Federal Ministry
of Finance

Green bond impact report

2021

Green bond impact report

2021

September 2023

Contents

I. Overview

This impact report relates to the Green German Federal securities issued in 2021. The report first provides a summary of the main impacts before going on to look at each budget item individually (Chapter II).

Green German Federal securities were issued in 2021 with a volume of € 12.5 billion (see following table). The equivalent amount of this issuance volume was allocated to the 2020 expenditures identified as green (hereinafter: eligible) in the Green Bond Allocation Report[1]. The proceeds of the 2021 issuances of Green German Federal securities were fully allocated. This impact report therefore concludes the reporting for the 2021 issuances in accordance with the Green Bond Framework.[2]

The Core Green Bond Team consisting of the Federal Ministry of Finance (BMF) (Chair), the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU[3]) and the Federal Republic of Germany – Finance Agency identified eligible expenditures of around € 13.4 billion from 77 items in the 2020 federal budget. The auditing firm Deloitte conducted an external audit of the allocation and confirmed the allocation of the issuance proceeds to the eligible expenditures (third-party verification).

Green German Federal securities 2021

Issuance date	Type of issue	Issuance procedure	Type of security	Maturity date	Coupon	ISIN	Issuance volume
11.05.2021	New issue	Syndicate	30-year Green Federal Bond ("Green Bund (Aug2050)")	15.08.2050	0 %	DE0001030724	€ 6.0bn
08.09.2021	New issue	Auction	10-year Green Federal Bond ("Green Bund (Aug2031)")	15.08.2031	0 %	DE0001030732	€ 3.5bn
20.10.2021	Tap	Auction					€ 3.0bn

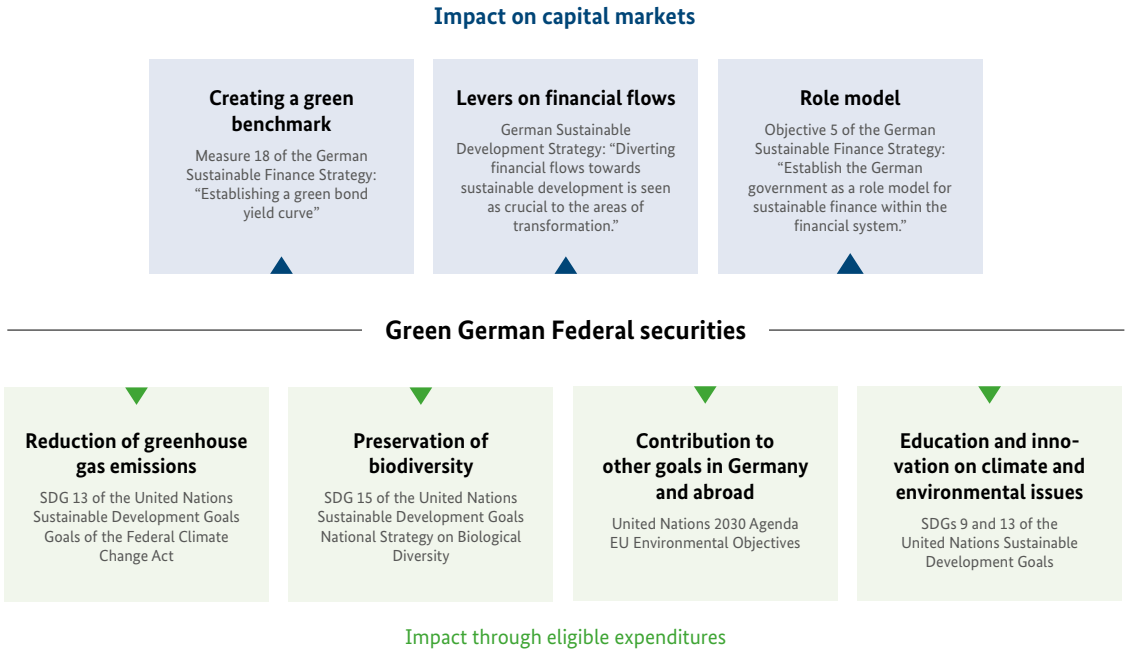
Green German Federal securities manifest their impact in various and multifaceted ways, both directly on the capital markets and indirectly through the underlying expenditures at national and international levels.

1 Allocation Report for Green German Federal securities 2021 of 10 May 2022: Green bond allocation report 2021 (deutsche-finanzagentur.de)

2 Tap issuances of the 2021 newly issued Green German Federal securities in subsequent years are transparently reported in the allocation and impact reports for the year of the taps. This is in line with section 4.3 of the Green Bond Framework of 24 August 2020.

3 The names and departmental responsibilities of the ministries correspond to the financial year 2020.

Figure 1: Goals and impacts of Green German Federal securities



Source: Federal Ministry of Finance

Capital markets

On the capital markets, Green German Federal securities directly transfer Germany's established market approach to the green segment, offering a reliable green investment with maximum price transparency. Combined with the aim of creating and maintaining a liquid green Bund market with a diversified maturity spectrum for different types of investors, this will attract new investors and new issuers to the green bond market. This is expected to accelerate the development of sustainable capital markets overall and serve as a catalyst to channel more public and private investment into a greener economy.

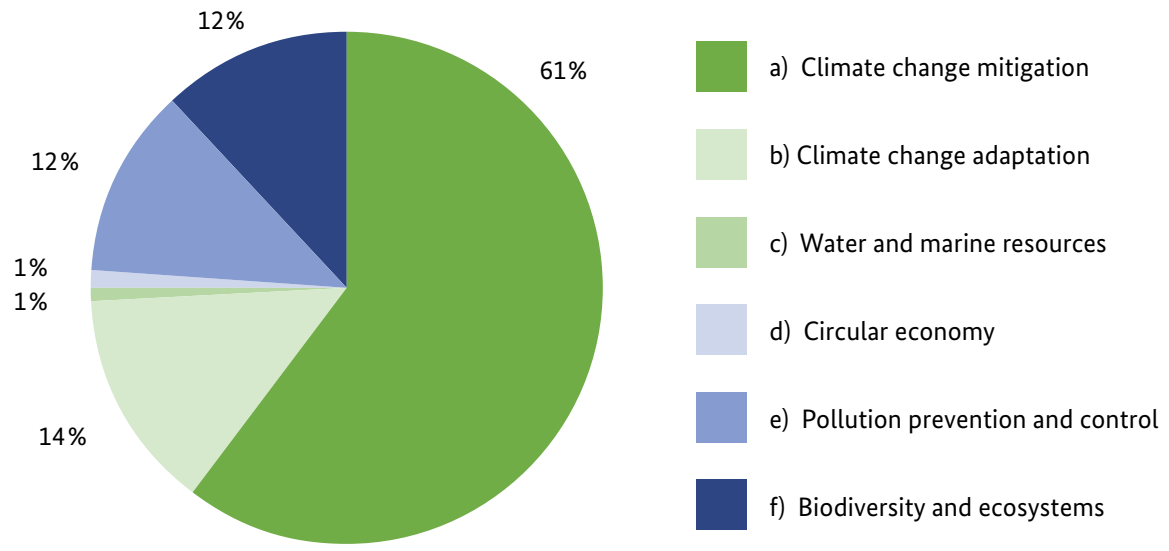
With the firm intention of establishing a green Bund curve, the Federal Republic of Germany is signalling that it will issue Green German Federal securities on a permanent and long-term basis. This is based on the eligible expenditures of the federal budget (including the Energy and Climate Fund[4]), through which Green German Federal securities achieve their indirect effect.

EU environmental objectives

In accordance with the 2021 Green bond allocation report, the eligible expenditures in 2020 are distributed among the environmental objectives of the EU taxonomy for environmentally sustainable economic activities as follows:

4 With the entry into force of the Second Act Amending the Act Establishing a Special Energy and Climate Fund on 22 July 2022, the Special Fund was renamed to "Climate and Transformation Fund" (see Federal Law Gazette I no. 26 of 21 July 2022). For the purposes of the impact report 2021, the name as it stood in the financial year 2020 will be used.

Figure 2: Breakdown of 2021 eligible expenditures in accordance with the EU's environmental objectives



Source: Allocation report 2021

National commitment

Germany is committed to the Paris Agreement and the 17 United Nations Sustainable Development Goals (SDGs). Its goal of becoming greenhouse gas neutral by 2045 was enshrined in the amended Federal Climate Change Act[5] in 2021. Moreover, binding interim targets and annually decreasing emission levels up to and including 2030 have been set for the individual emission sectors:

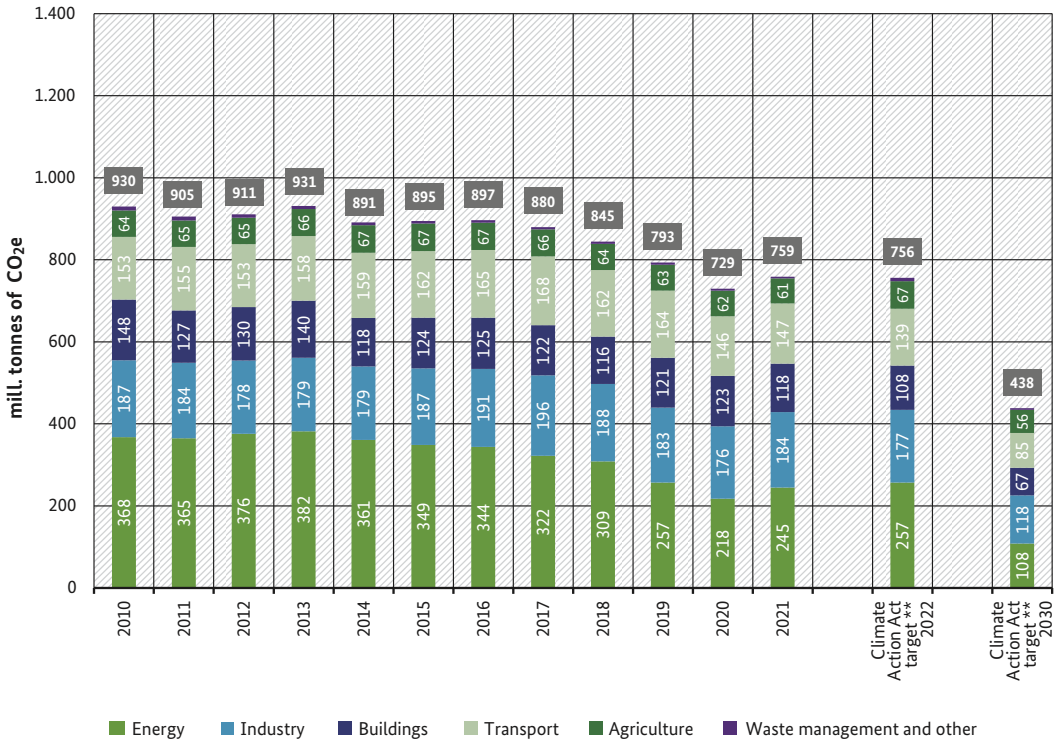
- Energy
- Industry
- Buildings
- Transport
- Agriculture
- Waste management and other

In 2021, about 760 million tonnes of greenhouse gases were released – about 30 million tonnes or 4 % more than in 2020, but less than the 800 million tonnes emitted in 2019. Compared to 1990, there was a 39 % reduction in greenhouse gas emissions[6]. The reduction targets are 65 % for 2030 and 88 % for 2040.

5 https://www.bundesregierung.de/breg-de/schwerpunkte/klimaschutz/climate-change-act-2021-1936846

6 For the Impact Report 2021, the data of the Climate Action Report 2022 and the final greenhouse gas emissions balance 2021 are used: see https://www.umweltbundesamt.de/en/press/pressinformation/final-2021-greenhouse-gas-emissions-balance. The Climate Action Report 2023 and the final greenhouse gas emissions balance 2022 will be included in the impact report 2022. Detailed information on this can be found at https://www.bmwk.de/Redaktion/DE/Downloads/Energie/klimaschutzbericht.html

Figure 3: Greenhouse gas emission trends in Germany based on the Federal Climate Action Act sectors



* The breakdown of the emissions deviates from the UN reporting, the total emissions are identical

** in accordance with the amendment to the Federal Climate Action Act of 12 May 2021, the years 2022-2030 adjusted to over- and undershooting of targets

Source: Federal Environment Agency, 26 January 2023

These goals are to be achieved through numerous measures: targets, incentives, financial support and investment programmes. The German climate target for 2030 also takes into account the new, more ambitious EU climate target for 2030, which all member states agreed on under the German Council Presidency at the end of 2020. Other goals in the transition to a sustainable economy include switching to renewable energy sources, using energy more efficiently, adapting to climate change and preserving biodiversity.

International cooperation

Germany plays a key role in international cooperation for sustainable development. In this way, Germany supports developing countries and emerging economies in their transition to more ecologically sustainable economies and societies. Through its participation in international bodies, its involvement in United Nations framework conventions and its bilateral and multilateral cooperation with other states, Germany emphasises the shared responsibility of all states for a healthy planet and addresses topics in the areas of climate action and climate change, the environment, nature, biodiversity and sustainable resource use.

Significant contributions of eligible expenditures

The Federal Republic of Germany's Green Bond Framework[7] dated 24 August 2020 contains possible expenditure categories that contribute to environmental protection, nature conservation and climate action and that can be assigned to Green German Federal securities. They are divided among five central thematic areas (sectors):

1. Transport
2. International cooperation
3. Research, innovation and awareness raising
4. Energy and industry
5. Agriculture, forestry, natural landscapes and biodiversity

Chapter II of this report delivers a final conclusion on the impact of the 2020 eligible expenditures of € 13.4 billion on the climate, the environment and nature, broken down by these sectors. The following is an initial summary of the manifold impacts of the broad and very diversified expenditure portfolio, aggregated only when the different calculation approaches allow.

Contributions to the reduction of greenhouse gas emissions (based on methodologies used for this report)

More than 1.7 million t CO_2e p.a. (co-financing)

In the transport sector, eligible expenditures of around € 1.5 billion were used for new construction and expansion projects in the rail and waterways sectors. The rail construction and upgrading projects in the Federal Transport Infrastructure Plan 2030, which are being co-financed by this amount, will contribute to an annual reduction in emissions of around 1.4 million tonnes of CO_2 equivalents from the time the routes are opened. Together with the investments in the federal waterways, a reduction of more than 1.7 million tonnes of CO_2 equivalents per year is calculated for the transport sector after completion of the measures.

More than 1.4 million t CO_2e in 2020

The pro rata subsidy for track access charges provides incentives to safeguard existing rail freight transport and to shift transport to the railways. Without the subsidy, more than 0.9 million additional tonnes of CO_2 equivalents would have been emitted in 2020. In addition, funding for combined transport and for railway sidings reduced emissions by around 0.5 million tonnes of CO_2equivalents in 2020.

1.4 million t CO_2e p.a.

In the energy and industry sector, an annual reduction in greenhouse gas (GHG) emissions of about 1.4 million tonnes of CO_2 equivalents can be attributed to the programmes to promote renewable energy sources and increase energy efficiency (eligible expenditures of € 346 million).

more than 2.3 million t CO_2e (impact period)

In addition, the measures of the National Climate Initiative and the energy efficiency incentive programme (with expenditures of around € 151 million) are contributing to CO_2 savings of more than 2.3 million tonnes of CO_2 equivalents over the entire impact period of the projects.

7 Green Bond Framework 2020 (deutsche-finanzagentur.de)

Renewal of tracks, switches, bridges

1,995 km of track
2,277 switches

In the transport sector (the largest sector with eligible expenditures of around € 7.4 billion), about € 6.7 billion was spent on the rail system. With investments in the existing network from federal funds amounting to € 4.6 billion, a significant contribution was made to the maintenance of the rail network. Among other things, according to Deutsche Bahn AG (DB AG), 1,995 km of track and 2,277 switches were renewed.

Decarbonisation of the mobility sector

More than 360 H_2 vehicles
500 infrastructure assets
120 research projects

Alternative drive systems and fuels are a key instrument for decarbonising the mobility sector. With eligible expenditures of around € 74 million, more than 360 H_2 vehicles, 500 infrastructure assets and 120 research projects, among other things, were funded.

International support, especially for developing and emerging countries

Approx.
1,800 projects

In the international cooperation sector, eligible expenditures of more than € 3.2 billion financed or co-financed around 1,800 projects, for example to support developing and emerging countries in their transition to more ecologically sustainable economies and societies.

Education and innovation on climate and environmental issues

More than 6,800 projects

The eligible expenditures of around € 1.1 billion in the research, innovation and awareness raising sector include more than 6,800 projects that enable and support education and innovation on climate and environmental issues.

Coastal and flood protection

More than 1,000 funding cases and 1,500,000 ha protected area

In the agriculture, forestry, natural landscapes and biodiversity sector, numerous funding opportunities for coastal and flood protection are being implemented by the *Länder*. The eligible expenditures of the federal budget (around € 186 million), which are co-financed by the *Länder*, contribute to coastal and flood protection over an area of more than 1,563,000 ha with 1,040 funding cases in 2020.

Biodiversity, natural landscapes and forests

More than 130,000 ha of funded area

The eligible expenditures for the conservation of nature, landscapes, forests and biodiversity were used to co-finance protected or restored areas with a total size of 131,224 ha.

II. Impact of eligible expenditures by budget item

The following section provides detailed reporting for each of the 77 budget items used. The budget items as well as the programmes and projects are very diverse. Therefore, a summary report at item level is supplemented by detailed examples and descriptions. The number of projects and/or funding recipients indicates the range of different funding measures. The assumptions and limitations of the reporting are presented transparently at the level of the budget items. The impacts presented are based on the current state of knowledge according to the available data and methods.

Impact indicators and metrics vary depending on the type of expenditure, sector, relevance and (data) availability or methodology. The impact reporting takes into account the International Capital Markets Association (ICMA) Green Bond Principles' Harmonised Framework for Impact Reporting and its core principles and recommendations.[8] The data was provided by the relevant federal ministries and is based on existing analyses and reports where possible. Special features of government expenditure categories, such as international cooperation grants or research and development projects, mean that the available impact indicators partly differ from those commonly used on the market. They therefore include all impact dimensions (output, outcome and impact indicators). The German Sustainability Strategy stipulates that legislative projects must undergo sustainability impact assessments and that subsidies must be evaluated on a regular basis.[9] This will also expand the data basis of future impact reports on Green German Federal securities issuances in subsequent years.

The Core Green Bond Team coordinated the preparation of the report. The impact report was validated by the Interministerial Working Group. The names and responsibilities of the ministries correspond to the financial year 2020.[10]

a) Tabular overview of the key indicators

The following tables provide an overview of the key eligible expenditure figures which are of particular importance for the sector or the budget item. The values given are rounded in the standard manner. Indicators, examples and detailed information such as assumptions and limitations can be found in the fact sheets for each budget item (part b) directly after the tabular overview. For ease of navigation, the names of the budget items in the table are linked to the corresponding fact sheets.

8 https://www.icmagroup.org/assets/documents/Sustainable-finance/2022-updates/Harmonised-Framework-for-Impact-Reporting-Green-Bonds_June-2022v2-020822.pdf

9 In addition, the federal government is committed to the mandate in the 2021 coalition agreement: "Step by step, we will convert the federal budget (excluding personnel and administrative costs) to target and impact-oriented budget management, within the framework of which the political objectives of all funding and expenditure programmes will already be translated into clearly defined, measurable indicators (e.g. SMART targets) at the political decision-making stage and provided with fixed evaluation deadlines."

10 Official order according to the announcement of the formation of the government on 14 March 2018 in the Federal Gazette of 16 March 2018. Where websites have already been changed to the current ministry names, updated abbreviations are used: BMDV (formerly BMVI), BMWK (formerly BMWi) and BMUV (formerly BMU).

Budget chapter	Budget item	Name of the budget item	Eligible expenditures (in € million)	Allocated to Green Bund (Aug 2050)	Allocated to Green Bund (Aug 2031)	Selected impact indicators
		1. Transport sector				
1.1. Rail transport						
1202	891 11	Construction cost subsidies for maintaining the federal rail infrastructure	4,642.5	2,077.5	2,250.6	Investment in the existing network: 1,995 km of track, 2,277 switches, 35,414 m² of bridges
1202	891 01	Construction cost subsidies for investments in the federal rail infrastructure	1,385.0	619.8	671.4	1.382 million t CO_2e p.a GHG reduction 2,298 t p.a. NO_x reduction
1210	891 01	Construction cost subsidies for investments in the non-federal rail infrastructure	30.9	13.8	15.0	112 projects
1210	682 05	Reduction in track access charges for rail freight transport	350.5	156.8	169.9	0.961 million t CO_2e GHG emissions avoided in 2020
1202	891 05	Measures to reduce noise pollution from existing federal railways	190.4	85.2	92.3	195 km noise-reduced route in 2020 61,085 people benefited from noise reduction
1210	892 41	Subsidies to private companies for investments in combined transport	48.1	21.5	23.3	0.143 million t CO_2e GHG reduction in 2020
1210	892 42	Investment subsidies to private companies for the construction, expansion and reactivation of railway sidings	9.1	4.1	4.4	0.324 million t CO_2e GHG reduction in 2020
1.2. Alternative drive systems and fuels						
1210	892 03	National Hydrogen and Fuel Cell Technology Innovation Programme (NIP) 2016–2026	67.0	30.0	32.5	367 subsidised H_2 vehicles 513 critical infrastructure assets
1210	686 61	Subsidies for research, development and pilot projects for the market activation of alternative fuel use and the establishment of a corresponding filling and charging infrastructure	7.1	3.2	3.4	6 projects
1.3. Public transport						
1206	882 02	Financial assistance to the *Länder* for rail-bound local public transport infrastructure	166.0	74.3	80.5	27 projects
1206	891 01	Investment subsidies for public transport projects to Deutsche Bahn AG and companies majority-owned by the federal government	146.8	65.7	71.2	21 projects
6092	633 01	Local-authority public transport pilot projects from 2018 to 2020 to complement the Immediate Action Programme for Clean Air	49.4	22.1	23.9	0.024 million t CO_2e p.a GHG reduction 60 t p.a. NO_x reduction

Budget chapter	Budget item	Name of the budget item	Eligible expenditures (in € million)	Allocated to Green Bund (Aug 2050)	Allocated to Green Bund (Aug 2031)	Selected impact indicators
1.4. Waterways						
1203	780 02	Replacement, extension and construction projects relating to federal waterways	138.7	62.1	67.2	0.345 million t CO_2e p.a GHG reduction
1203	780 01	Maintenance of transport infrastructure	61.5	27.5	29.8	List of projects
1.5. Cycling						
1201	746 22	Construction of bike lanes including maintenance (federal highways)	83.0	37.1	40.2	103 km of newly built and repaired cycle paths
1210	632 91	Implementation of the National Cycling Plan – grants to *Länder* and other public-law entities	11.3	5.1	5.5	53 projects
	686 91	Implementation of the National Cycling Plan – subsidies to companies under private law				
	882 91	Grants to *Länder* for the construction of cycle highways				
	891 92	Subsidies for the expansion of Germany's network of cycle routes ("Radnetz Deutschland")				
	891 91	Funding of pilot projects in the area of cycling – subsidies to *Länder* and other public-law entities				
2. International cooperation sector						
2.1. Bilateral financial cooperation						
2301	896 11	Bilateral financial cooperation – grants	504.4	225.7	244.5	428 projects
2301	896 01	Financial cooperation with regions	264.2	118.2	128.1	20 projects
2301	866 11	Bilateral financial cooperation – loans	149.0	66.7	72.2	70 projects
2.2. Bilateral technical cooperation						
2301	896 03	Bilateral technical cooperation	683.0	305.6	331.1	635 projects
2.3. International climate and environmental protection						
1602	896 05	Investments to protect the climate and biodiversity abroad	592.5	265.1	287.2	371 projects of which 35 projects newly funded in 2020
1601	687 06	International climate and environmental protection – export of technologies to tackle marine litter	12.4	5.5	6.0	6 projects

