and the Circular Economy Package in 2018 and the publication of the EU Strategy for Plastics in the Circular Economy. At EU level, the topics have been

	additionally addressed by large funding budgets under Horizon 2020.
CAPEX/OPEX	No financial support
Technology maturity	Not technology specific
Target group/ sector/technology	EU member states
Typical grant/ project size	No financial support
Eligibility	EU member states
Budget available	No financial support
Evaluation	Circular Economy Monitoring Framework
Sources	EUR-Lex - 52020DC0098 - EN - EUR-Lex (europa.eu) implementation_tracking_table.pdf (europa.eu) First Circular Economy Strategy - Environment - European Commission (europa.eu)

2.7 Energy efficiency

The following provides a complete overview of measures addressing energy efficiency improvement. While some of the programs also address topics beyond energy efficiency like renewable energies or material efficiency, the main focus of these programs is clearly on energy efficiency.

r) Federal support for energy efficiency in the economy - grants and loans

Description	The program reorganizes a number of previously separate support programs. The programs for the promotion of highly efficient cross-cutting technologies (e.g. electric motors), the Waste Heat Directive, the promotion of energy-efficient and climate-friendly production processes, the promotion of energy management systems, and the promotion of renewable process heat in the Market Incentive Program
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all expired in December 2018 at the latest. They were re-launched as a joint promotion package with adapted conditions and rates of support in January 2019. The programs were bundled in four modules and their application procedures were aligned. The aim of the restructuring is to offer an integrated energy efficiency support package for industry, to reduce obstacles in the application process, and to eliminate overlaps between programs.

In the new funding program "Federal funding for energy efficiency in the economy", funding is possible in four modules that can be selected and combined:

- ▶ Module 1: Cross-cutting technologies (e.g. electric motors, pumps, fans)
- ▶ Module 2: Process heat from renewable energies
- ▶ Module 3: MSR, sensor technology and energy management software
- ▶ Module 4: Energy-related optimization of plants and processes.

The extent to which technologies and measures to increase material efficiency in Modules 1, 3, and 4 can also be promoted more intensively is being examined, provided that they also demonstrably support the achievement of the relevant funding objectives. These activities also relate to the German Resource Efficiency Program III (promoting material and energy-efficient production processes).

It is expected that the program's €300 million budget for 2020 will also apply to subsequent years.

s) Energy audits in SMEs

Description

Small and medium-sized enterprises (SMEs) are offered qualified energy advice within the framework of the BMWi program "Energy Consulting for SMEs" (Directive on the Promotion of Energy Consulting for SMEs of 11.10.2017, BAnz AT 07.11.2017 B1, (EBM)). Qualified energy consultants identify potentials to save energy and make concrete proposals for energy-efficiency measures tailored to the respective company. The proposed measures can be used, for example, to create concepts for waste heat utilization. The directive complies with the EU requirements for energy audits according to the EU Energy Efficiency Directive (2012/27/EU). The program is administered by the German Federal Office for Economic Affairs and Export Control (BAFA). The maximum funding per audit is €6,000.

Identified energy-efficiency measures should also include material efficiency with the aim of saving energy in industrial processes. Corresponding training courses for auditors to identify material and resource efficiency measures are recognized. These activities also serve the implementation of measure 29 of the German Resource Efficiency Program III, which aims, among other things, to improve the coordination of the content and structure of consulting services on material and energy efficiency, and to avoid duplication of consulting services.

t) KfW Energy Efficiency Program: Low-interest loans for energy efficiency projects

Description

With the KfW Energy Efficiency Program, the KfW grants low-interest loans to commercial enterprises for the implementation of energy efficiency measures. The program promotes energy-efficient production facilities/processes including cross-cutting technologies with the highest energy-saving potential. Further development of the program introduced a new entry-level standard (10% savings) and a new premium standard (30% savings). Funding intensity is

therefore aligned to the amount of energy savings, regardless of the size of the company. Projects with the premium standard have particularly favorable conditions. The improved funding conditions became effective in July 2015. By 2019, 219 commitments had been made with a funding volume of €974 million. The program is financed from KfW's own funds.

u) Pilot program "Einsparzähler" (Savings meter)

Description

The pilot program "Einsparzähler" aims to foster innovations in digitalization to improve energy efficiency. Funding is available to companies that want to test and demonstrate innovative digital systems and related business models. The companies will receive funding of up to two million euros. In the pilot projects, energy consumption data must be precisely metered and able to be assigned to individual devices or systems (groups). The current funding announcement "Pilotprogramm Einsparmeter" of the German Federal Ministry of Economics and Energy (BMWi) is dated February 18, 2019 (BAZ AT 21.02.2019). It runs until December 31, 2022 and replaces the funding announcement "Pilotprogramm Einsparzähler" of May 20, 2016. The Federal Office for Economic Affairs and Export Control (BAFA) is the granting authority. The pilot projects to date have achieved energy savings in private households, the commercial, trade and services sector (GHD), industry, and transport.