Budget chapter	Budget item	Name of the budget item	Eligible expenditures (in € million)	Allocated to Green Bund (Aug 2050)	Allocated to Green Bund (Aug 2031)	Selected impact indicators
2310	687 01	International climate and environmental protection	79.4	35.5	38.5	59 projects
2.4. Multilateral cooperation						
2303	896 09	Developmentally important multilateral aid for global environmental protection, biodiversity conservation and climate protection	714.4	319.7	346.3	12 initiatives
1601	687 01	Contributions to international organisations	23.1	10.3	11.2	27 organisations
2.5. Specific funding						
2310	896 31	Special initiative ONE WORLD – No Hunger	204.0	91.3	98.9	27 projects
6092	687 02	International energy cooperation, commodity partnerships and technological cooperation	23.1	10.3	11.2	46 projects
1602	532 05	International cooperation [in the area of climate action]	21.6	9.7	10.5	36 projects
1601	687 04	Export of green and sustainable (environmental) infrastructure	7.2	3.2	3.5	40 projects
3. Research, innovation and awareness raising sector						
3.1. Research for sustainability						
3004	683 30	Bioeconomy	133.7	59.8	64.8	496 beneficiaries 1,475 projects
3004	685 41	Energy technologies and efficient energy usage - research and development projects	111.7	50.0	54.2	583 projects
3004	685 42	Environmental technologies, resources and geological research	110.1	49.3	53.4	1,311 beneficiaries
3004	685 40	Climate research, biodiversity and globalised living spaces – R&D projects	97.0	43.4	47.0	405 beneficiaries 975 projects
3004	685 44	Ocean, coastal and polar research – R&D projects	43.0	19.2	20.8	73 beneficiaries 250 projects
3004	683 10	Knowledge and technology transfer tools as part of the High-Tech Strategy	2.7	1.2	1.3	33 projects
3004	685 43	Social sciences for sustainability	36.1	16.2	17.5	430 beneficiaries 430 projects

Budget chapter	Budget item	Name of the budget item	Eligible expenditures (in € million)	Allocated to Green Bund (Aug 2050)	Allocated to Green Bund (Aug 2031)	Selected impact indicators
3.2. Environmental protection, nature conservation and climate change adaptation						
1601	544 01	Research, studies, etc. [in the area of climate and environmental protection]	52.1	23.3	25.3	625 ongoing projects in 2020 of which 151 projects newly committed in 2020
1601	892 01	Investments to reduce pollution [environmental innovation programme, Germany]	14.8	6.6	7.2	79 ongoing projects in 2020 of which 14 projects newly committed in 2020
1604	544 01	Research, studies, etc. [in the area of nature conservation]	13.1	5.9	6.4	60 projects newly committed in 2020
1601	685 04	Subsidies for organisations in the areas of environmental protection and nature conservation	10.4	4.7	5.0	project examples
1602	685 05	Funding of climate change adaptation measures	5.8	2.6	2.8	182 projects
3.3. Aerospace, energy, transport and digitalisation						
6092	683 05	Hybrid electric aviation	4.7	2.1	2.3	64 projects
0901	685 31 894 31	German Aerospace Center (DLR) – operation and investments	439.9	196.9	213.3	280 projects
0901	683 12	Maritime technologies – research, development and innovation	9.9	4.4	4.8	289 beneficiaries 467 projects
4. Energy and industry sector						
4.1. Energy research						
0903	683 01	Energy research	528.1	236.3	256.0	4,491 ongoing projects
4.2. Renewable energy						
6092	686 13	Energy transition programmes and measures in the areas of renewable energy sources, electricity and power grids, digitalisation and energy infrastructure	44.2	19.8	21.4	199 beneficiaries
4.3. Energy efficiency						
6092	686 08	Energy efficiency in industry and businesses	250.5	112.1	121.4	0.815 million t CO_2e p.a GHG emissions avoided

Budget chapter	Budget item	Name of the budget item	Eligible expenditures (in € million)	Allocated to Green Bund (Aug 2050)	Allocated to Green Bund (Aug 2031)	Selected impact indicators
6092	686 14	Providing advice on energy efficiency	60.7	27.2	29.4	0.6 million t CO_2e p.a GHG emissions avoided
6092	686 10	Heating Optimisation Programme	34.8	15.6	16.9	0.016 million t CO_2e p.a GHG emissions avoided
6092	686 11	Energy efficiency incentive programme	12.8	5.7	6.2	0.27 million t CO_2e GHG emissions avoided
6092	893 04	Industrial production of mobile and stationary energy storage units	14.8	6.6	7.2	4 beneficiaries
4.4. National Climate Initiative						
6092	686 05	National Climate Initiative	138.6	62.0	67.2	2.04 million t CO_2e over the entire impact period
6092	686 23	National climate action measures	8.7	3.9	4.2	10 projects
5. Agriculture, forestry, natural landscapes and biodiversity sector						
5.1. Agriculture						
1005	686 43	Subsidies to fund organic farming and other sustainable forms of agriculture (BÖLN)	13.8	6.2	6.7	261 subprojects
1005	686 31 893 31	Funding of innovation in the area of food, agriculture and health-related consumer protection	42.1	18.8	20.4	903 subprojects
6092	686 22 893 07	Subsidies to fund measures for improving energy efficiency in agriculture and horticulture	25.7	11.5	12.5	0.046 million t CO_2e p.a GHG reduction 1,030 beneficiaries
5.2. Land use, land use change and forestry (LULUCF)						
Annex 1 to 1003(1095)	632 41 882 41 632 42 882 42	Grants to fund forestry measures (excluding investments) Grants to fund forestry measures (investments) Grants to fund measures that combat the effects of extreme weather events in forests (excluding investments) Grants to fund measures that combat the effects of extreme weather events in forests (investments)	124.3	55.6	60.3	58,115 funding cases 6,475 ha reforested *area (as part of close-to-nature forest management)* 90 ha grant-aided area *(for planting as part of initial afforestation (planting of new forest))* 19.7 million m³ of processed infested wood 32,043 ha of grant-aided area *(as part of contract-based forest nature conservation)*
6092	686 06	Forest Climate Fund	15.8	7.1	7.7	192 ongoing projects in 2020, of which 99 newly committed in 2020

Budget chapter	Budget item	Name of the budget item	Eligible expenditures (in € million)	Allocated to Green Bund (Aug 2050)	Allocated to Green Bund (Aug 2031)	Selected impact indicators
1005	686 11 893 11	Subsidies to fund research, development and demonstration projects in the area of renewable resources and to fund national sustainable forestry projects	42.4	19.0	20.6	379 beneficiaries 585 projects
5.3. Biodiversity and natural landscapes						
1604	893 02	Wilderness fund	10.0	4.5	4.8	616 ha placed under protection
1604	882 01	Grants for the establishment and long-term protection of areas of nature and landscapes of national importance (chance.natur)	13.2	5.9	6.4	92,000 ha total area restored in projects ongoing in 2020
1604	685 01	Grants to fund measures within the federal programme for biodiversity	31.0	13.9	15.0	259 projects
5.4. Coastal defences and flood protection						
Annex 1 to 1003(1095)	882 15	Grants to fund flood protection facilities, the renaturation of dykes, torrent control and the renaturation of water bodies	75.5	33.8	36.6	1,152 funding cases 405,137 ha protected area 38 ha retention area gained 541 km/1,175 ha extent of support for nature-oriented watercourse development
	882 61	Grants for funding coastal defence measures	83.6	37.4	40.5	1,158,443 ha protected area (impact reported together with Annex 1 to 1003(1095) 882 81) 211 funding cases
	882 82	Federal share for funding the special framework programme for preventative flood protection measures	59.8	26.8	29.0	16,675 ha reclaimed floodplain area 509 million m^3 reservoir space gained
	882 81	Grants to fund coastal defence measures to counter the effects of climate change	26.8	12.0	13.0	1,158,443 ha protected area (impact reported together with Annex 1 to 1003(1095) 882 61) 68 funding cases

b) Fact sheets

The following individual fact sheets provide detailed reports on the impact on the climate, the environment and nature for each budget item used. For ease of navigation, there is a link to the tabular overview (part a) at the end of each fact sheet.

The primary objective of the Federal Climate Change Act is to reduce greenhouse gas emissions. Where available, CO_2 reduction is therefore reported as a key indicator.[11] For the other goals in the transition to a sustainable economy, including the switch to renewable energy, more efficient use of energy, adaptation to climate change and preservation of biodiversity, available indicators are reported accordingly. The EU environmental objectives pursued with the expenditures are illustrated in each fact sheet.[12]

Current developments and forecasts of greenhouse gas emissions are published in the federal government's annual Climate Action Report and the German greenhouse gas inventory.[13] According to this reporting, about 760 million tonnes of CO_2 equivalents were released in 2021 – about 30 million tonnes or 4 % more than in 2020, but less than the 800 million tonnes emitted in 2019.

11 For consistent reporting (paragraph 13 of the ICMA Green Bond Principles' Harmonised Framework for Impact Reporting), reporting is uniformly in CO_2 equivalents. In accordance with the prudence principle, CO_2 figures are reported as CO_2 equivalents.

12 In the order they are listed in Article 9 of the EU Taxonomy Regulation: a) climate change mitigation, b) climate change adaptation, c) water and marine resources, d) circular economy, e) pollution prevention and control and f) biodiversity and ecosystems.

13 Pursuant to section 10 (1) of the Federal Climate Change Act, the federal government's Climate Action Report contains the development of greenhouse gas emissions in the various sectors, the status of implementation of the climate protection programmes and the emergency programmes, and a forecast of the expected greenhouse gas reduction effect. The Climate Action Report is prepared annually by the federal government for the respective previous year. The final greenhouse gas emissions balance is published by the Federal Environment Agency at https://www.umweltbundesamt.de/en/press/pressinformation/final-2021-greenhouse-gas-emissions-balance.

1. Transport

The transport sector emits around 19% of Germany's greenhouse gases, with road transport accounting for the majority of transport emissions.[14] The transport sector must therefore make a significant contribution if Germany is to achieve the climate targets it has set itself. In addition, the federal government has set itself the goal of reducing air pollutants that are harmful to health and the environment, such as nitrogen oxides.[15] Accordingly, it has adopted extensive measures to, among other things, decarbonise passenger and freight transport and make it more environmentally friendly.

According to the German greenhouse gas inventory, around 147 million tonnes of CO_2 equivalents were emitted in the transport sector in 2021. The sector's greenhouse gas emissions were thus 1% up on 2020, but well below the 163 million tonnes emitted in 1990. One cause of the increase in 2021 was road freight, which on the motorways increased to a level slightly higher than in 2019. Car traffic, on the other hand, continued to be lower in 2021 than before the Covid-19 pandemic (2019).[16]

The eligible expenditures of the sector amount to €7,387.3 million and are distributed across 20 budget items in the following categories:

- Rail transport (7 budget items with eligible expenditures of €6,656.5 million),
- Alternative drive systems and fuels (2 budget items with eligible expenditures of €74.1 million),
- Public transport (3 budget items with eligible expenditures of €362.2 million),
- Waterways (2 budget items with eligible expenditures of €200.2 million) and
- Cycling (6 budget items with eligible expenditures of €94.3 million).

In accordance with the Framework, the sector's expenditures are categorised under the following UN Sustainable Development Goals:

[14] The federal government's 2022 Climate Action Report: https://www.bmwk.de/Redaktion/DE/Downloads/Energie/klimaschutzbericht.html

[15] See Federal Immission Control Act (BImSchG) and associated ordinance (BImSchV)

[16] See p. 4 of the Climate Action Report 2022; data updated on the basis of the final greenhouse gas emissions balance published by the Federal Environment Agency, see https://www.umweltbundesamt.de/en/press/pressinformation/final-2021-greenhouse-gas-emissions-balance

1.1. Rail transport

1.1.1. Construction cost subsidies for maintaining the federal rail infrastructure

Budget chapters and items:	**1202 891 11**					
Eligible expenditures 2020:	**€4,642.5 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**Investment in the existing network:**					
	1,995 km of track					
	2,277 switches					
	35,414 m² of bridges					
Funding share:	**Approx. 60%**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: The impact data relates to the €7,699 million total amount invested (i.e., including grants for construction costs from third parties, other financing from the federal government, and own funding of DB AG). The share of eligible expenditures 2020 in the total investment sum 2020 is 60.3%.						
Links: Figures according to the Infrastructure Status and Development Report 2020, p. 44-52: https://www.eba.bund.de/SharedDocs/Downloads/DE/Finanzierung/IZB/IZB_2020.html						

Rail transport and infrastructure are of great importance in Germany for achieving climate targets. This includes, in particular, the shift of transportation from road to rail and the increased electrification of propulsion systems and routes for decarbonisation. Under the Service and Financing Agreement III, federal funds are invested in line with requirements in measures to maintain and carry out replacement investments in federal rail infrastructure. Under that agreement, the federal rail infrastructure companies have undertaken to meet the contractually specified infrastructure quality requirements and to report on this annually. The Infrastructure Condition and Development Report 2020 (IZB) prepared by DB AG and reviewed by the Federal Railway Authority contains investment examples and quality indicators that provide information on the condition of the network. Explanations and further information can be found at https://www.eba.bund.de/SharedDocs/Downloads/DE/Finanzierung/IZB/IZB_2020.html

Regarding the selected impact indicators, detailed information with investment examples is presented on the following pages in the IZB 2020: tracks: p. 44 ff.; switches: p. 47-48; bridges: p. 49 ff. In addition, the respective investment reports of DB Netz AG (p. 38 ff.), DB Station&Service AG (p. 198 ff.) and DB Energie GmbH (p. 290 ff.) included in the IZB present numerous other investments in more detail.

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1.1.2. Construction cost subsidies for investments in the federal rail infrastructure

Budget chapters and items:	**1202 891 01**					
Eligible expenditures 2020:	**€1,385.0 million**					
GHG emission reduction:	**1.382 million t CO_2e p.a.**					
Other indicators:	**2,298 t NO_x p.a.**					
	10 t particulate matter (PM) p.a.					
Funding share:	**1.1%**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: The annual GHG emission reduction represents the annual GHG reduction share from route opening. Recording of the CO_2 reduction was not part of the project assessment for the 2003 Federal Transport Infrastructure Plan (FTIP); this data was only recorded for projects in the 2030 FTIP, i.e. a CO_2 reduction estimate is only available for some of the projects. The actual CO_2 reduction is therefore higher than indicated here. The stated funding share of 1.1% was determined on the basis of the data in the Transport Investment Report 2020 (2020 expenditures in relation to the total investment sum of the projects for which a GHG reduction estimate is available).						
Links: https://bmdv.bund.de/SharedDocs/DE/Artikel/G/BVWP/bundesverkehrswegeplan-2030-inhalte-herunterladen.html Methodology: https://bmdv.bund.de/SharedDocs/DE/Anlage/G/BVWP/bvwp-methodenhandbuch.pdf?__blob=publicationFile Project details: https://www.bvwp-projekte.de/map_railroad_2018.html https://bmdv.bund.de/SharedDocs/DE/Publikationen/G/verkehrsinvestitionsbericht-2020.html						

The federal government provides investment subsidies for the construction and upgrading of rail projects in the requirement plan for federal railways (Annex to section 1 of the Federal Railways Expansion Act). The 2030 Federal Transport Infrastructure Plan is the most important transport infrastructure planning tool. Further details on the projects, including the size of the CO_2 reduction in each case, are available at: https://www.bvwp-projekte.de/map_railroad_2018.html.

The following indicators can be reported for the largest projects (basis: 2020 expenditures according to the Federal Transport Infrastructure Report 2020 (VIB 2020); annual emission reduction from route opening):

Project	GHG emission reduction (in t CO_2e p.a.)	NO_x emission reduction (in t p.a.)	Particulate matter (PM) reduction (in t p.a.)
ABS/NBS Karlsruhe – Basel	-189,701	-67	2
ABS/NBS Nuremberg – Erfurt (VDE 8.1)	-29,862	-37	0
ABS Ulm-Friedrichshafen-Lindau (Südbahn)	-16,883	-169	-1
Rhein-Ruhr-Express (RRX): Cologne – Düsseldorf – Dortmund/Münster	-16,151	-65	1
Major hubs (Frankfurt, Hamburg, Cologne, Mannheim, München, Hannover)	-282,626	-190	-1
Combined transport/shunting stations	-221,251	N/A	N/A
ABS/NBS Hanau – Würzburg/Fulda – Erfurt	-42,180	-48	0
ABS/NBS Hamburg – Lübeck – Puttgarden (Fehmarn Belt tunnel hinterland link)	-66,664	-270	-1

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1.1.3. Construction cost subsidies for investments in the non-federal rail infrastructure

Budget chapters and items:	**1210 891 01**					
Eligible expenditures 2020:	**€30.9 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**112 projects**					
Funding share:	**max. 50% federal funding**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: --						
Links: --						

In the Long-Distance Rail Freight Network Funding Act (SGFFG) of 7 August 2013, the federal government created the legal basis for funding the upgrading and maintenance of non-federal public rail infrastructure serving long-distance rail freight and not exclusively local rail freight and/or passenger rail transport. Up to a maximum amount of 50% of investment spending on the replacement of non-federal public rail infrastructure is financed by the federal government in line with available federal budget funds in the form of non-repayable construction cost subsidies. The costs of maintaining and repairing their rail infrastructure are borne by the non-federal public railways.

112 projects totalling €30.9 million were (part-)funded in the financial year 2020. The majority of this funding (around 80%) was earmarked for replacement investments in superstructure renewal (i.e. renewal of tracks, sleepers and switches, including related measures). Approximately 10% of the federal funding was invested in measures at level crossings (among others, bringing barrier opening and closing systems up to the latest standards and renewing track base plates). The remaining approximately 10% of the federal funding provided was spent on adapting control and safety systems (such as the partial renewal of signal boxes), renewing bridges and replacing electrical systems (such as rail switch heaters and rail yard lighting).

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1.1.4. Reduction in track access charges for rail freight transport

Budget chapters and items:	**1210 682 05**					
Eligible expenditures 2020:	**€350.5 million**					
GHG emission reduction:	**0.961 million t CO_2e in 2020**					
Other indicators:	**70 beneficiaries with subsidies over €500,000**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)			e)	
Assumptions and limitations: The evaluation report determines CO_2 savings only in total for the funding period 1 July 2018 to 31 December 2020. The share for 2020 is estimated approximately from the ratio of subsidies.						
Links: https://www.eba.bund.de/SharedDocs/Downloads/DE/Finanzierung/Foerderung_anteiliger_Trassenentgelte/41_Bekannntgabe_Beihilfe_2020.pdf?__blob=publicationFile&v=5						

The partial subsidy of track access charges in rail freight transport creates a significant incentive to keep existing rail freight transport volumes on the railways as well as incentives to shift freight transport from road to rail. To this end, federal budget funding is made available via DB Netz AG to companies operating in the area of rail freight transport.[17] Funding is available for all transport operations that serve the national or cross-border carriage of goods within the scope of DB Netz AG's system of track prices. Funding is provided for the DB Netz AG track charge, which is levied per kilometre. Measurement runs and movements of construction machinery and breakdown trains are excluded from the subsidies. The subsidy amount relates to the net track charge. The grant recipients with grants of more than €500,000 are published in accordance with section 6 (5) of the funding guidelines for the 2020 working timetable period:
https://www.eba.bund.de/SharedDocs/Downloads/DE/Finanzierung/Foerderung_anteiliger_Trassenentgelte/41_Bekannntgabe_Beihilfe_2020.pdf?__blob=publicationFile&v=5
Model calculations from the evaluation carried out in 2021 show that without the funding, 2.4 million tonnes more CO_2e would have been emitted in the 2.5 years of the previous funding period (01.07.2018-31.12.2020). The evaluation does not provide a separate overview of the funding in 2020, but only calculates the CO_2 savings in total for the entire funding period. The share for 2020 is therefore estimated approximately from the ratio of funding: The funding for the entire funding period amounted to €875 million, so that with a share of 40.1%, the avoided CO_2 emissions for 2020 are estimated at 0.961 million tonnes of CO_2e.

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[17] Funding guidelines available at: https://www.eba.bund.de/DE/Themen/Finanzierung/Foerderung_anteiliger_Trassenentgelte/foerderung_anteiliger_trassenentgelte_node.html

1.1.5. Measures to reduce noise pollution from existing federal railways

Budget chapters and items:	**1202 891 05**					
Eligible expenditures 2020:	**€190.4 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**195 km noise-reduced route in 2020**					
	76.22 km of noise barriers erected in 2020					
	29,088 eligible housing units in 2020					
	61,085 people benefited from noise reduction in 2020					
Funding share:	**N/A**					
EU environmental objectives					e)	
Assumptions and limitations: --						
Links: https://bmdv.bund.de/SharedDocs/DE/Artikel/E/schiene-laerm-umwelt-klimaschutz/laermvorsorge-und-laermsanierung.html						

The implementation of the goals for shifting traffic to the railways depends on whether the necessary public acceptance can be gained. For decades, intensive work has been done to improve noise protection on and along the railways. Noise reduction measures are being carried out on existing lines affected by rail noise. Technological progress and innovative developments help in this process. The federal government provides annual funding for the programme “Measures for Noise Abatement on Existing Railway Lines of the Federal Railways”. The funding is provided for buildings constructed before 1 January 2015. The same applies to residential buildings constructed on land that was designated for residential use before 1 January 2015.

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1.1.6. Subsidies to private companies for investments in combined transport

Budget chapters and items:	**1210 892 41**					
Eligible expenditures 2020:	**€48.1 million**					
GHG emission reduction:	**0.143 million t CO_2e**					
Other indicators:	**1.97 billion tkm freight transport performance**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: Source: Report on the evaluation of the "Guidelines on the promotion of transhipment facilities for combined transport by non-federally owned companies". The relief effect of 40.95 tkm per euro of funding used, on which the calculation is based, is an average figure calculated on the basis of the relief effect due to the additional transhipment volume of all CT terminals funded in the period 1998-2019. It is not possible to calculate the relief effect on the basis of the funding measures implemented in 2020.						
Links: https://bmdv.bund.de/SharedDocs/DE/Artikel/G/umschlaganlagen-foerderrichtlinie.html						

In order to shift more freight transport from road to rail and inland waterways, the federal government funds investment in combined transport (CT)[18] transhipment facilities of private-sector companies. The promotion of combined transport contributes to an additional transhipment volume in combined transport and consequently to a reduction of transport on the roads.

For the year 2020, the additional transhipment based on the subsidies for CT terminals used in 2020 is assumed to have had a relief effect on freight transport performance of 1.97 billion tkm. This relief effect comprises 1.74 billion tkm for road-rail CT and 0.23 billion tkm for inland waterway-road CT. Assuming that per tkm 73.7 g CO_2 are avoided for road-rail CT and 61.9 g CO_2 are avoided for inland waterway-road CT, a total relief of 0.143 million tonnes of CO_2e was achieved in 2020 via the subsidised CT terminals.

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[18] Combined transport is a special form of freight transport where load units (containers, swap bodies or semi-trailers) are transported over longer distances by rail or via waterways. Carriage by road is limited to the shortest possible route to transport the loading units to a CT transhipment facility or to collect them from there and take them to the unloading point.

1.1.7. Investment subsidies to private companies for the construction, expansion and reactivation of railway sidings

Budget chapters and items:	**1210 892 42**					
Eligible expenditures 2020:	**€9.1 million**					
GHG emission reduction:	**0.324 million t CO_2e**					
Other indicators:	**-**					
Funding share:	**Up to 50% of eligible costs for sidings, feeder lines and industrial lines and up to 80% for multifunctional facilities.**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: The CO_2 reduction figures are based on the findings of a 2019 evaluation of the sidings funding guidelines. This put the average annual reduction at 35,648 tonnes of CO_2 per €1 million of subsidy funding used.						
Links: https://www.eba.bund.de/DE/Themen/Finanzierung/Gleisanschluesse/gleisanschluesse_node.html						

The Federal Ministry for Transport and Digital Infrastructure (BMVI) provides grants for the construction, reactivation, upgrading and replacement of sidings, multifunctional facilities, feeder lines and industrial lines to the extent that they are necessary for the achievement of the funding objectives. There is no entitlement to the grants. The Federal Railway Authority, which is the granting authority, decides at its due discretion based on the available budget funding.

The overarching objective of the funding is to shift a proportion of freight from road to rail and to keep such volumes on the railways in the long term. The specific target in the sidings funding guidelines is to avoid 31,000 road freight trips per €1 million of funding.

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1.2. Alternative drive systems and fuels

1.2.1. National Hydrogen and Fuel Cell Technology Innovation Programme (NIP) 2016–2026

Budget chapters and items:	**1210 892 03**					
Eligible expenditures 2020:	**€67.0 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**367 H_2 vehicles approved, of which** **– 316 cars** **– 51 industrial trucks**					
	2 filling stations (depot)					
	513 critical infrastructure assets					
	42 R&D projects approved in 2020					
	108 ongoing R&D projects in 2020					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: Stipulations on the type of hydrogen are contained in the funding guidelines (in 2020 at least 50% certified green hydrogen for industrial trucks)						
Links: An overview of funded measures can be found on the BMVI's interactive funding map under the National Investment Programme for Hydrogen and Fuel Technology funding programme: https://bmdv.bund.de/SharedDocs/DE/Artikel/foerderlandkarte-bmvi-iframe.html						

Hydrogen and fuel cells are a useful complement to battery-powered vehicles in the transport sector. With the National Hydrogen and Fuel Cell Technology Innovation Programme (NIP), the Federal Ministry of Transport and Digital Infrastructure has an established programme to promote research and development (R&D) measures and to support investments in the area of market activation in the transport sector. The use of green hydrogen in fuel cell vehicles would enable all modes of transport to become completely carbon-free. The measures under the NIP include fuel cell and hydrogen applications in the road, rail, water and air transport sectors and in special applications.

Sample projects from 2020:

Pa-X-ell 2: Investigation and development of a decentralised energy network and a hybrid proton exchange membrane (PEM) energy system with a new generation of high-temperature (HT) fuel cells for use on ocean-going passenger ships

As part of the broader e4ships 2.0 research cluster, the Pa-X-ell 2 module builds on the previous Pa-X-ell project with the aim of investigating and developing a new generation of high-temperature (HT) PEM fuel cells for use on ocean-going passenger ships.
Pa-X-ell 2 focuses on the integration of fuel cells on passenger ships as part of a decentralised energy grid and a hybrid energy system with energy storage. This includes the conceptualisation of a decentralised energy grid, the development and design of subsystems and the testing of the subsystems under conditions that simulate their future operating environment in the decentralised grid. Pa-X-ell 2 also aims to validate the basic functionality of a hybrid energy system and storage in a test facility.
Both energy solutions require the development of a new generation of fuel cells and the processes for producing them. Testing fuel cell technology systems on passenger ships is an important element in the development of sustainable energy solutions.

HyLightCom: Development of a light commercial vehicle with electric hybridised fuel cell propulsion and competitive operating costs

Fuel cell electric propulsion systems have a number of advantages that make them a promising alternative to battery-electric vehicles: they are CO_2-neutral if run on green hydrogen, can be refuelled in minutes and offer a long driving range without a massive increase in vehicle weight. The high cost of the fuel cell system has so far prevented them from making the leap into the market.
The HyLightCom project is therefore working on a light commercial vehicle with an electric, hybridised fuel cell propulsion system and with total operating costs equal to or – depending on the application – lower than internal combustion engine or purely battery-electric commercial vehicles, without tangible compromises for fleet operators in terms of payload and range. To achieve this goal, research and development work in the project focuses on compensating for the currently still high cost of a fuel cell propulsion system by hybridising a medium-power fuel cell system and maximising the proportion of off-the-shelf parts while retaining the full operator benefits (payload and cargo volume) of a battery-electric reference vehicle.

ManTyS: Development of economically viable manufacturing technologies for the series production of PEM fuel cell stacks in annual quantities exceeding 100,000

The production of PEM fuel cell stacks has so far been characterised by low volumes and cost-intensive production processes involving skilled oversight and lengthy throughput times and cycle times. Market forecasts for fuel cell vehicles predict strong growth and volumes in the millions for the next ten years. However, the production technologies and process sequences in use today do not allow fuel cell stacks to be produced economically for this level of market penetration.
To address this problem, the ManTyS project is developing production technologies, together with a process sequence combining them, for the economic large-scale production of PEM fuel cell stacks. The focus is on innovative solutions for the production of media distribution structures and for media sealing and on technologies for joining metallic bipolar half-plates. The technologies are each evaluated by performing suitable characterisation work on assembled test samples.
A technological readiness level (TRL) of 5 to 6 is targeted for the developed technologies by the end of the project. The development of the production technologies is based on a production volume exceeding 100,000 stacks per year.

BETA: Fuel cell system development for aviation technology

The BETA research project on fuel cell system development for aviation technology is investigating the feasibility of an innovative approach using hydrogen and fuel cells to generate the torque to power propellor shafts. Rather than following the conventional route of fuel cell > power electronics > electrical system > motor, the motor windings are directly coupled to the electrical energy source, the fuel cell. This has a significant impact on the design of the motor control unit and the electrical system. Initial studies have shown potential that is now to be verified by adaptive development and lab trials.
The objective of the BETA research project is to develop solutions for the reliable and safe operation of hydrogen/fuel cell technology in the powertrains of future aircraft. To this end, the H_2-to-torque approach, which presents a variable propulsion solution for various aircraft applications, is to be refined by creating a laboratory platform for demonstration, technology readiness verification, component and system characterisation, and control system design.

Go4City: Development of city buses with hydrogen fuel cell propulsion and a modular approach to vehicle architecture with hardware and software components

ELO Mobility, a Berlin startup, in partnership with Fraunhofer IVI, is developing high-performance hydrogen city buses with smart energy management systems on the basis of a modular platform. The aim of the project is to design a modular fuel-cell-based powertrain and test it on two prototype bus types comprising a 12-metre and an 18-metre bus version. Due to their high fuel economy, the resulting city buses will have a significantly improved range and minimum operating costs. The

project is starting at a technology readiness level (TRL) of 5 and will end with a TRL of 8. Special importance is attached to the software-based operating strategy developed by ELO Mobility, primarily to ensure optimum interoperation between the system components: fuel cell, electrical energy storage, traction motor and air conditioning system. The simulation tool developed for this purpose uses public big data and models route-dependent performance profiles to coordinate the components. In a further step, the performance profiles are continuously validated with empirical data sets from Fraunhofer IVI and used for the design of the novel powertrain.

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1.2.2. Subsidies for research, development and pilot projects for the market activation of alternative fuel use and the establishment of a corresponding filling and charging infrastructure

Budget chapters and items:	**1210 686 61**					
Eligible expenditures 2020:	**€7.1 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**6 funded projects**					
Funding share:	**Subsidies co-financed due to recipients' own contribution; contract award fully funded**					
EU environmental objectives	a)					
Assumptions and limitations: --						
Links: --						

The subsidies for pilot projects under the Mobility and Fuels Strategy relate to research and development projects to establish charging infrastructure for public transport, convert vehicles to alternative propulsion systems and fund a planning tool to identify infrastructure needs throughout Germany.

Project name (Click on the project name to visit the website, if link provided)	**Number of projects/ Number of beneficiaries/ main contractors**
Infrastructure project for stationary and dynamic charging for local transport buses	4 projects 11 beneficiaries
Vehicle conversion	1 project 2 beneficiaries
Location tool	1 project 1 beneficiary

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1.3. Public transport

1.3.1. Financial assistance to the *Länder* for rail-bound local public transport infrastructure

Budget chapters and items:	**1206 882 02**					
Eligible expenditures 2020:	**€166.0 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**27 projects**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: --						
Links: --						

Due to its high energy efficiency and high degree of electrification, public passenger transport is associated with significantly lower greenhouse gas emissions per person-kilometre than private motorised transport. Shifting from private motorised transport to public transport can therefore reduce greenhouse gas emissions from the transport sector. This requires attractive and user-friendly local public transport (LPT). However, shifting private motorised transport to public transport is not only aimed at reducing greenhouse gas emissions; it also plays an important role in making cities and communities more environmentally friendly.

As regional and local transport is the responsibility of the *Länder* and local authorities, the federal government provides indirect support in the form of financial assistance. Impact indicators are not available in the aggregate. Representative examples are therefore described below.

Chemnitz, expansion of the light rail system as the "Chemnitz Model" (Saxony)

The "Chemnitz Model" is a measure that aims to link the city and the surrounding area by means of a transfer-free rail connection. A single means of transport is to start in the city centre of Chemnitz and end at the stations of regional centres, using the track networks in the city and of DB Netz AG as far as possible. In addition to improving the public transport services between the city of Chemnitz and the region, improvements are also to be made in important inner-city routes. The expansion and realisation of the network as the "Chemnitz Model" is planned in several stages, which as they are implemented will enable the gradual entry into service of the individual lines. Overall, the project will significantly increase the efficiency and attractiveness of public transport services in the Chemnitz-Erzgebirge region.

Magdeburg, expansion of the tram network (Saxony-Anhalt)

The aim of the project is to extend the tram network in Magdeburg by a total of approximately 13.5 km, which will contribute significantly to the further development of the Saxony-Anhalt state capital. The Reform, Neustädter Feld and Kannenstieg districts will be accessible by tram for the first time, giving more than 44,000 people a new connection to the network. A total of 37 pairs of stops will be upgraded or made accessible and will ensure optimal accessibility and short distances to reach the tram. Frequent services and more direct connections to the city centre will significantly shorten travel times by public transport, especially to the city centre. This is expected to result in greater use of public transport, which should relieve the environment of car traffic and climate-damaging greenhouse gas emissions. Accompanying urban design measures in the districts newly served by the tramway will increase quality of life for residents.

Augsburg, Augsburg Mobility Hub (Bavaria)

The Augsburg Mobility Hub is a large-scale project to increase the attractiveness of local public transport in Augsburg. A range of coordinated subprojects will better integrate the existing long-

distance, regional and local rail networks and make the interchanges in the local public transport network more convenient to use. In particular, the central station is to be converted into a modern hub linking all rail services. In addition, new tram services on new lines will boost sustainable urban mobility to make transport in Augsburg faster, more convenient and more environmentally friendly.

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1.3.2. Investment subsidies for public transport projects to Deutsche Bahn AG and companies majority-owned by the federal government

Budget chapters and items:	**1206 891 01**					
Eligible expenditures 2020:	**€146.8 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**21 projects**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: --						
Links: --						

Due to its high energy efficiency and high degree of electrification, public passenger transport is associated with significantly lower greenhouse gas emissions per person-kilometre than private motorised transport. Shifting from private motorised transport to public transport can therefore reduce greenhouse gas emissions from the transport sector. This requires attractive and user-friendly local public transport (LPT). However, shifting private motorised transport to public transport is not only aimed at reducing greenhouse gas emissions; it also plays an important role in making cities and communities more environmentally friendly.

As regional and local transport is the responsibility of the *Länder* and local authorities, the federal government provides indirect support in the form of financial assistance. Impact indicators are not available in the aggregate. Representative examples are therefore described below.

Rhine-Main S-Bahn, Bad Vilbel – Frankfurt/Main West section (Hesse)

The project aims to optimise local rail passenger transport with regard to the three quality criteria of speed, punctuality and regularity. The upgrade of the highly frequented Main-Weser railway to four tracks will give the S6 S-Bahn suburban railway service between Frankfurt West and Bad Vilbel its own tracks so that it can run unaffected by faster long-distance and freight traffic, increase the punctuality of the trains and enable a stable 15-minute service interval at all stations. For this purpose, two additional tracks will be laid over a length of 12.6 km. The implementation of the project will also improve the quality of S-Bahn services for users: five stations will be converted to be accessible and one new station will be built. In addition, the existing level crossings will be adapted and noise protection measures implemented.

Munich S-Bahn, second S-Bahn main line (Bavaria)

In order to relieve the existing S-Bahn main line in Munich, a second main line with a total length of around 10 km is to be built between Laim station in the west and Leuchtenbergring station in the east. Splitting rail traffic between two main lines is expected to bring a noticeable improvement to the performance capacity of the S-Bahn network.

The centrepiece is a 7 km tunnel linking Munich Central Station and Munich East with an additional subterranean station at the Marienhof interchange. With just three stations, the new main line will enable significantly shorter travel times and make it possible to introduce an express S-Bahn system. In future, many S-Bahn services will run at 15-minute intervals all day. In addition, express S-Bahn services running every 30 minutes will connect the surrounding areas quickly and conveniently with central Munich. Also to be operated are the first of what are referred to as regional S-Bahn services, creating a direct link between central Munich and destinations in the metropolitan region.

Berlin S-Bahn, construction of the new S 21 S-Bahn line (Berlin)

Construction of the new S21 S-Bahn line is intended to improve the attractiveness and performance capacity of the Berlin rapid transit network with the primary aim of providing a faster direct link on the north-south axis to Berlin Central Station and central Berlin. The 7.2 km route will run from the Nordring (northern circular) via the central station and Potsdamer Platz to the Südring (southern circular), thus connecting the northern and southern S-Bahn lines and the Ringbahn to the central station and to the S-Bahn services running on the east-to-west Stadtbahn line. Passengers will gain convenient transfer opportunities between major S-Bahn lines, almost all regional and long-distance rail services and various subway and bus services. The additional north-south axis will also relieve other stations, first and foremost the existing Friedrichstrasse S-Bahn interchange. The project constitutes a general improvement to public transport in Berlin.

Nuremberg S-Bahn, second construction phase Bamberg-Nuremberg-Hartmannshof (Bavaria)

The aim of the measure is to create the necessary infrastructure for an attractive 20-minute service interval on the Nuremberg-Erlangen route and a 20/40-minute interval further on to Forchheim, as well as an hourly service as a regional train to Bamberg. To achieve this, the four-track Nuremberg-Fürth line will be adapted to S-Bahn operation (Steinbühl station), a separate S-Bahn track will be built between Fürth (Bay) main station and the Eltersdorf junction, and the existing double-track line between Eltersdorf and Forchheim/Ostfranken will be adapted to the requirements of regular S-Bahn operation. Overall, this will lead to an increase in demand for local passenger rail transport and a reduction of negative externalities from competing motorised private transport.

Rhine-Main S-Bahn, Gateway Gardens (Hesse)

The aim of the measure is to connect the new Gateway Gardens urban district, which is being built on the site of a former American housing estate near Frankfurt, to the existing local public rail transport system. The project includes the relocation of the S-Bahn line between Frankfurt Stadium and Frankfurt Airport Regional Station as well as the construction of the new Gateway Gardens station. This will provide the new district with a direct and convenient transport connection to Frankfurt city centre. For commuters in particular, travel times will be considerably reduced, as it will no longer be necessary to travel by shuttle bus between the regional railway station and Gateway Gardens. In addition, the project will reduce congestion on the highly frequented road network around Frankfurt Airport and the Frankfurter Kreuz interchange.

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1.3.3. Local-authority public transport pilot projects from 2018 to 2020 to complement the Immediate Action Programme for Clean Air

Budget chapters and items:	**6092 633 01**					
Eligible expenditures 2020:	**€49.4 million**					
GHG emission reduction:	**0.024 million t CO_2e p.a.**					
Other indicators:	**60 t p.a. NO_x reduction**					
Funding share:	**N/A**					
EU environmental objectives	a)				e)	
Assumptions and limitations: In addition to model-related uncertainty, the change in user behaviour due to the Covid-19 pandemic had an impact on the implementation and evaluation of the measures.						
Links: --						

With the aim of improving air quality in inner cities, transport projects in five representative model cities with nitrogen oxide pollution were funded from October 2018 to June 2021 in addition to the Clean Air Emergency Programme 2017-2020. The selected model cities – Bonn and Essen in North Rhine-Westphalia and Herrenberg, Mannheim and Reutlingen in Baden-Württemberg – implemented measures to improve public transport and bicycle use. In addition to bicycle lanes, measures were implemented in the areas of service improvement (e.g. increased frequency, introduction of new lines), tariff adjustments and pricing (e.g. improved conditions, new tickets), traffic management (e.g. dynamic speed control on main traffic routes) and digital networking (e.g. a mobility app). The evaluation examined to what extent the funded measures bring about an improvement in air quality in the cities, in particular in terms of reducing nitrogen dioxide pollution.

All of the cities' packages of measures had a positive effect on local air quality. The effectiveness of the individual measures varied due to various factors such as the size of the city, the scope and expansion of the public transport system and the design of the measures implemented. Overall, in all model cities, the measures analysed can potentially save an average of 82,000 car trips per day. This can potentially lead to daily savings of 264,000 car km, 165 kg NO_x and 66 tonnes of CO_2 and annual savings of around 60 t NO_x and around 24,000 tonnes of CO_2.

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1.4. Waterways

1.4.1. Replacement, extension and construction projects relating to federal waterways

Budget chapters and items:	**1203 780 02**					
Eligible expenditures 2020:	**€138.7 million**					
GHG emission reduction:	**0.345 million t CO_2e p.a.**					
Other indicators:	**1,564 t p.a. reduction in air pollutants**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: According to the Environmental Report on the 2030 Federal Transport Infrastructure Plan (FTIP) (p. 143), the implementation of the priority federal waterways projects under the 2030 FTIP leads to the stated reductions. Information on CO_2 savings and reductions in air pollutants is available from the FTIP evaluation in relation to upgrading projects only. This relates in all instances to the entire completed project and is based on the assumptions on the emission factors for the individual modes of transport applicable at the time of the FTIP forecast. It is not possible to infer information on CO_2 savings from the annual proportion of financing spent in an upgrading project. There is no project-specific information relating to maintenance and replacement projects and no methodology for determining direct CO_2/air pollutant savings. However, the environmental and climate friendliness of waterways as a mode of transport can be seen in the overall balance of the annual greenhouse gas emissions of the modes of transport. According to a comparison of emissions by the Federal Environment Agency (see https://www.umweltbundesamt.de/themen/verkehr/emissionsdaten#verkehrsmittelvergleich), the current transport performance of waterways results in savings of around 4 million tonnes of CO_2 per year.[19] Maintenance and replacement measures on the federal waterways serve to keep freight transport on the waterways and to maintain the emission savings. Every additional tonne of freight traffic shifted from road to waterway through measures such as upgrading projects results in a further reduction of CO_2 pollution in the transport sector. It is not possible to quantify impacts and attribute them to specific projects.						
Links: --						

By financing replacement, extension and construction measures on German waterways, the federal government creates the conditions for the use of waterways for transport purposes and supports sustainable inland navigation. As an efficient and high-performance alternative to trucks, the system of ports, vessels and waterways can contribute to transporting more goods by inland waterway vessel and at the same time relieve road congestion, thus reducing emissions of greenhouse gases, NO_x and particulate matter. According to the Environmental Report on the 2030 Federal Transport Infrastructure Plan (FTIP), the implementation of the priority upgrading projects in the 2030 FTIP in the area of federal waterways will lead to a reduction of GHG emissions of more than 0.34 million tonnes of CO_2e per year after completion of the upgrading measures. There is no methodology for determining a project-related CO_2/air pollutant reduction for maintenance and replacement measures.

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[19] Per tonne-kilometre (tkm), inland navigation saves around 80 g of CO_2 compared to road transport (emissions table for freight transport, UBA 2020), meaning that existing transport by waterway (around 50 billion tkm/year) saves around 4 million tonnes of CO_2 per year compared to transport by road (around 500 billion tkm).

1.4.2. Maintenance of transport infrastructure

Budget chapters and items:	**1203 780 01**					
Eligible expenditures 2020:	**€61.5 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**N/A**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: According to a comparison of emissions by the Federal Environment Agency (see https://www.umweltbundesamt.de), the current transport performance of waterways results in savings of around 4 million tonnes of CO_2 per year. Maintenance and replacement measures on the federal waterways serve to keep freight transport on the waterways and to maintain the emission savings. Every additional tonne of freight traffic shifted from road to waterway through measures such as upgrading projects results in a further reduction of CO_2 pollution in the transport sector. It is not possible to quantify impacts and attribute them to specific projects.						
Links: --						

Funding is provided for the maintenance of waterways in the required state for use as an environmentally friendly mode of transport. This includes dredging to maintain waterways in the required state for navigation. Impact indicators are not available in the aggregate. Examples are therefore provided of infrastructure measures on federal waterways (maintenance and upgrading investments).[20]

West German Canals (page 308 of the Transport Investment Report 2020)
The West German Canals connect the Rhine and the ports in the Ruhr area with the North Sea ports and, via the Mittelland Canal, with the Baltic Sea ports and the East European waterway network.

Upgrading target/project status:
- Navigability for cargo vessels (135 m long, 11.4 m wide) and pushed convoys (185 m long, 11.4 m wide) with 2.8 m draught; two-layer container transport
- Projected opening of the Rhine-Herne Canal in 2030
- Projected opening of the Datteln-Hamm Canal (western section) to traffic in 2025
- Projected opening of the Dortmund-Ems Canal (DEK) South in 2026

Ongoing activities 2020:
- DEK South: Canal upgrading measures including bridge modifications
- General overhaul of the small locks on the Wesel-Datteln Canal (WDK)
- Rhine-Herne Canal: Preparation for the replacement of the second lock chamber in Wanne-Eickel, upgrading measures, bridge and culvert modifications
- Replacement investments and extensive measures to prevent and repair mining damage were carried out in the remainder of the West German Canals.

Moselle (page 312 of the Transport Investment Report 2020):
The Moselle connects the Rhine with the Saar (Saarland), Luxembourg and the Lorraine region (France).

Upgrading target/project status:
- Navigability for cargo vessels (135 m long, 11.4 m wide) and pushed convoys (185 m long, 11.4 m wide) with approx. 2.8 m draught; two-layer container transport

[20] Extract from the Transport Investment Report 2020: https://www.bmvi.de/SharedDocs/DE/Publikationen/G/verkehrsinvestitionsbericht-2020.html. Expenditures reported in the report include expenditures that were not eligible for Green German Federal securities.

- Due to the high traffic load, the construction of second lock chambers is necessary at the 10 Moselle barrages between Koblenz and Trier.
- The second lock chambers have already been completed at the barrages in Fankel and Zeltingen; the other structures will follow successively depending on the available resources.

Ongoing activities 2020:

- The second lock chamber in Lehmen is to be built according to the "new Moselle standard". The corresponding plan amendment procedure has been completed.
- The second lock chamber was opened for traffic at the end of November 2021.
- The rehabilitation work on the invert of the Koblenz weir is well advanced. Preliminary planning for the construction of the new weir will begin soon.