v) Federal funding for energy efficiency in the economy - funding competition

Description

The program promotes the implementation of energy efficiency projects in companies in a competitive process that is open to all actors, sectors and technologies with the objective to finance projects with the best cost/benefit ratio. The program supports investment measures to optimize the energy efficiency of industrial and commercial plants

and processes that contribute to increasing energy efficiency or reducing fossil energy consumption in companies. This also includes measures for the provision of process heat from renewable energies. Costs for preparing a savings concept and implementation support of the subsidized investment measure by external experts are also eligible for funding. This program is a further development of the "Promotion of electricity savings within the framework of competitive tenders" program introduced in 2016: Use electricity efficiency potentials - STEP up! A funding budget of €35 million was earmarked for the year 2020.

w) Energy efficiency networks for businesses

Description

Energy Efficiency Networks (EEN) are networks of companies that set common energy efficiency and CO₂ reduction targets and want to learn from each other. Following a successful pilot phase of the EEN concept, in 2014, the German government decided to implement EEN as a main pillar of the National Energy Efficiency Action Plan (NAPE). The plan was to establish up to 500 new networks by 2020. For this purpose, a voluntary agreement "Initiative Energy Efficiency Networks" was signed in 2014 between the federal government (BMWi and BMU) and 22 business associations and organizations. This agreement was extended in September 2020 to create an additional 300-350 networks by 2025.

Companies participating in the networks need to conduct an energy audit at company level and set a savings target at network level based on the individual company targets. The networks are supported by a qualified energy consultant. The implemented measures are recorded in the context of an annual monitoring. 282 networks had been established as of 9.10.2020.

x) Energy audit obligation for large companies (implementation of Art. 8 EU Energy Efficiency Directive)

Description

"Large" companies are obliged to conduct energy audits under Article 8, Paragraph 4-7 of the EU Energy Efficiency Directive (2012/27/EU; EED). The energy audits should be carried out by qualified and/or accredited experts. The directive requires that the first energy audit should have been conducted by 5 December 2015 at the latest. In order to implement these requirements, the Energy Services Act (EDL-G) was amended accordingly with effect from 22.4.2015. According to this, large companies (non-SMEs, i.e. companies that do not fall under the European Commission's definition of SMEs (< 250 employees or turnover < €50 million or annual balance sheet total < €43 million)) are obliged to have carried out an energy audit according to DIN EN 16247-1 by December 5, 2015 and thereafter a further audit at least every four years. Companies that have an energy management system certified according to DIN EN ISO 50001 or an EMAS environmental management system are exempt from the obligation to conduct energy audits.

As part of the amendment in 2019, a de minimis threshold was introduced of 500 MWh total energy consumption. Below this threshold, a simplified energy audit can be carried out by sending a declaration of energy consumption and energy costs to the BAFA.

2.8 Others

z) IN4climate.NRW

Description

IN4climate.NRW is a platform for sharing knowledge, dialogue and collaboration between industry, science and politics for the decarbonization of the industrial sector. Currently, the platform consists of about 30 companies and associations from steel and metal, cement, glass, paper and construction materials as well as six research institutions and is supported by the Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia.

Focusing on the circular economy, hydrogen, carbon economy, political frameworks, narratives and heat, the platform strives to maintain the future viability of the state of North Rhine-Westphalia as an industry location. For this purpose, financial and technical strategies based on technology studies and innovation roadmaps as well as research projects are to be developed. In addition to the economic objective, the superordinate goal is the transition to carbon-neutral industry.

In 2019 and 2020, the platform produced a hydrogen study as well as five papers discussing hydrogen, climate-friendly revitalization of the economy, chemical plastics recycling, expansion of renewable energies, and unavoidable GHG emissions. Furthermore, IN4climate.NRW has carried out diverse events, some in cooperation with its scientific competence center SCI4climate.NRW. This competence center has also published diverse reports and papers supporting the work of IN4climate.NRW.

CAPEX/OPEX

No financial support

Technology maturity

Not defined (TRL 1-9)

Target group/sector/technology

Industry (esp. steel and metal, cement, glass, paper, construction materials)


Typical grant/ project size	No financial support
Eligibility	Industrial companies in North Rhine-Westphalia, relevant research institutions
Budget available	No financial support
Evaluation	No evaluation available
Sources	Home IN4climate.NRW Treibhausgasneutrale Industrie WIRTSCHAFT.NRW

aa) SME Initiative Energy system transformation and climate protection

Description	<p>The SME initiative is a joint project of ministries and industry as well as handicrafts chambers/associations (BMW i, BMU, DIHK and ZdH). The first funding period expired on 31.12.2015. The second phase was launched on January 1, 2016 and ran until December 31, 2018. Seven environmental centers of the skilled trades sector were included, which support regional development workshops in their chamber districts. In addition, around 10,000 company contacts were made to raise awareness of the topic of energy efficiency and 375 companies were visited directly. On January 1, 2019, a further period of the SME initiative was launched to continue the projects already started and to design new measures such as digitalization, the development of a roadmap for SMEs, and mobility-related topics. The measures are implemented on the basis of action plans coordinated with the environment centers and the ZdH.</p>
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Authors' affiliations

Tobias Fleiter, Meta Thurid Lotz, Marlene Arens, Barbara Schlomann

Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI)
Competence Center Energy Technology and Energy Systems
Competence Center Energy Policy and Energy Markets

Contact: Dr. Tobias Fleiter

Fraunhofer Institute for Systems
and Innovation Research (Fraunhofer ISI)
Breslauer Strasse 48
76139 Karlsruhe
Germany
E-Mail: Tobias.Fleiter@isi.fraunhofer.de
www.isi.fraunhofer.de

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