Elbe Side Canal (page 305 of the Transport Investment Report 2020):

The Elbe Side Canal connects the seaport of Hamburg with the Mittelland Canal and the northwest German inland waterway network. When the water level of the Elbe is low, it also serves as a substitute for the Hamburg-Magdeburg route in conjunction with the Mittelland Canal.

Upgrading target/project status:

- Navigability for cargo vessels (100 m long, 11.4 m wide) and pushed convoys (SV, 185 m long, 11.4 m wide) with 2.8 m draught; two-layer container transport

Ongoing activities 2020:

- General overhaul of the Lüneburg ship lift, west trough under construction
- Second descent structure in Lüneburg; planning approval procedure in preparation

Dortmund-Ems Canal (northern section) (page 301 of the Transport Investment Report 2020)

The Dortmund-Ems Canal connects the seaport of Emden with the Mittelland Canal and, further on, via the West German Canals, also with the Ruhr area and the Rhine. The connection to the Coastal Canal has also gained significantly in regional importance.

Upgrading target/project status:

- Planned navigability for cargo vessels (110 m or 135 m long, 11.40 m wide)
- At present, navigability on the DEK northern stretch is possible with a European vessel unloaded up to 2.70 m.
- Replacement of the five locks Bevergern, Rodde, Venhaus, Hesselte and Gleesen, plus canal and bridge modifications

Ongoing activities 2020:

- Construction activity at Gleesen
- Construction started at Rodde and Venhaus (preliminary work)

Kiel Canal (page 293 of the Transport Investment Report 2020)

Important trade and transport link to the Baltic Sea region, especially for the German North Sea ports. The Kiel Canal is part of the Trans-European Transport Network (TEN-T). With around 32,000 ships passing through every year, it is the world's busiest artificial waterway navigable by seagoing ships.

Upgrading target/project status:

- Navigability of the canal with ships up to L = 280 m, W = 32.5 m, D = 9.5 m, improvement of provision for passing in upgraded parts and consequent shorter canal passage time
- Replacement of locks

Ongoing activities 2020:

- Modification of the eastern section comprising:
  - Construction of a transshipment point for building materials
  - Disposal of dry dredged material on onshore disposal sites
  - Preparation of further disposal sites
- Replacement of the Brunsbüttel lock

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1.5. Cycling

1.5.1. Construction of bike lanes including maintenance (federal highways)

Budget chapters and items:	**1201 746 22**					
Eligible expenditures 2020:	**€83.0 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**103 km of newly built and repaired cycle paths**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: No km figures are available for maintenance measures on existing cycle paths.						
Links: --						

The federal budget finances the construction and maintenance of cycle paths on federal roads. A total of 103 km of newly constructed cycle paths on federal roads were completed in the 2020 financial year. In addition to new construction measures, maintenance measures were also financed, although no km figures are available.

Project examples: B 42 federal highway, upgrading and construction of a foot and cycle path from the Rhineland-Palatinate/Hesse border via Lorch to Rüdesheim am Rhein (second construction phase).

The aim is to improve road safety by creating a sufficiently wide carriageway together with foot and cycle paths along the road to accommodate the growing number of tourists and daytrippers. Implementing the planning objectives in the narrow Rhine valley between the Lorch-Rüdesheim railway on one side and the Rhine – a major federal waterway – on the other is very difficult in terms of both planning and construction. A very space-efficient road cross-section developed for the purpose does not interfere with the Rhine's flood discharge regime and accommodates the overall planning requirements of the waterways administration, DB AG and in particular the Middle Rhine Valley World Cultural Heritage Site. There are three construction phases in all.

The second construction phase from Lorch am Rhein to Assmannshausen is 5,500 metres in length, of which no less than 4,100 metres is cantilevered over the Rhine. The portion of the cost for cycle paths is financed from this budget item.

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1.5.2. Allocations and grants in the area of cycling

- *Implementation of the National Cycling Plan – grants to Länder and other public-law entities*
- *Implementation of the National Cycling Plan – subsidies to companies under private law*
- *Grants to Länder for the construction of cycle highways*
- *Subsidies for the expansion of Germany's network of cycle routes ("Radnetz Deutschland")*
- *Funding of pilot projects in the area of cycling – subsidies to Länder and other public-law entities*

Budget chapters and items:	**1210 632 91, 1210 686 91, 1210 882 91 1210 891 92, 1210 891 91**					
Eligible expenditures 2020:	**€11.3 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**53 projects**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: --						
Links: --						

The federal government supports cycling through measures for the implementation of the National Cycling Plan 3.0, through the promotion of innovative model cycling projects and through grants for the expansion of Germany's cycling network. In addition, financial assistance is given to the *Länder* for the planning and construction of cycle highways.

These measures for the implementation of the National Cycling Plan are very wide-ranging. They include the construction and conversion of cycle paths, cycle path underpasses, overpasses and intersections, the removal of unsignalised right-turn lanes, the construction of bicycle parking facilities (bicycle racks, bicycle boxes bicycle parking garages) and the organisation of the National Cycling Congress, the Bicycle Climate Test and the German Bicycle Award. The variety of categories of funding in the National Cycling Plan makes it difficult to specify indicators. Representative examples are therefore described instead. The National Cycling Plan is able to initiate multifaceted improvements that boost cycling as a whole. The recommended measures for the expansion of cycling infrastructure improve conditions for cycling and thus contribute to an increase in bicycle travel.

Under the **funding guidelines for non-investment measures for implementing the National Cycling Plan 3.0**, non-investment cycling-related projects are funded that advance the objectives of the National Cycling Plan 3.0 and thus the implementation of the cycling strategy. The projects are required either to deliver outcomes that are transferable to similar applications – that is, they serve as a model and are not just a one-off activity that can only be implemented at a single location – or to produce new knowledge about the thematic area concerned. Eligible projects of this kind notably include research and development projects, information and communication campaigns, competitions and other suitable projects geared to coordinating and promoting cycling.

Projects are funded through allocations to the *Länder* and other legal entities under public law. They include:

- Concepts for integrating cycling into future urban transport structures with autonomous vehicles
  In the future, autonomous vehicles will transform the coexistence of means of transport in urban areas. The project "RAD-AUTO-NOM – Concepts for the integration of cycling into future urban traffic structures with autonomous vehicles" therefore aims to make a practical contribution to developing traffic-regulation, traffic-infrastructure, urban-space-design and vehicle- and traffic-technology solutions that will be needed in the future for the smooth interaction of bicycles and

autonomous vehicles. The target groups are planning and engineering offices, road construction and urban planning offices, vehicle manufacturers and suppliers, and startups. In the reporting period, urban planning concepts were developed for the design of cycling infrastructure in urban environments with autonomous vehicles.

- Investigating the number of unreported safety-critical incidents between cyclists, cyclists and cars, pedestrians and public transport

  Up to now, infrastructure changes to increase road safety have mostly been driven by accident figures. According to experts, however, the number of unreported accidents involving cyclists with minor injuries or safety-critical incidents is significantly underestimated. The aim of the National Cycling Plan project to investigate the number of unreported safety-critical incidents between cyclists, cyclists and cars, pedestrians and public transport is to obtain representative information on the real road safety situation. For this purpose, a survey instrument was designed during the reporting period, which is to be evaluated in a feasibility study and applied in an observational study in three major German cities. In particular, the study will investigate how prevalence is influenced by infrastructural, situational and personal factors (e.g. perception of safety).

- With the help of rides in a 3D bicycle simulator, the SuSi3D research project aims to evaluate and infer infrastructure measures for intersections that are adapted to the needs of cyclists.

Projects continue to be supported by grants to companies under private law, including:

- Bicycle Monitor

  The Bicycle Monitor is a representative survey conducted by the SINUS Institute as part of efforts to promote cycling. It surveys the subjective perception of cyclists in Germany at intervals of about two years. For this purpose, about 3,100 citizens between the ages of 14 and 69 are surveyed online about their mobility behaviour and preferences. The monitor is representative according to gender, age, education and place size. The Bicycle Monitor is funded under the National Cycling Plan. The findings on the acceptance of cycling measures and attitudes in transport behaviour also serve as orientation for the direction of cycling policy.

- Further development of cycling education in schools with a special focus on safe cycling for children in real traffic scenarios.

  The overall objective of the project is to improve children's cycling safety. Cycling education often takes place exclusively in a protected space, such as in protected areas inside road safety education centres, schoolyards or in closed-off public roads. As a result, children are not sufficiently prepared for the dangers of traffic and do not learn to react appropriately to the unexpected. The aim of the project is to investigate under what conditions school cycling education could take place in real road traffic and what support schools need to integrate this form of education.

The **funding guidelines for innovative projects to improve cycling in Germany** produce cycling "beacons" (innovative and exemplary structures or engineering measures) that serve as a model, boost cycling and enhance the attractiveness of cycling in Germany. The aim is to test models and apply them in practice in order to develop new ideas and approaches that can also make valuable contributions to improving cycling elsewhere in Germany. The federal funding gives impetus, creates incentives and – as the results are transferable – helps create equivalent living conditions, for example through the provision of cycle overpasses, underpasses, fully automated cycle parking garages and cycle-friendly crossing solutions at major intersections. A further possibility consists of measures and mobility approaches that combine cycling with other climate-neutral or climate-friendly modes of transport.

The aim of the **German Cycling Network funding programme** is to create a safe, comprehensive and attractive network of long-distance cycle routes across all German *Länder* and to make Germany a "land of cycling" in everyday life and for leisure and tourism. The German Cycling Network consists of

the German Unity Cycle Route, the Iron Curtain Trail and 12 D-Routes – an extensive network of long-distance cycle routes running through the whole of Germany and integrated into EuroVelo, the European cycle route network. A total of 24 digital service points had been completed along the German Unity Cycle Route by 2021.

Finally, until the end of 2030, under section 5b of the Federal Trunk Roads Act (FStrG), the federal government can grant financial assistance to the *Länder* for the building of **cycle highways** within the road construction remit of the *Länder*, local authorities and local-authority associations. For this to be implemented, an administrative agreement with committed funding amounts was entered into with the *Länder* in 2017. The *Länder* have pushed ahead systematically with the expansion of cycle highways in recent years. In the 2020 fiscal year, approximately €0.742 million was spent on planning and €1.0 million on construction in 12 cycle highway projects. No cycle highway was completed in the 2020 fiscal year.

One sample project is the Ruhr cycle highway. “RS°1” will run for a total of 114 km connecting 11 cities across the Ruhr region. €1.0 million was spent on construction of the 1.2 km Gelsenkirchen section in the 2020 fiscal year. This section was completed in 2021.

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2. International cooperation

Global challenges such as climate action and species and resource conservation require global responses. Germany is highly committed to sustainable development in international cooperation and hence supports developing and emerging countries in their transition towards more environmentally sustainable economies and societies. This is done within the framework of the United Nations Sustainable Development Goals, the Paris Agreement and other relevant international agreements and initiatives. Key areas of focus include:

- Climate change mitigation and adaptation
- Transition to low-emission, sustainable energy systems, including the development of renewable energy generation infrastructure
- Improvements in energy and resource efficiency in production and buildings
- Protection of marine and terrestrial habitats and biodiversity
- Sustainable use of natural resources and sustainable agriculture

Key outcomes of development cooperation are presented in the federal government's 16th Development Policy Report[21]:

- The federal government has advocated internationally for more ambitious climate action. Its contribution to international climate finance more than doubled from 2014 to 2020 – from €2 billion to more than €5 billion.
- 350 million people in over 100 developing and emerging countries are covered by climate risk insurance as a result of the initiative launched by Germany.
- At the multilateral level, Germany is one of the largest donors to the Green Climate Fund (GCF) and the Global Environmental Facility (GEF).
- Germany supports more than 70 countries in their transition to sustainable energy. Germany is one of the largest bilateral donors in the energy sector.
- In total, the federal government supports 660 protected areas covering an area of two million square km, six times the size of Germany.
- In total, the federal government contributes to the protection of 130 million ha of forest worldwide.

Germany is also working with other industrialised countries to jointly accelerate the energy transition and exploit the potential for innovation and sustainable growth. Examples of this include the federal government's 21 global energy partnerships and dialogues with countries such as Australia, Japan and the USA, which focus on exchange and cooperation on energy transition issues.

The sector's eligible expenditures amount to €3,278.3 million and are distributed across 13 budget items in the following categories:

- Bilateral financial cooperation (3 budget items with €917.6 million in eligible expenditures),
- Bilateral technical cooperation (1 budget item with €683.0 million in eligible expenditures),
- International climate and environmental protection (3 budget items with €684.3 million in eligible expenditures),
- Multilateral cooperation (2 budget items with €737.5 million in eligible expenditures) and
- Specific funding (4 budget items with €255.9 million in eligible expenditures).

[21] https://www.bmz.de/en/news/publications/100882-100882

In accordance with the Framework, the International Cooperation sector's expenditures are categorised under the following UN Sustainable Development Goals:

2.1. Bilateral financial cooperation

2.1.1. Bilateral financial cooperation – grants

Budget chapters and items:	**2301 896 11**					
Eligible expenditures 2020:	**€504.4 million**					
GHG emission reduction:	**N/A (see list of sample projects)**					
Other indicators:	**428 projects**					
Funding share:	**CO_2 impacts are already scaled to the 2020 eligible expenditures**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: CO_2 impacts are scaled to eligible expenditures in 2020; other indicators apply to the overall project; ex-ante estimates, internal BMZ calculations						
Links: See project name in list of sample projects						

The eligible expenditures in bilateral financial cooperation are used to support partner countries of German development cooperation. The projects are intended to contribute to climate change adaptation and mitigation, environmental protection and resource conservation and/or support for biodiversity in the partner countries.

Due to the large number of projects, the expected impact can only be reported for a selection. The eligible expenditures relating to the sample projects correspond to 13.8% of the eligible expenditures of the entire budget item.

Project name (Click on the project name to visit the website)	Eligible expenditures (in € million)	GHG emission reduction (in t CO_2e p.a.)	Other indicators Description of the project objective
Programme promoting energy efficiency and access to energy	11.67	2,510	The project as a whole is expected to contribute to energy access for around 130,000 people.
Climate-friendly Urban Mobility IV	9.0	20,967	
Regional programme for energy efficiency in power transmission	7.57	2,417	Energy saved annually (in MWh): 210,000
West African Power Pool (WAPP) Côte d'Ivoire-Liberia-Sierra L-Guinea (CLSG) II transmission line	6.47	34,946	The project as a whole is expected to contribute to energy access for around 5,000 people.
Renewable energy power plants	4.72	9,664	Energy saved annually (in MWh): 175,000 Additional generation capacity provided (in MW): 125 The project as a whole is expected to contribute to energy access for around 100,000 people.

Project name (Click on the project name to visit the website)	Eligible expenditures (in € million)	GHG emission reduction (in t CO_2e p.a.)	Other indicators Description of the project objective
Climate-friendly Urban Mobility II	4.62	631.6	
Rwanda-Burundi transmission line	4.55	N/A	
WAPP 4 Countries Transmission Line (CLSG), Liberia I	3.43	5,987	The project as a whole is expected to contribute to energy access for around 11,000 people.
Promotion of certified forest management (VP)	3.42	5,153	
EDM power network modernisation programme	3.35	3,326	
Promotion of renewable energy	3.09	2,177	The project as a whole is expected to contribute to energy access for around 56,000 people.
Productive use of renewable energy	2.87	2,869	The project as a whole is expected to contribute to energy access for around 4,500 people.
Solar Energy and Energy Efficiency Promotion Programme	2.43	3,354	Energy generated annually (in MWh): 14,100 Additional generation capacity provided (in MW): 9 The project as a whole is expected to contribute to energy access for around 28,000 people.
Malawi-Zambia Transfrontier Conservation Area	2.43	N/A	Contribution to the preservation of conservation areas totalling 1,657,000 ha

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2.1.2. Financial cooperation with regions

Budget chapters and items:	**2301 896 01**					
Eligible expenditures 2020:	**€264.2 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**20 projects**					
Funding share:	**CO_2 impacts are already scaled to the 2020 eligible expenditures**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: CO_2 impacts are scaled to eligible expenditures in 2020; other indicators apply to the overall project; ex-ante estimates, internal BMZ calculations						
Links: See project name in the list of sample projects						

The eligible expenditures of bilateral financial cooperation with regions finance regional approaches as well as regional actors without partners under international law. The projects are intended to contribute to climate change adaptation and mitigation, environmental protection and resource conservation and/or support for biodiversity in the regions.

The expected impact is only reported for a selection of projects for which quantitative indicators can be estimated. The eligible expenditures of the sample projects correspond to 57% of the eligible expenditures of the entire budget item.

Project name (Click on the project name to visit the website)	Eligible expenditures (in € million)	GHG emission reduction (in t CO_2e p.a.)	Other indicators
SME fund for nature conservation-related private investments (Eco Business IV)	63.00	26,033	The project as a whole is expected to contribute to financing services for 18,600 farms.
eco.business Fund Africa Window (EBFA)	23.00	40,250	
Citizens' Energy Fund Facility for Energy Inclusion – OnGrid (FEI-OnG)	20.00	82,875	Energy generated annually (in MWh): 140,250 Additional generation capacity provided (in MW): 76
AfricaGoGreen Fund for Renewable Energy and Energy Efficiency	32.00	667	The project as a whole is expected to contribute to energy access for around 574,000 people.
Legacy Landscape Initiative VP	8.25	113,580	Contribution to the preservation of conservation areas totalling 400 ha
Transboundary Biosphere Reserve V (PONT)	4.40	N/A	Contribution to the preservation of conservation areas totalling 61,007 ha
Integrated Tiger Habitat Conservation Programme in Asia II	0.74	N/A	Contribution to the preservation of conservation areas totalling 151,600 ha

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2.1.3. Bilateral financial cooperation – loans

Budget chapters and items:	**2301 866 11**					
Eligible expenditures 2020:	**€149.0 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**70 projects**					
Funding share:	**CO_2 impacts are already scaled to the 2020 eligible expenditures**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: CO_2 impacts are scaled to eligible expenditures in 2020; other indicators apply to the overall project; ex-ante estimates, internal BMZ calculations						
Links: See project names in the list of sample projects						

The eligible expenditures of bilateral financial cooperation loans are used to support partner countries of German development cooperation. Loans support projects that contribute to climate change adaptation and mitigation, environmental protection and resource conservation and/or support for biodiversity in countries with appropriate debt sustainability.

The expected impact is only reported for a selection of projects for which quantitative indicators can be estimated. The eligible expenditures relating to the sample projects correspond to 53% of the eligible expenditures of the entire budget item.

Project name (Click on the project name to visit the website)	Eligible expenditures (in € million)	GHG emission reduction (in t CO_2e p.a.)	Other indicators
Green hospitals	24.30	N/A	Reduction in energy consumption (annual electricity and gas consumption) relative to a similarly equipped conventional hospital: 20%
Composite financing project solar credit line via TKYB	13.30	8,831	Energy generated annually (in MWh): 60,000 Additional generation capacity provided (in MW): 30
Gulf of Suez Wind Farm	12.90	63,280	Energy generated annually (in MWh): 650,000 Additional generation capacity provided (in MW): 200
Renewable Energy Programme: Pilot Photovoltaic Project	8.80	1,701	Energy generated annually (in MWh): 17,000 Additional generation capacity provided (in MW): 17 The project as a whole is expected to contribute to energy access for around 42,000 people.

Project name (Click on the project name to visit the website)	Eligible expenditures (in € million)	GHG emission reduction (in t CO_2e p.a.)	Other indicators
Promotion of renewable energy in West Africa	5.50	3,256	Energy saved annually (in MWh): 550,000
Access to financial services	4.60	3,692	
Sustainable Ocean Fund	4.18	20,918	
Energy efficiency programme	3.50	4,172	Energy saved annually (in MWh): 34,908
Asyut barrage and hydropower plant (Inv.)	0.95	359	Renewable energy generated annually (in MWh): 190,000
Managua Sewage Treatment Plant: Biogas and Solar Sludge Drying	0.67	335	Renewable energy generated annually (in MWh): 5,000
Medium-sized hydropower plants Basho and Harpo in the Northern Areas	0.34	1,123	The project as a whole is expected to contribute to energy access for around 13,000 people.
Biodiversity and Natural Resources (Inv)	0.47	N/A	Contribution to the preservation of conservation areas totalling 30,445 ha

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2.2. Bilateral technical cooperation

2.2.1. Bilateral technical cooperation

Budget chapters and items:	**2301 896 03**					
Eligible expenditures 2020:	**€683.0 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**635 projects**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)			e)	f)
Assumptions and limitations: --						
Links: https://www.giz.de/en/aboutgiz/63962.html						

Through bilateral technical cooperation (TC), the federal government helps to increase the technical, economic and organisational knowledge and skills of people and organisations in partner countries and to support them in achieving national climate and environmental goals through the effective, efficient and sustainable use of resources. Bilateral TC mainly consists of consulting provided by the deployment of technical personnel (e.g. in government bodies or other partner country organisations), the funding of consulting services and the limited provision and funding of goods and equipment. Primarily, the federally owned Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is entrusted with the implementation of TC projects. Eligible expenditures contribute to climate change adaptation and mitigation, environmental protection and resource conservation and/or support for biodiversity.

No aggregated data on eligible expenditures is available. The following selection of projects represents exemplary impacts (approx. 6% of eligible expenditures).

Project name (Click on the project name to visit the website)	Eligible expenditures (in € million)	Qualitative description of effects
Transboundary biosphere reserve of the WAP region in Benin, Burkina Faso and Niger	6.0	The WAP region transboundary biosphere reserve project supports the protection and sustainable use of five national parks and fragile ecosystems around the W-Arly-Pendjari region in Niger, Burkina Faso and Benin. By the end of 2020, 200,000 local residents had been trained in ecological value chains and €10 million in additional income had been generated. Reafforestation projects on 20,000 ha bound 160,000 tonnes of CO_2.
South African-German Energy Programme (SAGEN)	12.5	The SAGEN project advises the national electricity supplier on the grid integration of renewable energy sources, assists important reform processes in the country's energy sector and supports selected municipalities regarding energy efficiency measures. In total, the project enabled savings of almost 228,051 tonnes of CO_2 emissions in 2020. In that year, the project also supported the grid integration of 15.6 MW of renewable energy from solar roofs. Additionally, SAGEN helped reduce electricity consumption in municipalities by 20,000 MWh per year.

Project name (Click on the project name to visit the website)	Eligible expenditures (in € million)	Qualitative description of effects
Energising Development (EnDev) global programme	10.0	EnDev grows and strengthens local markets for the dissemination of renewable energy and more efficient technologies for households, social institutions and businesses. EnDev is currently active in 21 partner countries on three continents (Africa, Asia and Latin America). Between the project's launch in 2005 and 2020, access to climate-friendly energy has been provided for 23.8 million people (920,000 in 2020), 28,500 social infrastructures (1,096 in 2020) and 73,550 micro, small and medium-sized enterprises (19,688 in 2020). The carbon-dioxide emission savings directly associated with the EnDev measures amount to 16.9 million tonnes of CO_2e (2.33 million tonnes of CO_2e in 2020) and have been steadily increasing.
Contribution to the environmental objectives of Peru (ProAmbiente II)	2.0	The project supports the management of nature conservation areas in order to conserve biodiversity in protected areas and buffer zones. The marketing of environmentally friendly products and sustainable tourism improves the living conditions of the local population and the public acceptance of nature conservation. The project helped to improve the protection of a total of 9.8 million ha in Peruvian protected areas in 2020. It also contributes to the strengthening of legal and sustainable forestry in Peru and cooperates with state institutions, the private sector and indigenous communities. In 2020, the project helped enable the sustainable and legal use of 4.0 million ha of forest in Peru. This prevented deforestation and resulting greenhouse gas emissions totalling 503,460 tonnes of CO_2e.
Indo-German Energy Programme – Access to Energy in Rural Areas (IGEN-Access II)	3.0	The project aims to create a reliable, cost-effective and sustainable energy supply in the rural areas of selected Indian states. Project activities focus on expanding the market and promoting innovative business models to make sustainable energy available in rural areas, with the aim of providing access for all. The programme is divided into three strategic components: supporting long-term energy planning for selected states; developing funding opportunities and instruments for renewable energy systems for rural energy users; capacity building for micro-entrepreneurs at village level to promote products and services through decentralised renewable energy systems (DREs); and developing and testing solutions to improve the quality of the energy supply. In 2020, more than 70,000 households gained access to financial resources from financial service providers to acquire small DRE systems.
Governance and sustainable management of natural resources in the Comoé and Taï area, Côte d'Ivoire	5.0	The project supports rural producers in the Comoé and Taï region to become more self-organised and efficient. It also uses innovations, such as technical innovations for tree care, to improve their agricultural productivity while conserving resources. The project additionally aims to improve protected area management. It also advises on developing and implementing local agreements on governance and the sustainable use of natural resources. The project helped to store 918,284 tonnes of CO_2e in the Comoé and Taï National Parks and in neighbouring areas.

Project name (Click on the project name to visit the website)	Eligible expenditures (in € million)	Qualitative description of effects
Decarbonisation of the energy sector in Bosnia and Herzegovina	3.2	The project supports the Ministry of Foreign Trade and Economic Relations (MoFTER) and the entities' ministries of energy in the field of individual and organisational capacity development. The aim is to establish well-functioning departments that plan, coordinate and monitor the implementation of long-term decarbonisation scenarios aligned with the 2050 climate goals. Assisting in the establishment of a digital monitoring system will make it possible to monitor progress towards decarbonisation. In addition, the project supports the conduct of public consultations and helps initiate dialogue between civil society and the public and private sectors. By promoting decarbonisation in the residential sector, the project supports the relevant authorities in developing a national energy efficiency programme.

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2.3. International climate and environmental protection

2.3.1. Investments to protect the climate and biodiversity abroad

Budget chapters and items:	**1602 896 05**					
Eligible expenditures 2020:	**€592.5 million**					
GHG emission reduction:	**Direct GHG emission reduction over the course of the project: 6.67 million t CO_2e** (total for 18 International Climate Initiative projects over the project duration up to and including 2020)					
Other indicators:	**Land area with improvements/improved ecosystem protection: 15,668,163 ha** (total for 32 International Climate Initiative projects over the project duration up to and including 2020)					
	Number of people assisted in ecosystem adaptation and protection: 999,147 (total for 53 International Climate Initiative projects over the project duration up to and including 2020)					
	371 projects funded in 2020					
	– of which 35 new projects					
Funding share:	**N/A**					
EU environmental objectives	a)					f)

Assumptions and limitations:

- Only part of the International Climate Initiative portfolio consists of ex-post audited projects with plausible reductions that have already been achieved. The disbursements to the 18 projects in 2020 amounted to only 2.18% of the total eligible expenditures.
- The GHG reduction relates exclusively to mitigation effects obtained during the project period (ex-post). It does not include projected savings generated by, for example, the ongoing use of new technologies.
- The International Climate Initiative uses narrow definitions for the indicators in order to obtain plausible and reliable figures. Impacts are only counted if they are directly attributable to a project, arose during the project lifecycle and are sufficiently documented in the project. The figures reported here are relatively small as a result. The real impacts of the International Climate Initiative, including those that arise after the end of a project or indirectly as a result of it, can be assumed to be much higher.

Links:

- Further information on the International Climate Initiative: www.international-climate-initiative.com/en/about-iki/
- Information on standard indicators used in the International Climate Initiative and evaluation figures (including completed projects): www.international-climate-initiative.com/en/about-iki/impact-and-learning/
- 220 International Climate Initiative evaluation reports can be viewed here and filtered by additional criteria (search category “IKI Evaluation”): www.international-climate-initiative.com/en/iki-media/?tx_solr%5Bfilter%5D%5B0%5D=category%3A%2F9%2F98%2F104%2F

The International Climate Initiative (IKI) funds a wide variety of projects that help developing and emerging countries to reduce greenhouse gas emissions in any sector (funding area I), adapt to the consequences of climate change (funding area II), preserve natural carbon sinks such as forests and peatlands (funding area III) and protect or restore ecosystems and biodiversity (funding area IV).

A large variety of approaches to climate action and biodiversity conservation are applied in the project portfolio. For example, International Climate Initiative projects advise partner policymakers, authorities and the private sector on the development of strategies and action plans or laws at all levels – from small villages to metropolitan regions right up to the multilateral level – provide capacity building, and develop financing instruments. Quantifiable impacts in terms of the above three standard indicators will not materialise until these plans and instruments are implemented. Since this does not normally take place until after project completion, they are not included in the assessment of the direct impacts of the International Climate Initiative.

With these measures, many projects therefore aim to improve the political and regulatory framework and to overcome structural barriers and barriers to investment. In this way, they help partner countries to independently adopt and sustainably pursue climate-friendly and biodiversity-friendly development paths. While impacts cannot usually be measured during the lifetime of such projects in terms of indicators such as land area with improved ecosystem protection, they act in the longer term as key drivers of large-scale and measurable effects with regards to climate change mitigation and biodiversity conservation, as well as paving the way for further investments in areas such as GHG-mitigating infrastructure after project completion. The post-projects follow-up effects can no longer be quantified and counted as eligible in the International Climate Initiative (and are therefore not included in the following indicators).

The following projects provide an insight into the various approaches and impact pathways in the International Climate Initiative portfolio that cannot be mapped using the above indicators:

Project name	Eligible expenditures (in € million)	State government	Qualitative description of effects
Clean, Affordable and Secure Energy for Southeast Asia (CASE)	1.1	Indonesia, Philippines, Thailand and Vietnam	The project aims to promote evidence-based solutions for the energy transition and ambitious climate targets in the region. To this end, it develops solutions to energy challenges with broad stakeholder involvement, builds up a knowledge platform, participates in the South East Asian Energy Transition Partnership and provides technical and policy support.
Linking Market Mechanisms and Climate Finance in Africa	0.67	Ethiopia, Senegal and Uganda	The project promotes the use of financing mechanisms for climate change mitigation and adaptation in implementing countries. To this end it pilots climate financing models in partner countries that contribute to their NDCs. It also assists governments and the private sector in formulating GCF proposals. Project findings feed into climate negotiations and the public debate, thus helping to shape policy instruments.
Climate Action Tracker	0.86	--	The purpose of the Climate Action Tracker is for relevant stakeholders to possess knowledge about the adequacy of national mitigation activities to achieve long-term goals so that they can contribute to meeting ambitious climate targets. To this end, it conducts regular, transparent, independent investigations and assessments of the national and global implementation of the Paris Agreement in around 40 countries that account for over 85% of global emissions.

Project name	Eligible expenditures (in € million)	State government	Qualitative description of effects
Climate friendly technologies and capacity development for the implementation of the Brazilian National Waste Policy	1.35	Brazil	The project aims to improve the conditions for a climate-friendly and resource-efficient circular economy in Brazil. This includes integrating climate-relevant criteria into rules, regulations and laws, carrying out wide-ranging capacity-building measures for various different target groups and assisting with the introduction of climate-friendly waste management measures in courses of study.
Supporting the design and first implementation steps of the new global framework for biological diversity	0.59	--	The project supports partner countries in the design and first implementation steps of the new global framework for biological diversity beyond 2020. To this end, it assists project partners in preparing for CBD COP 15, promotes integrated approaches to biodiversity and climate change, and identifies funding instruments to implement the goals of the new biodiversity framework. It also advises on issues such as nature-based solutions for climate action and biodiversity conservation.
West African Alliance on Carbon Markets and Climate Finance	0.46	--	The project seeks to deepen sub-regional cooperation in the West African Alliance on Carbon Markets and Climate Finance and to improve countries' resources and capabilities for implementation of Article 6 of the Paris Agreement. Member participation in international climate negotiations on Article 6 ensures that African priorities are taken into account. In addition, a platform for bringing together strategic partners (such as financiers and project developers) supports the launch of carbon market projects. The Alliance was the model, among other things, for the Eastern Africa Alliance on Carbon Markets and Climate Finance.
Transparent policymaking: The Caribbean Cooperative MRV Hub (CCMRVH)	0.57	Caribbean small island developing states	The CCMRVH assists Caribbean countries in developing and using measurement, reporting and verification (MRV) systems that can collect and process data, compile greenhouse gas inventories, model climate policies and track progress toward national climate goals. It offers a wide range of capacity development and support measures for this purpose. The aim is to build national expertise, make MRV systems more efficient and reduce dependence on experts from elsewhere.
RESTORE+: Addressing Landscape Restoration on Degraded Land in Indonesia and Brazil	1.12	Indonesia and Brazil	The project promotes land-use and degradation monitoring, modelling, policymaking and land-use planning for degraded landscapes in Brazil and Indonesia. In Indonesia, it combines mapping campaigns (in collaboration with the local population) with land-use and supply chain modelling. In this way, the project identifies areas that are suitable for restoration while analysing impacts on production, biodiversity, GHG emissions and society. In Brazil, it supports existing land monitoring and modelling technologies and the implementation of the Bonn Challenge.

Project name	Eligible expenditures (in € million)	State government	Qualitative description of effects
Enabling Long Term Defossilisation Pathways through Power-to-X (PtX Pathways)	0.14	Argentina, Morocco and South Africa	PtX Pathways supports the development of sustainable Power-to-X (PtX) and hydrogen markets as a building block for the energy transition in Morocco, South Africa and Argentina. The project supports the competent ministries for energy and the economy in the development of allocation scenarios for PtX, including the analysis of value chains. Working jointly with the partners, the team identifies business development opportunities and derives recommendations for improving the regulatory framework for PtX. In Morocco, a power-to-liquid pilot plant demonstrates the entire PtX value chain, paving the way for upscaling and capacity development. Good practices, tools and guidelines are disseminated to other countries via the International PtX Hub and thus fed into the PtX debate in other markets.
Establishing Sustainable Consumption and Production – a South-South Transfer ("SCP South-South")	0.97	Indonesia, Colombia, Paraguay, Philippines and Thailand	The project promotes sustainable consumption and production methods through a variety of measures and strategies: Among other things, it provides support for national governments in the development of mitigation strategies in the agro-food sector, promotes the implementation of sustainable business models and uses information campaigns to raise awareness about sustainable approaches to production and consumption.

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2.3.2. International climate and environmental protection – export of technologies to tackle marine litter

Budget chapters and items:	**1601 687 06**					
Eligible expenditures 2020:	**€12.4 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**6 projects**					
Funding share:	**N/A**					
EU environmental objectives			c)	d)	e)	f)
Assumptions and limitations: --						
Links: https://www.bmuv.de/programm/foerderprogramm-gegen-meeresmuell						

The oceans are important ecosystems for countless species of animals and a vital source of life for humans. Every year, approximately 13 million tonnes of plastic waste is washed into the oceans. As a result, marine animals mistake plastic debris for food or become entangled in it and die. In addition, plastics ingested by animals can reach humans through the food chain.

With the "Marine Debris Framework – Regional Hubs around the Globe" (Marine:DeFRAG) funding programme, the Federal Environment Ministry supports international projects that help to collect plastic debris at source or prevent it from entering the oceans in the first place.

Funding is provided both for activities to reduce the amount of plastic waste in the medium term and for activities to establish and develop effective waste and recycling management systems in the short term. In addition to countries and regions along rivers that transport plastic waste from inland areas to the sea, the project also focuses on coastal regions and island nations.

List of projects on technology cooperation and investment, policy advice, capacity building, and policy and strategy implementation:

Project name	Brief description	Eligible expenditures (in € million)	Duration
Contribution to PROBLUE fund	PROBLUE is an Umbrella Multi-Donor Trust Fund (MDTF) administered by the World Bank, designed to help countries chart a course towards the sustainable and integrated development of coastal regions and the oceans.	9.20	Indefinite
Contribution to Basel-Rotterdam-Stockholm (BRS) Secretariat	The Secretariat supports the implementation of the Basel, Rotterdam and Stockholm Conventions on environmental protection.	1.45	Indefinite
Mitigating Marine Plastic Debris in Vietnam		1.26	2019 – 2024

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2.3.3. International climate and environmental protection

Budget chapters and items:	**2310 687 01**					
Eligible expenditures 2020:	**€79.4 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**59 projects**					
Funding share:	**See list of sample projects**					
EU environmental objectives	a)	b)				
Assumptions and limitations: The funding share is calculated as a share of the total costs of the project (excluding third-party funding).						
Links: See list of sample projects						

The International Climate and Environmental Protection (IKU) budget item funds new and particularly innovative climate change mitigation and adaptation approaches that contribute to the implementation of the Paris Agreement in developing and emerging countries. The budget item is not limited to specific instruments. Funding can be provided to projects carried out by GIZ and KfW, private institutions, churches, political foundations and public authorities or to research projects.

Due to the large number and heterogeneity of the projects, it is not possible to aggregate at budget item level. A qualitative description of the impact is therefore reported for a selection of projects (approximately 34% of eligible expenditures). The funding share is calculated as a share of the total costs of the project.

Project name Links (click on the project name to visit the website)	Eligible expenditures (in € million)	Description	Funding share
Programme to Support Municipal Climate Change Mitigation and Adaptation Projects (FKKP)	0.3	Engagement Global's Communities in One World Service Agency funded three projects under this programme from 2019 to 2021. Twinning projects between German municipalities and municipalities in DAC countries are eligible if they contribute to the following objectives: • Climate change mitigation/reduction of greenhouse gas emissions through the use of efficient and/or regenerative technologies • Climate change adaptation/improving climate change adaptability (including to the impacts of slow-onset events) in regions heavily impacted by climate change • Integration of climate change mitigation and adaptation into development goals and activities of recipient municipalities, supported among other things by institution and capacity building for relevant stakeholders, including civil society stakeholders	33%
Emission reduction, climate change adaptation, forest conservation, marine and coastal protection, and biodiversity conservation	9.0	The project is implemented by Engagement Global and consists of three phased sub-projects (total duration 2017 to 2023). The aim is to enable German non-governmental organisations and their local partners to carry out development-related projects in the areas referred to in the project title. Project and programme approval is primarily based on the OECD-DAC criteria of relevance,	31%

Project name Links (click on the project name to visit the website)	Eligible expenditures (in € million)	Description	Funding share
		effectiveness, efficiency, significance and sustainability. In addition, projects funded under the IKU budget title in this area must, among other things, make a recognisable contribution to sustainable development and the equal inclusion of women and men.	
International climate and environmental protection	0.2	The project is being implemented by the Friedrich Naumann Foundation for Freedom. Its aim is to encourage representatives from politics, business and civil society, particularly from emerging economies, to promote climate-friendly growth and climate change adaptation. Countries or regions where the project is active include the Western Balkans, Morocco and Indonesia, each of which is allocated around €47,000. This is used to fund political education and policy dialogue activities to raise awareness of climate change and potential solutions. Duration: January 2020 to December 2022.	30%
Climate action, environmental protection and resource conservation through the implementation of an integrated circular economy in selected communities in South America	0.1	By introducing integrated circular economy approaches, the project aims to contribute to achieving the goals of the Paris Agreement. It targets communities in three South American countries. The project is implemented by the Hanns Seidel Foundation.	25%
Climate and Energy Global Programme (KE4)	0.9	The Global Programme is implemented by the Konrad Adenauer Foundation and promotes national, interregional and international exchange on climate and energy issues in the Asia-Pacific region (mainly China, Vietnam, Kazakhstan, Singapore, Thailand and India) and in Latin America.	33%
Funding of the UNDP Global Fund for Coral Reefs (GCFR)	3.2	The GFCR is implemented by the United Nations Development Programme (UNDP) and is expected to increase the resilience of more than 150,000 ha of coral reefs, improve ecosystem services for more than 380,000 local beneficiaries and create 2,500 jobs, all by 2030. More than 50 reef restoration and protection solutions are being implemented in this connection. GFCR grants are expected to mobilise about four times as much co-financing for reef protection. The funded phase ran from January 2020 to December 2021.	100%
Covid-19-related premium subsidy for African Risk Capacity (ARC)	8.5	In partnership with the World Food Programme (WFP) and others, the project funds insurance premiums to cover climate risks in Africa during the Covid-19 pandemic. In the period from June 2020 to December 2021, this enabled nearly 14 million vulnerable people in Africa to be insured against droughts and cyclones.	100%

Project name Links (click on the project name to visit the website)	Eligible expenditures (in € million)	Description	Funding share
IMF-Germany Climate Change Capacity Building Programme	1.5	Through this programme, the IMF (International Monetary Fund) supports capacity building in developing countries to implement climate change mitigation projects to meet national climate targets, strengthen resilience and promote green recovery. Measures include strengthening the capacity of finance ministries and central banks to integrate climate change mitigation and adaptation into fiscal policy. It also supports the exchange of knowledge between government institutions and central banks on issues related to financial and economic stability and climate change. Total cost of the project from 2019 to 2023: approximately €7 million.	21%
Continuation of accelerated technical cooperation with partner countries to implement their National Climate Contributions (NDCs) in line with the Sustainable Development Goals (SDGs)	1.7	Through this programme, the World Resources Institute (WRI) supports the efficient implementation of advice measures between a support unit, various NDC partners and governments. This enables the development of demand-driven knowledge solutions to implement long-term strategies to improve climate policies in partner countries. Duration: January 2018 to December 2021.	24%
Blue Action Fund – Save Our Mangroves Now! Initiative	1.3	Save Our Mangroves Now is a BMZ, WWF and IUCN joint initiative running from 2020 to 2022. Its aim is to raise awareness of the importance of mangrove conservation among national and international policymakers. Action areas include incorporating mangrove conservation into relevant international agreements, building international networks and promoting more effective mangrove conservation in the West Indian Ocean pilot region.	36%

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2.4. Multilateral cooperation

2.4.1. Developmentally important multilateral aid for global environmental protection, biodiversity conservation and climate protection

Budget chapters and items:	**2303 896 09**					
Eligible expenditures 2020:	**€714.4 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**Contributions to 12 international initiatives**					
Funding share:	**Variable according to beneficiary**					
EU environmental objectives	a)	b)				f)
Assumptions and limitations: Outcomes of funding provided by the listed institutions are not recorded on a provider-specific basis. The contributions are made under international agreements. There are various beneficiaries with differing tasks and objectives. The outcomes cannot be aggregated.						
Links: --						

Multilateral organisations implement large programmes of considerable scope in developing and emerging countries and coordinate the contributions of various donors for this purpose. They are important players in supporting transformation processes in partner countries. Germany therefore contributes to 12 multilateral initiatives. Quantitative impact indicators are not available. The initiatives are therefore each described in qualitative terms.

Initiative Links (click on the name to visit the website)	Eligible expenditures (in € million)	Description
Green Climate Fund (GCF)	195.0	The Green Climate Fund is an instrument of the UN Framework Convention on Climate Change with the aim of providing financing for both greenhouse gas emission reduction and climate change adaptation in developing countries. The fund approved 209 projects in developing countries by the end of 2022. The funded projects are split 50:50 between adaptation and mitigation projects. By 2022, 2.4 billion tonnes of CO_2 were avoided and USD 1.5 billion invested in a total of 59 sustainable forestry and land-use projects.
Global Environment Facility (GEF)	87.5	By the end of the fourth year (2021) of the GEF-VII implementation period (July 2018 to June 2022), the Global Environment Facility (GEF) has financed projects with a total volume of just under USD 3 billion, leveraging USD 7.9 in co-financing per dollar of GEF grant. This has enabled more than 87 million ha of marine area to be brought under sustainable use and 1,328 marine protected areas to be established and, on land, more than 8 million ha of habitat to be restored and 167 million ha to be brought under sustainable use. It has also prevented approximately 1.44 billion tonnes of CO_2e in emissions.
Global Agriculture and Food Security Program (GAFSP)	100.0	The Global Agriculture and Food Security Program works to build resilient and sustainable agriculture and food systems in low-income countries, in times of crisis and beyond. By 2021, USD 1.5 billion in grant financing had been invested in 75 projects in over 47 countries. More than 16 million people have benefited directly from this support.

Initiative Links (click on the name to visit the website)	Eligible expenditures (in € million)	Description
Global Energy Storage Program (GESP)	80.0	The Global Energy Storage Program is part of the Climate Investment Funds. It promotes efficient energy storage solutions with over USD 400 million in support.
Montreal Protocol X	11.9	The Multilateral Fund for the Implementation of the Montreal Protocol covers additional costs incurred by developing countries in complying with the Protocol to phase out the use of substances that deplete the ozone layer. Up to 2022, the fund has already co-financed more than 8,600 projects with nearly USD 4 billion.
Least Developed Countries Fund (LDCF) VIII	25.0	The Least Developed Countries Fund is primarily intended to support adaptation measures in countries heavily affected by climate change but lacking the resources to address it. The LDCF financed 365 projects up to 2022 and is expected to increase resilience for more than 52 million people and over 8 million ha of land.
InsuResilience Global Partnership	40.0	The InsuResilience Global Partnership develops financing and insurance solutions for climate and disaster risks. One of its goals is to provide financial protection against climate and disaster risk for 500 million people annually by 2025. In 2020, 22 individual programmes in 101 countries were active under the InsuResilience umbrella.
Nationally Determined Contributions II	15.0	Developing countries are supported by Germany and other countries in making their Nationally Determined Contributions (NDCs) more ambitious and in implementing them in a swift, coordinated and effective manner. Climate and development goals are addressed together.
African Development Bank Green Baseload Initiative	50.0	The African Development Bank's Green Baseload Initiative helps African countries transition from coal and other fossil fuels to renewable energy, with a strong focus on power system stability. It covers one of the strategic priorities of the Sustainable Energy Fund for Africa (SEFA).
ProGreen Multi Donor Partnership for Sustainable Landscapes	48.0	The ProGreen programme supports sustainable and climate-resilient activities to restore or improve ecosystem services.
Central African Forest Initiative (CAFI)	57.2	The Central African Forest Initiative promotes sustainable forest management and agricultural practices together with good governance and land use reforms in six countries. This serves to protect the Central African forest, which absorbs 4% of the world's CO_2 emissions. The Initiative has supported over 40 initiatives through to 2022 with 75 million tonnes of anticipated CO_2 emission reductions.
Forest Carbon Partnership Facility (FCPF) Readiness Fund	4.9	The FCPF capacity building programme advises and supports indigenous peoples, local communities and organisations of the Global South in the development and implementation of initiatives to reduce emissions by forest conservation and improved forest management (REDD+).

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2.4.2. Contributions to international organisations

Budget chapters and items:	**1601 687 01**					
Eligible expenditures 2020:	**€23.1 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**27 organisations**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)	c)	d)	e)	f)
Assumptions and limitations: --						
Links: --						

Environmental protection, climate action and nature conservation must be globally successful in order to achieve the Sustainable Development Goals (SDGs). Effective organisations are needed to implement, monitor and further develop international agreements on environmental protection and nature conservation. To support these, the federal government makes annual contributions. Examples of organisations are:

United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate Change (UNFCCC) is the international, multilateral climate protection agreement of the United Nations. Its aim is to prevent dangerous anthropogenic (man-made) interference with the climate system. The UNFCCC was launched in 1992 at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro and entered into force two years later. In the meantime, 197 states have ratified the UNFCCC and thus almost all states in the world.

Montreal Protocol for the Protection of the Ozone Layer

With the Montreal Protocol of 1987, a precise timetable was agreed for the global phase-out of the production and use of substances such as CFCs that destroy our ozone layer. Since 16 September 2009, the Montreal Protocol has been one of the first two agreements in the history of the United Nations to be ratified by all states in the world. The results of the agreed goals are clearly visible: worldwide, the production and consumption quantities of ozone-depleting substances fell drastically in just a few years. At the same time, the agreements under the Montreal Protocol prevented an additional increase in greenhouse gas emissions.

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) also supported the following international organisations in 2020:

- Permanent Secretariat of the International Commission for the Protection of the Rhine
- Permanent Secretariat of the International Commission for the Protection of the Saar and the Moselle
- Protocol on Further Reduction of Sulphur Emissions (Oslo) (1994)
- International Council for the Exploration of the Sea (Ices), Quality Assurance and Routine Data (QSR)
- Permanent Secretariat of the International Commission for the Protection of the Meuse
- Permanent Secretariat of the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area
- International Panel on Climate Change (IPCC)
- Permanent Secretariat of the International Commission for the Protection of the Elbe
- Permanent Secretariat of the International Commission for the Protection of the Oder
- Basel Convention (Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal)

- Permanent Secretariat of the International Commission for the Protection of the Danube River
- Strategic Approach to International Chemical Management (SAICM)
- Green Climate Funds
- UNEP/UNESCO/BMU Education Programme
- World Health Organisation (WHO)
- Vienna Convention for the Protection of the Ozone Layer
- Secretariat of the Cooperation Plan for the Implementation of Regional Sustainable Development at the Council of the Baltic Sea States (Baltic 21)
- Alpine Convention Secretariat (Protection and Sustainable Development of the Alps)
- Stockholm Convention (prohibition and restriction measures for certain persistent organic pollutants)
- Rotterdam Convention (prior informed consent procedure for certain hazardous chemicals; pesticides in international trade)
- International Panel for Sustainable Resource Management (International Panel on Resources)
- Transfer of funding for the UNEP Life Cycle Initiative
- Contribution to the Climate and Clean Air Coalition (CCAC) Secretariat
- Minamata Convention on the Control of Mercury
- Permanent Secretariat of the International Zero Emission Vehicle Alliance (IZEVA)

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2.5. Specific funding

2.5.1. Special initiative ONE WORLD – No Hunger

Budget chapters and items:	**2310 896 31**					
Eligible expenditures 2020:	**€204.0 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**27 projects**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)				
Assumptions and limitations: The impact indicators show ex-ante estimated target values over the entire project duration. The pro-rata figure for 2020 has been added on the basis of the total funding volume.						
Links: All projects of the GIZ special initiative are described in more detail here: https://www.weltohnehunger.org/ (without a breakdown of projects by annual expenditure and without a separate presentation of the "green" projects).						

The ONE WORLD – No Hunger special initiative finances projects that contribute to reducing hunger and malnutrition in the world or support rural development as an important prerequisite for food security. Eligible expenditures include projects that aim at the environmentally sound use of natural resources and land areas and contribute to climate change adaptation.

Quantitative impact indicators are not available for all projects. The available information is therefore reported only for a selection of projects (accounting for approximately 40% of eligible expenditures):

Project name Links (click on the name to visit the website)	Eligible expenditures (in € million)	Impact indicators	Description
Improving agricultural productivity through soil and water conservation measures	3.0	Number of people supported in coping with the impacts of climate change: – ex-ante target value: 26,000 – pro-rata value: 7,800 Sustainably managed area: – ex-ante target value: 17,000 ha – pro-rata value: 5,100 ha	The objective is to increase yields and productivity of rainfed agriculture on rehabilitated land and strengthen producer resilience to climate change. Soil and water conservation measures such as building stone contour lines, grass and field borders and demi-lunes (half-moon shaped berms of gravel or earth around one or more plants) are used to rehabilitate and protect cropland that is susceptible to degradation.
Improving agricultural productivity through soil and water conservation measures – Phase IIa	0.4	Number of people supported in coping with the impacts of climate change: – ex-ante target value: 19,156 – pro-rata value: 1,916 Sustainably managed area: – ex-ante target value: 6,800 ha – pro-rata value: 680 ha	

Project name Links (click on the name to visit the website)	Eligible expenditures (in € million)	Impact indicators	Description
Enhancing drought resilience and increasing food security in arid and semi-arid regions	0.4	Number of people supported in coping with the impacts of climate change: – ex-ante target value: 4,800 – pro-rata value: 192 Sustainably managed area: – ex-ante target value: 850 ha – pro-rata value: 34 ha	Under the ONE WORLD – No Hunger special initiative, sustainable approaches are implemented in selected partner countries to promote soil conservation and the rehabilitation of degraded soils on a broad scale in order to combat rural soil degradation in Ethiopia. By conserving and making more effective use of existing water and land resources, the measures aim to enable the population to manage their natural resources sustainably, even under changing climatic conditions, and thus significantly improve their food security.
Expansion of the Rural Resilience Initiative (R4) in Ethiopia	0.8	Number of people supported in coping with the impacts of climate change: – ex-ante target value: 650,000 – pro-rata value: 26,000	"Expansion of the Rural Resilience Initiative (R4) in Ethiopia" is a financial cooperation module to enhance the resilience of smallholder farming households to the impacts of climate change by (1) providing needs-based, economically and financially sustainable drought risk insurance, (2) soil conservation measures, (3) access to microcredit and (4) promotion of saving. The project supports the overall development objective of improving the food security of the rural population in the project region.
Green Innovation Centres for the agriculture and food sector	76.2	1.4 million direct beneficiaries 91% average income increase for 58% of direct beneficiaries over the overall term 26% average productivity increase for 58% of direct beneficiaries over the overall term 685,888 small-scale farms using the funded climate-smart innovations Creation of 14,500 new employment opportunities (new jobs and expansion of existing employment), including 9,749 for young people and 6,413 for women	In the course of the project, Green Innovation Centres were established in 14 countries in Africa and in India and Vietnam. The focus of the work is on smallholdings in 21 selected value chains. These farms are supported primarily through the provision of advisory services and of educational and training courses with the goal of enabling them to use input-based, technical, knowledge-based and organisational innovations to improve their productivity, income and climate resilience in the long term. This will also create new jobs in the area of food processing, ensuring that a greater portion of the added value from agricultural production remains in the countries, especially in rural areas. The new employment

Project name Links (click on the name to visit the website)	Eligible expenditures (in € million)	Impact indicators	Description
			opportunities will benefit young people and women in particular. At global and at local level, the project cooperates with over 150 partner organisations from civil society, producer associations, academia, research institutions and the private sector.
Climate adaptation and soil rehabilitation in watersheds, Component II (VPT II)	1.0	Number of people supported in coping with the impacts of climate change: – ex-ante target value: 77,000 – pro-rata value: 15,400 Sustainably managed area: – ex-ante target value: 18,000 ha – pro-rata value: 3,600 ha	The "Climate adaptation and soil rehabilitation in watersheds" financial cooperation project aims to strengthen the adaptive capacity of smallholders against climate change and climate variability through the improvement and sustainable use of soil and water as natural resources.

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2.5.2. International energy cooperation, commodity partnerships and technology cooperation

Budget chapters and items:	**6092 687 02**					
Eligible expenditures 2020:	**€23.1 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**46 projects**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: --						
Links: https://www.bmwk.de/Redaktion/EN/Publikationen/Europe/energy-partnerships-and-energy-dialogues-2020.html						

Funding is provided for international energy cooperation. This includes measures to support and continue bilateral and multilateral cooperation, especially with the aim of promoting the German and global energy transition and finding new partners that support partner countries in developing a sustainable energy supply and ensuring energy security. The cooperation takes place, for example, through the work of secretariats in partner countries, training courses, studies and international conferences.

The nature of the cooperation in energy partnerships, energy dialogues and multilateral forums means that it is not possible to establish a direct causal link with quantifiable CO_2 savings. The reporting is provided in the understanding that the measures will contribute substantially to global climate change mitigation.

In 2020, 46 projects were carried out with 261 workshops and four focus topics in 23 countries.

Further information and details can be found in the Energy Partnerships and Energy Dialogues 2020 Annual Report.

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2.5.3. International cooperation [in the area of climate action]

Budget chapters and items:	**1602 532 05**					
Eligible expenditures 2020:	**€21.6 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**36 EUKI projects**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: The projects generally fund non-investment measures and direct GHG emission reductions cannot be quantified						
Links: http://www.euki.de/en/						

The international climate action budget item funds climate action measures across the EU and worldwide as well as mitigation projects in developing and emerging countries that contribute to the implementation of the Paris Agreement. The budget item is not limited to specific instruments. Funding can be provided to projects carried out by GIZ and KfW, private institutions, churches, political foundations and public authorities or to research projects. Due to the large number and heterogeneity of the projects, it is not possible to aggregate at budget item level.

European Climate Initiative (EUKI)

The European Climate Initiative was launched in 2017 and supports climate action and knowledge transfer, primarily in eastern and southern Europe. EUKI funding measures focus on non-investment climate action projects. The objectives of EUKI are:

(a) Strengthening knowledge and awareness-raising of the drivers of climate change and the ecological, social and economic opportunities arising from climate action

(b) Promoting the sharing of good practices, intensifying the transfer of knowledge and experience and creating networks to support transformative processes and good conditions for reducing greenhouse gas emissions

(c) Promoting European integration by better connecting stakeholders; reflecting and supporting European climate policy.

A total of 613 project outlines were received in the annual calls for project ideas between 2017 and 2021, from which EUKI selected 118 for funding. Together with direct funding grants from the competent ministry, a total of 179 projects were selected for funding in the European Union during that period. More than 300 project implementers and implementing partners are currently active in 25 EU member states and six countries of the Western Balkans (eligible expenditure in 2020: approximately €15.6 million).

One example is the **Young Energy Europe (YEE)** project, which aims to raise awareness of climate change among nearly 500 young professionals from companies in Bulgaria, Greece, the Czech Republic, Hungary, Croatia, Serbia, Poland and Slovakia, train them as energy scouts, including with knowledge about resource efficiency, and encourage them to actively contribute to climate action in their companies by developing projects and putting them into practice. In total, such projects developed by the 2021 Energy Scout cohort identified a reduction potential of around 45,000 tonnes of CO_2 per year.

Carbon market mechanisms

The main purpose of the carbon market under the Paris Agreement is to increase the ambition of nationally determined contributions (NDCs). Under Article 2.1.c of the Paris Agreement, one of the aims of the Agreement is to make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. In support of this aim, funded international

activities are oriented towards leveraging various financial incentives, regulatory frameworks and alliances such as carbon pricing, climate finance and phasing out fossil finance. Activities are also directed at securing Germany's position as one of the most important players in aligning finance flows to the Paris Agreement and in the carbon market internationally at the intersection of business, science, policy and administration.

Measures to create an international carbon market

Germany is committed to developing emissions trading, as a key climate action instrument, into a global carbon market. To this end, it is taking initiatives to link regional emissions trading systems (ETS). Funding has been provided among other things for the International Carbon Action Partnership (ICAP) secretariat. Germany launched ICAP in 2007 as an initiative to align and link the EU Emissions Trading System with other regional ETSs. Bilateral activities have also been pursued with various countries to link emissions trading systems at international level.

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2.5.4. Export of green and sustainable (environmental) infrastructure

Budget chapters and items:	**1601 687 04**					
Eligible expenditures 2020:	**€7.2 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**40 projects funded**					
	20 publications					
	70 events held					
Funding share:	**N/A**					
EU environmental objectives	a)	b)	c)	d)	e)	f)
Assumptions and limitations: --						
Links: https://www.exportinitiative-umweltschutz.de/						

Since 2016, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has been supporting German green tech companies, including SMEs, in the internationalisation of their "green" innovations, products and services with its "Export Initiative Environmental Technologies" (EXI)[22] funding programme.

Modern, efficient and resource-saving technologies are not only drivers of growth and innovation – they also contribute to raising environmental standards, disseminating environmental knowledge and thus sustainably improving ecological foundations and local living conditions. In addition, changing lifestyles and consumption habits contribute to increasing prosperity (addressing SDGs), and raising awareness of German environmental technologies and know-how promotes Germany's position as a competent development partner (building trust).

A programme evaluation (2016-2019) concludes, among other things, that EXI makes an important contribution to creating the necessary conditions for the use of innovative environmental technologies and services in the selected target regions:

> *"In this way, the programme works towards sustainable development and an improvement in living conditions in these countries. At the same time, the programme paves the way for German suppliers to tap into those export potentials that result in the target countries from the implementation of the technological solution approaches addressed by the EXI projects.*
>
> *In the federal funding context, EXI forges a link between the field of development cooperation and classic export promotion. The programme is therefore unique."*[23]

According to the funding guidelines of 21 May 2019, the expenditure will finance around 50 (joint) projects in the following BMU action areas:

- Circular economy
- Water/wastewater management
- Innovative cross-sectional technologies
- Sustainable mobility, sustainable urban and regional development AND sustainable consumption.

Around 70 events and 20 project publications reached decision-makers and other relevant stakeholders in 2020. Success factors and potential impacts include the following (in addition to measurable or quantifiable indicators):

[22] Renamed the Environmental Protection Export Initiative in 2022

[23] See p. 5 of the abridged version of the report: https://www.exportinitiative-umweltschutz.de/de/exportinitiative-umwelttechnologien/evaluation-der-exportinitiative-umwelttechnologien

- Positioning Germany as a preferred development partner in the target countries by building trust: Door-opener/multiplier effect → other countries, regions, locations, companies etc. Reputation/seal of quality; official character
- Triggering sustainable systemic and structural developments in the target countries, such as with regard to legislation or the implementation of norms and environmental standards, which in turn can result in German export opportunities
- Improving the level of information and knowledge of relevant target groups in order to bring about investment decisions based on increased knowledge and learning effects
- Market analyses, feasibility studies, data availability, contact initiation and strategy formation
- Networking as well as technological and economic synergies: joint appearance, increased impact, etc.; integration of renowned partners
- Generating diffusion/imitation effects with a broad impact, for example from implemented pilot/model projects within the target countries (including the transferability of developed solutions to other countries)

The results of the external programme evaluation suggest that:

- Based solely on the information provided by a few project leaders who felt able to estimate export potentials for German suppliers of innovative environmental technologies and services in the target regions, it could be concluded that the benefits of the programme already exceeded the costs many times over.
- If only a fraction of this potential could actually be tapped in the medium term, the economic effects (and in particular export sales) would exceed the amount of funding.
- In addition, there would also be non-quantifiable effects, primarily transnational networking effects (which go as far as the formation of strategic cooperation and development partnerships).
- The programme's impacts contributed to overarching political objectives related to the German sustainability strategy with regard to the promotion of international knowledge transfer (especially in the technical field) and the economical and efficient use of resources. According to the external evaluators, other relevant areas of impact are combating climate change and promoting innovation.[24]

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[24] See: https://www.exportinitiative-umweltschutz.de/de/exportinitiative-umwelttechnologien/evaluation-der-exportinitiative-umwelttechnologien

3. Research, innovation and awareness raising

Social, ecological and economic challenges cannot be overcome without research and development. Germany has a highly effective academic and research system that has made a major contribution over many years to building resilience for the future, both nationally and internationally. These research activities identify long-term trends and risks and propose concrete solutions for social and political processes. With its innovative capacity, the German research landscape advances the development of new solutions and products for achieving the SDGs in Germany and around the world. A key factor driving this innovative capacity consists of participative, interdisciplinary and transdisciplinary research approaches that foster exchange between academia and policymaking, society and business.

The eligible expenditures in the research, innovation and awareness raising sector include projects to enable and support education and innovation on climate and environmental issues. In particular, the funds are used to develop solutions to combat climate change, conserve ecosystems and biodiversity and protect resources. This includes projects to develop innovations for the sustainable transformation of energy systems and to promote sustainable mobility, sustainable urban and regional development and a circular economy.

The sustainability effects of research and development projects are not directly quantifiable or scalable for the entire sector, notably because the utilisation of research results is uncertain at the time of expenditure. Where possible, however, expected quantitative impacts are given, or at least the number of funding recipients and/or the number of funded projects. In addition, objectives and impacts are described for project examples in the budget items in order to make transparent the sustainability of research expenditures in the precompetitive phase.

The eligible expenditures of the sector amount to €1,085.0 million and are distributed across 16 budget items in the following categories:

- Research for sustainability (7 budget items with eligible expenditures of €534.3 million),
- Environmental protection, nature conservation and climate change adaptation (5 budget items with €96.2 million in eligible expenditures) and
- Aerospace, energy, transport and digitalisation (4 budget items with €454.5 million in eligible expenditures).

Note: Research programmes are also assigned to other sectors – in accordance with the Green bond framework – especially if there is a clear connection to a specific sector.

In accordance with the Framework, the research, innovation and awareness raising sector's expenditures are categorised under the following UN Sustainable Development Goals:

3.1. Research for sustainability

3.1.1. Bioeconomy

Budget chapters and items:	**3004 683 30**					
Eligible expenditures 2020:	**€133.7 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**496 beneficiaries**					
	1,475 projects					
Funding share:	**33%**					
	As a rule, the project duration is 3 years, hence the funding share is stated as 33%. Third-party financing is not taken into account.					
EU environmental objectives	a)	b)	c)	d)	e)	f)
Assumptions and limitations: --						
Links: https://www.bmbf.de/bmbf/de/forschung/energiewende-und-nachhaltiges-wirtschaften/biooekonomie/biooekonomie.html Brochure “Tools of the Bioeconomy”: https://www.bmbf.de/SharedDocs/Publikationen/de/bmbf/7/31659_Die_Werkzeuge_der_Biooekonomie.html Brochure “Bioeconomy in Germany”: https://www.bmbf.de/SharedDocs/Publikationen/de/bmbf/FS/31106_Biooekonomie_in_Deutschland_en.pdf National Bioeconomy Strategy (summary): https://www.bmbf.de/bmbf/shareddocs/downloads/files/bmbf_bioeconomy-strategy_summary_en.pdf						

In the field of bioeconomy research, a large number of projects are being funded that deal, for example, with sustainable agriculture of the future, innovative crop cultivation and the transition to a circular economy, especially for a more efficient use of biogenic resources for all areas of application and in all economic sectors. Areas with potential include:

- Replacement of fossil raw materials with renewable raw materials, co-products and waste products
- Cascading use of substances and materials
- Reduction in the use of inputs generated on the basis of fossil raw materials (e.g. fertilisers)
- Adaptation of crops to climate change
- Increasing sustainability in crop production
- Development of more sustainable biotechnological methods and processes

The above areas are illustrated below with project examples. A monitoring system is under development that will track the status quo together with developments and areas of potential.

Replacement of fossil raw materials with renewable raw materials, co-products and waste products

In the PHAtex project, researchers are developing novel, biodegradable polyhydroxyalkanoate (PHA) textiles. As a sustainable alternative, bioplastics could help to reduce plastic waste in the sea and soil. To this end, regionally available, cost-effective biogenic raw materials and residues (such as rapeseed oil) are to be used as a source of carbon material. It has been possible to successfully demonstrate the optimisation of a microbial production strain, the substrate-flexible production of tailor-made PHAs, purification and solvent recovery. On completion, the project is intended to result not only in

the creation of a competitive green biotechnological process chain, but also a cost-effective recycling process without toxic chemicals.

Cascading use of substances and materials

Funding is provided for various regions that are developing models for sustainable, bioeconomy-based value creation. Substances and materials are to be reused and recycled. New raw materials are created from biogenic residues and waste. In the BioBall innovation space in the Frankfurt/Rhine-Main metropolitan region, researchers have joined forces for this purpose with municipally owned companies. In the SynBioTech project, they are developing processes to produce products from CO_2 for animal feed and the chemical industry. The project contributes to sustainability in two ways: residual materials are used and the use of fossil raw materials in the chemical industry is reduced. In addition, a mobile methanol synthesis plant is to be created.

Reduction in the use of inputs generated on the basis of fossil raw materials (e.g. fertilisers)

The sustainable organisation of agricultural production is a central task on the path to a climate neutral bioeconomy. This also involves reducing the use of raw materials and using them in circular systems. Researchers in the SUSKULT project are developing a circular production system for food. The plants grow in an indoor cultivation system in the city. The resources needed for this – nitrogen, phosphorus, potassium, CO_2 plus heat and water – come directly from the sewage treatment plant. This saves transportation and enables local, sustainable farming. SUSKULT additionally opens up new prospects: sewage treatment plants could not only produce clean drinking water, they could also become a nutrient supplier for agricultural production. In addition, the project is working towards the opening of a SUSKULT demonstration plant on the site of a wastewater treatment plant in Dinslaken.

Adaptation of crops to climate change

Rice is one of the most important staple foods worldwide. However, environmental and climate changes are endangering rice cultivation, among other places in Vietnam's Mekong Delta as a result of soil salinisation and drought. Researchers in the RiSaWa project are therefore looking for options for sustainable water use. The goal is to provide sustainable water management for sustainable agricultural rice production. In collaboration with researchers in Vietnam, 20 different rice genotypes are currently being evaluated for suitability under laboratory and field conditions.

Increasing sustainability in crop production

In addition to ensuring production yields, sustainable agriculture must also conserve resources and meet environmental and climate targets. In the DAKIS research project, researchers are focusing on digitalisation and field robotics in agriculture. The aim is to integrate ecosystem services, biodiversity and resource efficiency into modern planning processes and into production and marketing. A digital development system collects data on soil and plant condition, and also on societal needs and economic factors. This enables the optimum provision of ecosystem services. The project has presented a prototype decision support tool. This is a software tool designed to help farmers, agricultural consultants and also policymakers identify conflicts and synergies between economic objectives and the nature conservation benefits of different agricultural practices. The prototype is currently being improved on the basis of real-life application examples, such as hedges and flower strips, and tested in partnership with practitioners.

Development of more sustainable biotechnological methods and processes

In the ContiBio-Elect project, partners from research and industry are developing a bioreactor in which bacteria produce acetoin, an important platform chemical. The new feature is that the bacteria sit on an electrode and release energy to it during production. This means that potentially higher yields can be achieved than in the conventional process. In addition, electricity is generated. If the researchers are successful, the new process will open up access to many oxygen-sensitive chemicals that cannot be produced with current biotechnological processes. In the future, chemicals for pharmaceuticals, cosmetics or food could be produced using sustainable biotechnological processes. A range of technical refinements are currently being made to the various parts of the production system.

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3.1.2. Energy technologies and efficient energy usage – research and development projects

Budget chapters and items:	**3004 685 41**					
Eligible expenditures 2020:	**€111.7 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**583 funded projects**					
Funding share:	**33%**					
	As a rule, the project duration is 3 years, hence the funding share is stated as 33%. Third-party financing is not taken into account.					
EU environmental objectives	a)	b)			e)	
Assumptions and limitations: --						
Links: see programme names in list						

Energy research, which is also partly funded by the federal government's energy research programme, is aimed at building a sustainable energy system in Germany. Key areas of focus here are energy technologies, efficient energy use, green hydrogen, electricity grids and storage systems, industrial processes and sector coupling. The eligible expenditures of the budget item are distributed among the following programmes:

Programme name (Click on the project name to visit the website)	Eligible expenditures (in € million)	Number of projects
Kopernikus projects	34.9	243
Carbon2Chem	9.2	26
Energy materials	2.9	32
Solar construction	11.6	44
Synthetic fuels	7.4	38
Energy storage development	2.3	20
International partnerships	11.0	94
Cross-sectional tasks	22.5	84
iNew Immediate Coal Programme	10.0	2

Kopernikus projects for the energy transition

The aim of the Kopernikus projects is to identify technologies relevant to the implementation of the energy transition and to develop them to the point of large-scale application. The four Kopernikus projects provide practical solutions for central challenges of the energy transition. The *ENSURE* project is researching the electricity grid of the future. *SynErgie* examines how industry can flexibly adapt its electricity demand to the electricity supply. *Ariadne* analyses what laws can be used to achieve climate goals. *P2X* develops technologies to convert electricity into higher-value energy sources. The Kopernikus projects are at the midpoint of their ten-year total duration. In the current conceptual phase, preparations are being made for the demonstration of the developed technologies in the final project phase. The interim evaluation before the transition to the final project phase has begun, and the projects have already produced a wide range of results. For example, approaches have been developed for safely operating power grids even with large proportions of renewable energy. It

has also been possible to develop electrolysis technologies that use a fraction of the usual quantity of precious metals and to make an increasing range of industrial processes more flexible in terms of electricity consumption. In addition, a scenario report has been prepared that compares specific transformation paths for achieving energy and climate policy goals. In 2021, the more than 100 partners from science, business and civil society came a step closer to their goal of making a relevant contribution to the success of the energy transition by 2025.[25]

Carbon2Chem: CO_2 reduction in industry

In the Carbon2Chem project, steel and chemical companies are working with scientific partners to reduce CO_2 emissions from steel production. Instead of releasing smelter gases into the atmosphere, Carbon2Chem proposes purifying them and using green hydrogen to process them so that they can be used as a feedstock for producing basic chemical substances. As early as 2018, the process was used to produce methanol from the waste gases of a steel mill – a world first. The approach has now progressed to the point where planning has begun for the first large-scale facilities for methanol synthesis using the Carbon2Chem process. The methanol produced will not only be used in the chemical industry, but also in the transport sector to power ships or in a hybrid automotive powertrain. As a result, the Carbon2Chem approach could make it possible to commercially exploit up to 20 million tonnes of the German steel industry's annual CO_2 emissions.[26]

Solar construction

"Solar Construction/Energy Efficient City" is an interministerial initiative of the Federal Ministry of Education and Research (BMBF) and the Federal Minsitry for Economic Affairs and Energy (BMWi) which provides comprehensive funding for energy-optimised urban-neighbourhood construction projects. Special emphasis is placed on ideas for improving energy efficiency in urban residential neighbourhoods, efficient use of renewable energy sources, and sector coupling. The funding announcement includes two modules: "Solar Construction" and "Energy Efficient City". The BMBF exclusively funds the Energy Efficient City module for comprehensive and systemic model projects in urban neighbourhoods. In six model projects, partners from academia, business, civil society and policymaking are investigating how the energy transition can be implemented in cities and local authorities using the example of an urban neighbourhood.[27]

NAMOSYN: Synthetic fuels

The NAMOSYN research initiative investigates and evaluates production pathways and applications for synthetic fuels. Along with electric motors and fuel cells, these are one of the alternatives for CO_2-free mobility – especially in heavy freight transportation, which is difficult to electrify. Synthetic fuels are almost climate-neutral if they are produced from renewable energy sources, water and CO_2. More than 30 partners from the automotive, supplier, petroleum and chemical industries, as well as research institutions, are involved in a total of 38 subprojects in NAMOSYN.[28] Of the 38 subprojects, 34 were completed in 2022.

iNEW

In the iNEW innovation platform, scientists and companies from the Rhenish mining area exchange ideas on the use of promising Power-to-X (PtX) technologies to actively promote structural change and make the mining area a competitive and sustainable industrial region. PtX technologies are technologies that convert electricity into high-quality energy sources. iNEW identifies promising approaches and develops them up to the point of practical testing in real-world conditions.[29]

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25 https://www.kopernikus-projekte.de/en/home

26 https://www.fona.de/en/measures/funding-measures/carbon2chem-project.php

27 https://www.fona.de/en/call-for-the-funding-initiative-solar-construction-energy-efficient-cities

28 http://namosyn.de

29 https://www.fona.de/de/neue-innovationsplattform-zu-power-to-x-

3.1.3. Environmental technologies, resources and geological research

Budget chapters and items:	**3004 685 42**						
Eligible expenditures 2020:	**€110.1 million**						
GHG emission reduction:	**N/A**						
Other indicators:	**1,311 beneficiaries**						
	See below for specific objectives of the funding measures						
Funding share:	**33%**						
	As a rule, the project duration is 3 years, hence the funding share is stated as 33%. Third-party financing is not taken into account.						
EU environmental objectives	a)	b)	c)	d)	e)	f)	
Assumptions and limitations: --							
Links: see below							

The eligible expenditures of the budget item are distributed among the programme areas as follows. Examples are described below.

Funding areas (Click on the project name to visit the website)	Eligible expenditures (in € million)	Number of beneficiaries
Environmental technologies and raw material efficiency	48.9	449
Sustainable water management	40.7	607
Sustainable land management	12.3	166
Geosciences	8.2	89

Resource-efficient Circular Economy – Innovative Product Cycles (ReziProK)

The BMBF funding measure "Resource-efficient circular economy – Innovative product cycles (ReziProK)" supports 25 joint projects that use innovative business models in conjunction with digital technologies and eco-efficient product design to increase the lifespan and intensity of use of consumer goods and thus keep the value of the goods or the resources they contain in the economic cycle for longer. The circular economy thus helps to combat climate change and decouples economic growth from resource consumption. One example is the Di-Link project, which successfully developed an IT tool to address information gaps in the marketplace regarding the quality and availability of recycled plastics. Quality information from innovative sensors can be passed on to plastics processors in the value chain. This helps increase the use of recycled materials in new products, thus benefiting the circular economy. The knowledge gained during the project can be used as a basis for further development of digital product passports in the sector. Other current activities under the funding measure primarily focus on enhancing the dissemination of project outcomes to potential users. This objective is achieved through a scientific networking and transfer project conducted by DECHEMA e.V. as part of the funding measure.[30]

Innovative technology for resource efficiency (r4) – Raw materials for future technologies

To meet the growing global demand for resources in the context of the energy transition, it is crucial not only to prioritise recycling but also to explore and develop new resource deposits. The r4 DESMEX II project is dedicated to the development of highly innovative airborne geophysical

[30] https://innovative-produktkreislaeufe.de/Projekte

techniques for the discovery and detection of new subsurface ore deposits. A core element is the high-sensitivity magnetic field sensor technology developed in the project. Towed by a helicopter over the exploration area, this records the magnetic induction field generated by current injection into the subsurface. The project has conducted extensive geophysical resource explorations in Germany, Sweden, Spain, and Namibia. One notable milestone was the research consortium's involvement in the exploration of Europe's largest rare earth deposit in Kiruna, Sweden.[31]

CO_2 as a sustainable source of carbon – Pathways to industrial application (CO_2-WIN)

Meeting Germany's climate goals requires a fundamental transformation of energy and resource supplies. This transformation necessitates the industrial recycling of carbon, utilising CO_2, to meet the demand for carbon from non-fossil sources. The CO_2-WIN funding measure supports a total of 15 joint projects to develop CO_2 as a carbon source for sustainable industry. CO_2-WIN encompasses joint projects that cover various stages of development and thematic areas. These are (a) CO_2 capture; chemical and biotechnological CO_2 conversion, (b) electro- and photocatalysis and (c) CO_2 mineralisation. Within the electro- and photocatalysis thematic area, the DEPECOR project focuses on direct and efficient photoelectrocatalytic CO_2 reduction. Its objective is to develop multi-junction solar cells capable of sunlight-induced photoelectrocatalysis, aiming to create an "artificial leaf" integrating the production of chemical feedstocks from sunlight, CO_2 and water. These projects, along with others, lay the foundation for the advancement of innovative approaches in the field of artificial photosynthesis.[32]

WavE: Future-oriented Technologies and Concepts to Increase Water Availability by Water Reuse and Desalination

Demand for water for domestic, agricultural and industrial use is increasing dramatically around the world, but clean water is a scarce commodity in many regions. This situation is exacerbated by the growing world population, climate change and the pollution and overuse of water resources. In order to address these challenges and to increase the availability of water on a long-term basis, the BMBF has launched two funding measures under the umbrella of FONA: "Water Technologies: Reuse" (from 02/2021) and "WavE – Future-oriented Technologies and Concepts to Increase Water Availability by Water Reuse and Desalination" (funding period 2016-2021; 14 joint research projects plus an accompanying project on networking and knowledge transfer).[33]

GRoW: Global Resource Water

Increasing global demand for water (a projected 55% increase by 2050, with 5.7 billion people affected by water scarcity) together with its knock-on effects along global supply chains necessitate rapid action. To address this the BMBF funding measure Global Resource Water (GroW) has supported 12 joint research projects and an accompanying network and transfer project comprising a total of 90 sub-projects to develop tools for achieving the UN Sustainable Development Goals, with a specific focus on SDG 6 (Water). The funding period was 2017-2022. Examples include better regional forecasting of drought and flood events for the next six months, as well as high-resolution analysis of global drought risks and vulnerabilities through the GlobeDrought project.[34]

German-Israeli Cooperation in Water Technology Research

The development of innovative and environmentally friendly water technologies has been funded in joint German-Israeli cooperation projects since 1974. In 2020, two new projects were launched to investigate water reuse and digital control of drinking water systems. A total of 15 cooperation projects were active in the same year.[35]

Innovative Municipalities – Supporting municipalities in the provision of services of general interest

31 https://www.uni-muenster.de/DESMEX/startseite.html

32 https://co2-utilization.net/en/projects/electro-and-photocatalysis/depecor/

33 https://bmbf-wave.de/wave/en/

34 https://www.bmbf-grow.de/en

35 https://www.fona.de/en/measures/german_-israeli_cooperation_in_water_technology_research_copy.php

Under the Innovative Municipalities funding measure ("Kommunen innovativ"), cities, municipalities and rural districts undergoing demographic and structural change work with research institutions to develop new solutions for more sustainability and for services of general interest. The funding measure covers a wide thematic range. Examples include the development of new financing models, decision-making aids for municipal administration and approaches for public participation, internal municipal development and inter-municipal collaboration.[36]

Stadt-Land-Plus – Strengthening Urban-Rural Connections

The Stadt-Land-Plus funding measure aims to promote sustainable development in regions across Germany. One of 22 joint projects under the funding measure is RAMONA. Taking the Stuttgart metropolitan region as an example, researchers and practitioners have collaborated to develop solutions to defuse conflict situations. RAMONA focuses on the impact mitigation provisions and specially protected species under the Federal Nature Conservation Act. The existing nature conservation and planning law instruments were analysed and further enhanced to avoid or offset impacts of construction activities on nature and landscapes. Among other things, the joint project has advanced the concept of production-integrated compensation on agricultural land. The project outcomes relating to ways of shaping offsetting measures to generate added value have been presented to diverse target groups.[37]

Resource-Efficient Urban Districts RES:Z

"Resource Efficient Urban Districts (RES:Z)" is a BMBF funding measure that provides support for interdisciplinary and transdisciplinary projects focused on researching, developing and testing implementation-oriented concepts for water management, land use and material flow management. The objective is to lay the foundation for the sustainable development of urban districts. The projects focus on energy efficiency and climate adaptation issues. One of the projects, "Leipzig BlueGreen – Blue-Green District Development in Leipzig", aims to reduce the load on the central sewage system, enhance energy efficiency, improve the microclimate and implement climate-resilient stormwater management in the district. Another project, "BlueGreenStreets – Multifunctional Streetscape Design in Urban Districts", focuses on developing and testing transferable solutions for blue-green streetscape design in model communities. The blue-green technologies and planning tools (tree trenches for the irrigation of street trees are one example) are in high demand among practitioners and are being integrated into the design of specific model districts. As a result, the projects have a catalysing effect in the area of multifunctional system architecture throughout the urban environment, contributing to sustainable urban development both nationally and internationally.[38]

Geosciences/Underground Geosystems

The thematic focus on underground geosystems encompasses research projects that investigate fundamental processes in the immediate scientific context of technologies such as deep and near-surface geothermal energy and heat storage. The research targets the development of both conventional and unconventional hydrocarbon reservoirs and exploring the possibilities of deep underground storage for gases or fluids.[39]

International Partnerships for Sustainable Innovations

CLIENT II focuses on funding research and development collaboration with partners in selected emerging and developing countries. The focal areas include resource efficiency, water management and natural hazards. The objective is the joint development and implementation of innovative and sustainable solutions to address specific challenges in the partner countries. Additionally, CLIENT II aims to enhance education, research, and innovation within Germany while supporting the competitiveness of German companies through international cooperation.[40]

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[36] https://kommunen-innovativ.de

[37] https://www.zukunftsstadt-stadtlandplus.de/at-a-glance-in-english.html

[38] https://ressourceneffiziente-stadtquartiere.de/?lang=en

[39] https://www.fona.de/de/massnahmen/foerdermassnahmen/archiv/nutzung-unterirdischer-geosysteme.php

[40] https://www.bmbf-client.de/projekte

3.1.4. Climate research, biodiversity and globalised living spaces – R&D projects

Budget chapters and items:	**3004 685 40**					
Eligible expenditures 2020:	**€97.0 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**405 beneficiaries**					
	975 projects					
Funding share:	**33%**					
	As a rule, the project duration is 3 years, hence the funding share is stated as 33%. Third-party financing is not taken into account.					
EU environmental objectives	a)	b)				f)
Assumptions and limitations: --						
Links: https://www.fona.de/en/topics/climate.php https://www.fona.de/de/themen/zukunftsstadt.php						

The research funding addresses key challenges of global change across the research areas Climate and Atmosphere, Climate Policy, Climate Protection in the Economy and Society, Climate Adaptation/Risk Prevention, and Biodiversity. The research and development projects develop a knowledge base and explore actionable options. The funding thus contributes to the implementation of the BMBF framework programme "Research for Sustainable Development" (FONA3), including the flagship initiatives "City of the Future" and "Green Economy".

The main programme areas are presented below, followed by examples.

Funding areas	Eligible expenditures (in € million)	Number of beneficiaries and projects[41]
Climate and atmosphere	12.2	45 beneficiaries 174 projects
Climate policy	19.4	76 beneficiaries 177 projects
Climate protection in the economy and society	8.7	115 beneficiaries 136 projects
Climate adaptation/risk prevention	42.8	195 beneficiaries 362 projects
Biodiversity	13.5	66 beneficiaries 126 projects

[41] The number of beneficiaries has been corrected in the programme areas Climate (Climate and Atmosphere, Climate Policy, Climate Protection in the Economy and Society, Climate Adaptation/Risk Prevention) and Biodiversity. It should be noted that beneficiaries receiving multiple grants within either the climate or biodiversity thematic areas are counted only once in the total. However, there may still be some duplication of beneficiaries who are funded under both Climate and Biodiversity.

Climate change and extreme events
Extreme events such as heat waves, heavy precipitation, floods and storms cause billions in damage and pose threats to human life. Understanding the impact of climate change on the frequency and intensity of these events is therefore crucial for society, the economy, policymakers and public administration. In response to this, research funding dedicated to climate change and extreme events was further expanded in 2020. A wide range of meteorological and climatological extreme events, including heat waves, heavy rain, floods and storms, have been scientifically studied in depth to provide a basis for prevention, risk management and future preparedness. This improves the knowledge of extreme events and the influence of environmental changes on them.

Climate protection and policy in the economy and society
The Economics of Climate Change funding area was dedicated to investigating robust and practical approaches for assessing promising pathways, effective instruments, policies, and risks and opportunities associated with climate change mitigation and adaptation. The aim was to provide governments, businesses and individuals with a reliable basis for devising, implementing and financing courses of action. In 2020, a particular focus was on analysing existing policies, processes and proposals aimed at supporting the phase-out of fossil fuels, identifying effective approaches and determining their applicability in various regional contexts.

Climate adaptation/risk prevention
The “Urban Climate Under Change” funding measure is supporting the development of the PALM-4U simulation model, which enables towns and cities to simulate (extreme) weather and climate conditions down to building level. This allows cities to calculate how neighbourhoods will face extremes of heat and smog, and how climate adaptation measures will work.

Transdisciplinary, needs-driven research addressing regional challenges of climate change is the focus of the Climate Resilience through Action in Cities and Regions funding measure. The Sustainable Development of Urban Regions funding measure aims to address key issues on the path to sustainable and resilient cities in Southeast Asia. The focus is on technological solutions to improve energy and resource efficiency and to reduce carbon emissions, approaches for sustainable new infrastructure systems and the development of social innovations to cope with the resulting changes in living conditions.

International climate partnerships
Africa is hit particularly hard by climate change. The current research programmes aim to strengthen the climate resilience of regions by developing innovative solutions for a sustainable economy and society and for future-oriented decision-making. Thematic focus areas include migration, food security, water security, biodiversity conservation, sustainable forest management and the development and provision of climate services. Since 2020, the two climate competence centres in West and Southern Africa established by the BMBF with African partners have increasingly served as platforms for forging German-African strategic partnerships on green hydrogen and as the nucleus for developing a green hydrogen economy in the respective regions. The impetus for this was provided by the Atlas of Green Hydrogen Potentials in Africa compiled in collaboration with the two centres.

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3.1.5. Ocean, coastal and polar research – R&D projects

Budget chapters and items:	**3004 685 44**					
Eligible expenditures 2020:	**€43.0 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**250 projects**					
	73 beneficiaries					
Funding share:	**33%**					
	As a rule, the project duration is 3 years, hence the funding share is stated as 33%. Third-party financing is not taken into account.					
EU environmental objectives	a)	b)	c)	d)	e)	f)
Assumptions and limitations: --						
Links: https://www.fona.de/en/topics/maren-coastal-marine-and-polar-research-for-ustainability.php						

Federal government research programme MARE:N: Coastal, Marine and Polar Research for Sustainability

The MARE:N federal government research programme provides the framework for coastal, marine and polar research.

Activities funded under MARE:N aim to develop specific recommendations for decision-makers to promote the sustainable use of the coasts, seas, and polar regions.

The MARE:N programme represents a national contribution to the implementation of Agenda 2030 – specifically SDG 14 ("Conserve and sustainably use the oceans, seas and marine resources for sustainable development") and also SDG 13 ("Take urgent action to combat climate change and its impacts").

In substantive terms, the MARE:N research programme is implemented in agenda processes that define future research needs. Three agenda processes have been carried out in the areas of coastal, marine and polar research. Their outcomes form the basis for BMBF funding calls.

The MARE:N programme is designed to provide comprehensive research for preparedness, decision-making and action, and to contribute to the development of forward-looking and innovative technologies. The scientific programme consists of six major interdisciplinary, cross-cutting and socially relevant focus points.

These are Global Change and Climate Events, Ecosystem Function and Biodiversity, Global Biogeochemical Cycles and Energy Fluxes, Management of Natural Hazards, Sustainable Use of Resources, and Governance and Participation. They are supplemented by three cross-cutting activity areas: Research Infrastructures, Measurement and Observation Technology, and Data and Information Infrastructure.

The research activities that form part of MARE:N address these focal points in the three areas of coastal, marine and polar research:

Coastal research:

Coastal sea research in the North Sea and Baltic Sea (KüNo) – Coasts in Transition Investigation of the multi-factor impacts of climate and land-use change on the integrity of coastal ecosystems, the

future use of coastal areas and the protection of the natural and human environment from climate and land-use related risks, with a view to sustainable coastal protection and land-use policies.[42]

German Coastal Engineering Research Council (KFKI): Applied research in coastal and flood protection and in the maintenance and construction of waterways and ports.[43]

Marine research:

Meaning of Climate Change for Coastal Upwelling Systems: Investigation of the interactions between climate change, biodiversity and human use of the oceans to better address global challenges such as overfishing and pollution of the world's oceans.[44]

JPIO – Microplastics in the Marine Environment: Investigation of the origin and spatial distribution of microplastics in European seas and of their toxicological effects on marine organisms in order to protect marine habitats, conserve marine resources and implement international agreements.[45]

JPIO – Impacts of Deep-Sea Nodule Mining: Development of a management framework for sustainable deep-sea mining: Development of an environmental baseline, quantitative ecosystem vulnerability and resilience assessments, evaluation of actual environmental impacts at mining sites and testing of mitigation and remediation options.[46]

Polar research:

Funding of bilateral joint projects with the United Kingdom as part of scientific and technical cooperation in marine and polar research: Investigation of the impacts of future change on biological and biogeochemical processes, productivity, species distributions, food chains and ecosystems in the North Atlantic.[47]

Funding of grants for scientific data analysis of the MOSAiC Arctic expedition: The sharp decline in sea ice extent, thickness and volume has resulted in a new condition termed the "New Arctic", where winter ice is predominantly no more than one year old. In order to understand this new climate state and its future development, the Atmosphere Working Group of the International Arctic Science Committee (IASC) launched a large-scale international measurement campaign in 2011 with a focus on atmosphere-ice-ocean interaction processes in regional climate models. The core of this campaign entitled the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) is an intensive year-long programme of observations and measurements in which the German Polarstern research icebreaker serves as the third station. The focus of the research work is the use and evaluation of measurement data from the MOSAiC expedition in close cooperation with the MOSAiC consortium.[48]

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42 https://deutsche-kuestenforschung.de/

43 https://www.kfki.de/en

44 https://www.ptj.de/projektfoerderung/mare-n/klimaaenderungen and https://www.projektfoerderung-geo-meeresforschung.de/kuesten-meeres-und-polarforschung

45 https://www.jpi-oceans.eu/ and https://www.jpi-oceans.eu/en/joint-call-proposals-microplastics-marine-environment

46 https://www.jpi-oceans.eu/ and https://www.jpi-oceans.eu/en/miningimpact

47 https://www.ptj.de/projektfoerderung/wtz/wtz-grossbritannien and https://www.projektfoerderung-geo-meeresforschung.de/wtz

48 https://www.ptj.de/projektfoerderung/mare-n/mosaic

3.1.6. Knowledge and technology transfer tools as part of the High-Tech Strategy

Budget chapters and items:	**3004 683 10**					
Eligible expenditures 2020:	**€2.7 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**33 funded projects**					
Funding share:	**33%**					
	As a rule, the project duration is 3 years, hence the funding share is stated as 33%. Third-party financing is not taken into account.					
EU environmental objectives	a)	b)			e)	
Assumptions and limitations: --						
Links: https://www.forschungscampus.bmbf.de/homepage						

The eligible expenditures of the budget item serve the two research campuses Flexible Electrical Networks (FEN) and Mobility2Grid. A total of 33 projects have been funded. Further impact indicators are not available.

FEN (€1.0 million in eligible expenditures, 12 projects)

In order to manage the energy transition efficiently and sustainably, it is necessary to research and develop innovative technologies for future electrical grids with a high proportion of renewable and decentralised energy sources. The Flexible Electrical Grids (FEN) research campus is taking up this challenge and thus making an important contribution to a sustainable, secure and affordable energy supply. The transdisciplinary research focuses on the development and integration of DC voltage technology. In addition to technological issues, questions of social acceptance as well as biological, ecological, urban planning and economic aspects are also taken into account.[49]

Mobility2Grid (€1.7 million in eligible expenditures, 21 projects)

The Mobility2Grid research campus investigates the integration of decentralised grid, information and transport structures in urban areas. Public institutions, networks and the public also participate. In total, over 30 different institutions and companies are involved in the Mobility2Grid living lab on the EUREF site.[50]

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[49] https://www.forschungscampus.bmbf.de/forschungscampi/flexible-elektrische-netze/

[50] https://www.forschungscampus.bmbf.de/forschungscampi/mobility2grid

3.1.7. Social sciences for sustainability

Budget chapters and items:	**3004 685 43**					
Eligible expenditures 2020:	**€36.1 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**430 beneficiaries**					
	430 projects					
Funding share:	**33%**					
	As a rule, the project duration is 3 years, hence the funding share is stated as 33%. Third-party financing is not taken into account.					
EU environmental objectives	a)	b)	c)	d)	e)	f)
Assumptions and limitations: --						
Links: https://www.fona.de/en/topics/society.php						

The eligible expenditures of the budget item are distributed among the programme areas as follows.

Names of the programmes or examples in the budget item	Eligible expenditures (in € million)	Number of beneficiaries and projects
Systemic approaches for sustainable urban mobility	4.2	82 beneficiaries 82 projects
Social-ecological junior research groups	8.4	49 beneficiaries 49 projects
Social-ecological research and economics	23.5	299 beneficiaries 299 projects

Examples of funded projects:

Mobility
Commuter numbers in Germany have continued to rise in recent years, with widely known consequences for the climate, the environment, health and quality of life, particularly in cities with large inbound commuter flows. The PendelLabor ("CommuterLab") research project investigates how sustainable urban-rural commuter mobility could look in the future, using the Frankfurt Rhine-Main region as an example. Commuting is currently regarded as given, and action has only been taken to mitigate the symptoms. However, a deeper understanding of the complex interrelationships is needed. Suitable measures can then be developed and implemented for commuters, local authorities and companies to make commuting more compatible with social and environmental priorities. In the living lab, the everyday commutes of a diverse cross-section of participants are monitored and analysed. Numerous factors influence commuting, including the availability of local amenities and childcare, the digitalisation of the workplace and developments in the housing market. The final results of the research, such as obstacles and success factors for sustainable commuting, will be presented to public authorities and policymakers as recommendations for action.[51]

Sustainable urban development
"Stadtgrün wertschätzen" ("Valuing Urban Green") is an interdisciplinary and transdisciplinary project which aims to develop a science-based tool to map and monetarise the benefits of urban greenspace

[51] https://pendellabor.de/

in mitigating climate change. The tool would make it possible to run scenarios starting from the status quo and, for example, increasing (or reducing) the number of street trees and greenspace as a percentage of the total urban area. The impacts of the scenarios are quantified and priced in relation to the various urban ecosystem services.

Application of the tool at district or neighbourhood level has been tested using model projects in Leipzig, Karlsruhe and Berlin. Following project completion, the tool will be available to all major German cities with a population of more than 300,000. The user-friendly online platform enables administration staff, policymakers and interested members of the public to access the database and easily run scenarios. In this way, the tool serves information, awareness raising and environmental education purposes, supporting various stakeholders in the development, improvement and also defence of urban greenspaces.[52]

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[52] https://www.stadtgruen-wertschaetzen.de

3.2. Environmental protection, nature conservation and climate change adaptation

3.2.1. Research, studies, etc. [in the area of climate and environmental protection]

Budget chapters and items:	**1601 544 01**					
Eligible expenditures 2020:	**€52.1 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**625 ongoing projects in 2020**					
	of which 151 started in 2020					
Funding share:	**N/A**					
EU environmental objectives	a)	b)	c)	d)	e)	f)
Assumptions and limitations: --						
Links: Report on the Environmental Research Plan: https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Forschung/ressortforschungsplan_gesamt_2020_bf.pdf Final reports of all research projects can be found at: https://www.bmuv.de/ministerium/forschung/forschungs-und-entwicklungsberichte						

Environmental policy action, the development of strategies and concepts, the assessment of environmental impacts and substance risks and the observation of social, economic and technological trends all require a solid science-based decision-making foundation. Environmental rules and regulations have to be reviewed and revised, and ongoing environmental programmes and approaches accompanied by research. Bridging the gap between science and policymaking, the research conducted or commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) made a significant contribution in this respect in 2020. This research is generally geared towards supporting the Ministry and its higher federal authorities in their tasks.

The departmental research included in the Green German Federal securities is divided into the areas of **climate and environmental climate protection** (**1601** 544 01) and **nature conservation** (**1604** 544 01).

The eligible expenditures of the Research, studies etc. [in the area of climate and environmental protection] budget item (1601 544 01) are spread across the following 12 research areas. The main research fields are described below the table. Further descriptions of the research areas can be found in the linked BMU Environmental Research Plan 2020.

Name of research area	Number of planned new projects in 2020
Climate change mitigation	16
Climate change adaptation	10
International environmental protection – further development of the climate regime	8
Resource efficiency/circular economy	15

Name of research area	Number of planned new projects in 2020
Environment and the economy, sustainable product and consumer policy	14
Groundwater, water, soil and marine conservation	16
Clean air/environmentally friendly technologies/noise control/environmental requirements for the mobility transition	27
Environment and health	10
Substance risks	13
Urban environmental protection – sustainable land management	7
Environmental aspects of the energy transition	5
Cooperation with social groups/cooperation partners and intersecting environmental policy issues	10

Brief descriptions of the main research fields:

Climate change mitigation

One area of research relating to climate change mitigation targets the development of innovative climate finance instruments. Research is also being conducted into the implementation of measures in the energy sector and into various policy areas (such as structural policy and agricultural policy) from a climate change mitigation perspective. Conceptual and technical issues are also important, as are institutional aspects of carbon market development.

Climate change adaptation

Research in the field of climate change adaptation aims to help increase the climate resilience of our society. Specifically, management tools for mitigating climate risks in government and business are studied and adaptation measures derived. This relates in particular to areas such as soil biology, soil unsealing, flood control, stormwater preparedness and low water risk management. Research is also carried out into the impacts of climate change on water availability and groundwater replenishment.

Resource efficiency/circular economy

The BMU's research in the field of resource efficiency contributes to the transition to a circular economy. This research includes the development of tools to boost the recycling of building products and the use of recycled materials, the development of strategies for the recycling of fibrous plastics, the development of approaches for waste prevention and for the management of individual waste streams, technology transfer and the digital transformation.

Environment and the economy, sustainable product and consumer policy

Environmental protection and climate action policy instruments also have an impact on the economy and consumers. For this reason, the BMU investigates measures for making the social market economy more environmentally sustainable. This includes identifying and evaluating environmentally harmful subsidies and developing environmental policy control instruments as economic incentives to promote environmental innovations. In addition, strategies and instruments are investigated for the efficient export and transfer of environmental technologies and environmental innovations abroad (including the Environmental Technologies Export Initiative). The research also contributes to knowledge transfer, for example by developing practical tools for the implementation of the European Eco-Management and Audit Scheme (EMAS), corporate social responsibility (CSR) and environmental and sustainability reporting in companies, local authorities and other organisations.

Groundwater, water, soil and marine conservation

Water bodies are complex and fragile ecosystems. It is therefore essential to understand the pathways by which chemicals and undesirable microorganisms are introduced, as well as detection methods and emission requirements. Measures for sustainable use of water bodies can only be established on the basis of sound knowledge.

Soils are the foundation and a central component of terrestrial ecosystems and their biodiversity. They are a vital, non-renewable natural resource providing numerous ecological services. Key challenges include safeguarding the ecological services provided by soil and remediating contaminated sites. Research needs to be carried out in this context into the effects of climate change and globalisation and also into legal developments.

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3.2.2. Investments to reduce pollution [environmental innovation programme, Germany]

Budget chapters and items:	**1601 892 01**					
Eligible expenditures 2020:	**€14.8 million**					
GHG emission reduction:	**See project list**					
Other indicators:	**79 ongoing projects in 2020**					
	of which 14 projects newly approved in 2020					
	Resource saving: see project list					
Funding share:	**The projects were co-financed in the amount of €4.7 million in 2020 from budget item 6092 686 23, National Climate Action Measures**					
EU environmental objectives	a)	b)	c)	d)	e)	
Assumptions and limitations: See footnotes to project list						
Links: https://www.umweltinnovationsprogramm.de/						

Since 1979, the Environmental Innovation Programme has helped companies to put innovative, environmentally friendly technologies into practice and to demonstrate that industrial processes and production can combine environmental and economic interests. A total of 791 projects have been funded since the programme's inception. In the last 12 years alone, the funded projects have saved a total of around 2.0 million tonnes of CO_2e.[53]

A total of 79 projects were funded in 2020. Of these, 14 were newly approved and feature in revenues and expenditures, as listed below.

Project name	Brief description Links (click on the description to visit the website)	Eligible expenditures (in € million)	Estimated savings from project	Duration
SERAPLANT GmbH	**Production of phosphate fertiliser from sewage sludge ash (Seraplant process)**	2.63	N/A	2019 – 2022
Papierfabrik Palm GmbH & Co. KG	Investment in a line for the production of ultra-lightweight corrugated base paper with a basis weight of 60 grams per square metre using a new paper machine with innovative drying technology.	1.82	9,800 t CO_2 p.a.[54]	2019 – 2021
SUMTEQ GmbH	Resource-efficient production of high-performance nanocellular polystyrene insulation using supercritical CO_2	1.38	10,000 t CO_2 p.a.[55]	2020 – 2022
Neumann-Transporte und Sandgruben GmbH	**Process water recycling – innovative process water treatment plant**	0.55	1,728 t CO_2 p.a.	2019 – 2027

[53] As at 9 December 2022

[54] CO_2 reduction estimated for assumed production output of 700,000 t of paper per year.

[55] Estimated CO_2 reduction at full capacity.

Project name	Brief description Links (click on the description to visit the website)	Eligible expenditures (in € million)	Estimated savings from project	Duration
Superior Industries Production GmbH	**Resource-efficient manufacture of light alloy wheels**	0.33	597 t CO_2 p.a. 163 t waste 148 t of solvents	2020 – 2022
Mitsubishi Chemical Advanced Materials GmbH	**Special extrusion process for semi-finished medical products (EXT4Med)**	0.14	400 t CO_2 p.a.	2020 - 2024
S&S Scheftner GmbH	**Highly efficient production of non-precious-metal alloy powders for medical engineering applications**	0.03	N/A	2020 – 2023

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3.2.3. Research, studies, etc. [in the area of nature conservation]

Budget chapters and items:	**1604 544 01**					
Eligible expenditures 2020:	**€13.1 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**60 projects newly committed in 2020**					
Funding share:	**N/A**					
EU environmental objectives						f)
Assumptions and limitations: --						
Links: Report on the Environmental Research Plan: https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Forschung/ressortforschungsplan_gesamt_2020_bf.pdf Final reports of all research projects can be found at: https://www.bmuv.de/ministerium/forschung/forschungs-und-entwicklungsberichte						

Environmental policy action, the development of strategies and concepts, the assessment of environmental impacts and substance risks and the observation of social, economic and technological trends all require a solid science-based decision-making foundation. Environmental rules and regulations have to be reviewed and revised, and ongoing environmental programmes and approaches accompanied by research. Bridging the gap between science and policymaking, the research conducted or commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) makes a significant contribution in this respect. This research is generally geared towards supporting the Ministry and its higher federal authorities in their tasks.

The departmental research included in the Green German Federal securities is divided into the areas of **climate and environmental climate protection** (**1601** 544 01) and **nature conservation** (**1604** 544 01).

The eligible expenditures of the Nature Conservation budget item (1604 544 01) are distributed among the following programme areas. Three major areas are described below by way of example. Further descriptions of the research areas can be found in the linked BMU research report.

Name of research area	Number of planned new projects in 2020
Fundamental issues of nature conservation policy	2
Methodologies and instruments for the protection and sustainable use of nature and biodiversity	8
National and international species conservation	12
National and international protection of ecosystems and habitats	6
Integration of nature and biodiversity into other policy areas	15
Nature conservation and society	6
Nature conservation research accompanying the energy transition	11

Brief descriptions of the main programmes:

Fundamental issues of nature conservation policy

Research on fundamental issues of nature conservation policy supports, among other things, the implementation of the National Strategy on Biological Diversity. The economic value of ecosystems, ecosystem services and biodiversity is investigated and a relationship established with environmental economic accounting. In this way, the value of nature is taken into account in value creation. Support is also provided for international bodies, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

Methodologies and instruments for the protection and sustainable use of nature and biodiversity

Methodology development activities mainly focus on the development and testing of additional elements of a comprehensive biodiversity monitoring system. Landscape planning and Habitats Directive assessment instruments are improved and green infrastructure proposals operationalised. Research is conducted into the nature-friendly use of floodplains and peatlands, and instruments are developed for the recording, protection and development of urban nature.

National and international species conservation

In the area of national and international species conservation, the BMU's departmental research focuses on insect populations and distributions, the causes of insect die-off and insect conservation measures. Internationally, it also contributes to the improvement of instruments for implementing the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and to EU dossiers on subjects such as dealing with invasive species.

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3.2.4. Subsidies for organisations in the areas of environmental protection and nature conservation

Budget chapters and items:	**1601 685 04**					
Eligible expenditures 2020:	**€10.4 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**N/A**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)	c)	d)	e)	f)
Assumptions and limitations: The heterogeneity of the funded programmes does not allow for aggregation.						
Links: --						

The purpose of this budget item is to fund organisations, including support for standardisation activities, funding projects in the areas of chemical hazard assessment, environmental awareness and environmental action, and institutional funding for the German League for Nature and Environment (DNR) as the umbrella organisation and for the Association of German Engineers (VDI) for the VDI/DIN Clean Air Commission (KRdL).

The eligible expenditures of the budget item are mainly distributed among the following programme areas. Representative examples are described below.

Programme name	Eligible expenditures (in € million)
German League for Nature and Environment (DNR)	1.9
Support for standardisation activities	1.7
Projects to identify and assess chemicals in need of regulation	0.5
Environmental protection and nature conservation projects by associations	4.7
Association of German Engineers (VDI) for the VDI/DIN Clean Air Commission (KRdL).	1.5

Project: Health Care Without Harm Europe (HCWH): Combating the emergence of antimicrobial resistance (AMR) and its proliferation in the environment[56]

The aim of the project is to minimise the release of pharmaceuticals into the environment and to combat the proliferation of antimicrobial resistance (AMR). In particular, it aims to support the development of an improved EU strategy for reducing pharmaceutical pollution. This has included targeted action to limit human medicine residues in the environment and the proliferation of AMR. Dialogue with policymakers enabled recommendations to be incorporated in the EU pharmaceutical strategy. Members of the European Parliament have been recruited as ambassadors. Recommendations on the responsible use of antimicrobials have been developed for food producers. Reports in the European media and a social media campaign during World Antibiotic Awareness Week raised public awareness of AMR.

[56] https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/bekaempfung-der-entstehung-von-antimikrobieller

Project: NAHhaft e.V. – Exchange and networking on niche innovations in Europe for transformation of the food system

The primary goal of the project was to facilitate an exchange between those involved in European niche innovation projects in the food system and target groups in Germany, in order to support the transfer and dissemination of European niche innovations via civil society and the economy into the mainstream of the German food system. Those targeted by the project included representatives from German associations, societies, companies, foundations, journalists and members of the general public.

To achieve this objective, a three-day online congress was organised, bringing together a total of 40 experts from various countries, including practitioners and academics. The congress attracted more than 700 participants from across Europe and beyond, who took part in a total of 12 sessions in varying formations. The outcome of the congress was a collaboratively developed final declaration.

A forum and the congress website were established to provide ongoing opportunities for information gathering and networking beyond the project's duration. An additional website, "Plattform Ernährungswandel" ("Food System Transformation Platform"), serves as a long-term resource pool for participants, allowing them to continue exchanging ideas and fostering connections, and providing free access to the congress materials.

Project: ReUse e.V. – Reuse of white goods

This project aims to increase the reuse of large household appliances in Germany and break new ground in the collection of large household appliances with new business models between retailers and repair workshops in cooperation with manufacturers.[57]

In an initial phase, the project designed a scalable take-back and remarketing system and tested it in pilot implementations. Unused potential was identified through an integrated view of the value chain and initial business models selected for the various groups involved.

The focus on the next phase is on scaling up the project to the whole of Germany and using promotion campaigns to raise awareness among consumers, retailers, policymakers and manufacturers with regard to the economic environmental improvements that can be achieved with the refurbishment, repair and reuse of white goods.

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[57] https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/weisse-ware-wiederverwenden

3.2.5. Funding of climate change adaptation measures

Budget chapters and items:	**1602 685 05**					
Eligible expenditures 2020:	**€5.8 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**182 funded projects**					
Funding share:	**N/A**					
EU environmental objectives		b)				
Assumptions and limitations: --						
Links: https://www.bmuv.de/programm/foerderung-von-massnahmen-zur-anpassung-an-die-folgen-des-klimawandels						

The budget item is primarily used for two funding programmes that each target different stakeholders.

Programme to fund climate change adaptation measures (137 funded projects)
The programme is for the implementation of the German Strategy for Adaptation to Climate Change (DAS). Funding is primarily provided for local and local-authority players, and additionally associations, medium-sized companies and educational institutions in the following funding priorities:

- **A. Initiating local-authority adaptation management**
- **B. Innovative model projects for climate change adaptation**

The programme addresses urgent action areas by funding local-authority adaptation management and innovative model projects for climate adaptation. Grants of up to €275,000 are available in each case for the first area and of up to €500,000 for the second. In the case of innovative model projects (funding priority B), the funding programme prioritises outcomes that are readily transferable to similarly affected regions and actors.

Climate adaptation in social institutions (AnpaSo funding programme; 41 funded projects**)**

The "climate adaptation in social institutions" funding guidelines are intended to make it possible to address and implement necessary climate adaptation processes in the health, nursing care and social sectors. The aim is to stimulate transformation in the sector by funding model projects that inspire others. Projects are intended to have an impact primarily in climate hotspot regions. Funding is provided as follows:

- **Funding priority 1:** Development of sustainable climate change adaptation strategies
- **Funding priority 2:** Implementation of model climate change adaptation projects based on climate change adaptation strategies
- **Funding priority 3:** Intersectional support provided by social sector climate change adaptation officers (staff funding)

The overall focus is on nature-based solutions. This is intended to generate synergies and positive side-effects in relation to the objectives of the German Sustainable Development Strategy resulting in improvements in environmental sustainability and quality of life. In addition, the institutions granted funding are intended to disseminate the model projects beyond the region as best practice examples and encourage their replication elsewhere.

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3.3. Aerospace, energy, transport and digitalisation

3.3.1. Hybrid electric aviation

Budget chapters and items:	**6092 683 05**					
Eligible expenditures 2020:	**€4.7 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**64 projects**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: The projects normally have a minimum duration of 3¼ years but may be extended in individual cases if it increases the likelihood of achieving the project objectives. No project outcomes are yet available as project funding began during 2020.						
Links: --						

Funding objective

Funding is provided for R&D projects with the aim of producing low-emission and, in the medium to long term, zero-emission (carbon-neutral) aircraft. Engineering solutions are to be developed for an aircraft that emits zero pollution in flight or on the ground. This aligns aviation to the Renewable Energy Directive (RED II), the Paris Agreement and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) for sustainable mobility in air transport. The path to zero-emission aviation will require substantial investment and major research effort for technologies in all areas. From the present perspective, technologies for zero-emission (long-haul) aircraft that are capable of type approval can be developed by 2050. Market penetration to the point of complete fleet renewal requires huge industrial effort.

A key focus is the development of electric propulsion systems for primary flight power. Electric propulsion systems obtain electrical energy from batteries, fuel cells or a combination of the two. Fuel cells are intended to run on zero-emission “green” hydrogen. The next major technological challenge is the technology for storing sufficient quantities of hydrogen. Liquid hydrogen has to be kept at the extreme temperature of −256 °C or under the enormous pressure of 700 bar. Integrating such a technically demanding tank system into conventional aircraft wings is out of the question. To ensure that the new propulsion system is not developed at the expense of functional aspects, special new aircraft configurations are needed to match the specific system characteristics. Deliberate use is made of design flexibility to enable good integration of the new technologies into the overall system. As a result, all subsystems have to be redeveloped for the new propulsion system. The wide variety of different transportation roles performed by aircraft does not allow for a single zero-emission technology for all aircraft types. Each range of applications calls for specific solutions. In the urban air mobility and short-haul segments, battery-electric propulsion approaches are seen as having the best chance of implementation. Fuel cells running on hydrogen are the option of choice for regional flights. Hybrid systems are expected to be used in aircraft classes up to and including medium-haul. These are a combination of hydrogen, fuel cell and synthetic fuel. In extreme situations such as take-off and landing, high-energy power-to-liquid (PTL) synthetic fuels will be indispensable. To make long-haul operations carbon-neutral, these will be largely based on PTL fuels for some time to come.

Target achievement and funding efficiency

The promotion of hybrid-electric aviation is part of the National Hydrogen Strategy (Measure 27) and the 2020 stimulus package (Item 36).

Outcomes of the aeronautical research programme are already leading to massive carbon savings, both in operations (through improvements in propulsion technology and aerodynamics) and by way

of adjustments to air traffic routing. Hybrid-electric propulsion technologies combined with alternative fuels or fuel cells, and also hybrid-electric structures (cabin supply including avionics and emergency power supply) are contributing significantly to additional carbon emission reductions. Further research efforts are essential, however, in order to achieve the climate targets.
The funding measure combines climate change mitigation with industrial policy goals. It strengthens Germany as an aviation hub and opens up the opportunity for the German aviation industry to enhance its competitiveness with innovative, low-emission, climate-friendly technologies and to tap into new export markets. There is consensus in the aviation sector that disruptive technologies such as hybrid-electric flight will be crucial for achieving the ambitious goal of a further significant reduction in emissions or even of zero emissions in short and medium-haul aviation. The measure also contributes to achieving the ambitious emission reduction goals adopted in the Flightpath 2050 research and innovation strategy jointly developed by the European Commission and the aerospace industry. This targets a 75% reduction in CO_2 emissions and a 90% reduction in NO_x emissions per passenger kilometre (pkm) by 2050 (relative to 2000).

Given the complex and ambitious development efforts and the development risk involved, the adoption of hybrid-electric technologies for aircraft will take place over the medium term. For flights crossing German airspace alone, it is estimated that technical innovations will result in GHG emission reductions of around four million tonnes annually by 2040 (based on the European Aviation Environmental Report 2019). The dynamic evolution of new technologies with the objective of low-emission or even zero-emission aviation will deliver further significant reductions. The ultimate GHG reduction impact directly depends on the entry into service (EIS) of future new aircraft and how quickly airlines replace existing aircraft.

As innovations in the field of hybrid-electric aviation are expected to quickly penetrate export markets, even greater savings can be expected on a global level. The first projects being carried out in collaboration between industry, large-scale research institutions and universities are paving the way for zero-emission aviation in Germany.

As the measure only started in 2020, it is not possible to quantify any GHG emissions for the reporting period. The developed technologies will only reach industrial scale and penetrate the market gradually over years to come.

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3.3.2. German Aerospace Center (DLR) – operation and investments

Budget chapters and items:	**0901 685 31 and 0901 894 31**					
Eligible expenditures 2020:	**€439.9 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**280 projects**					
	1,283 cited scientific publications					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: The sustainability effects of research and development projects are not directly quantifiable or scalable for the entire sector, notably because the utilisation of research results is uncertain at the time of expenditure.						
Links: https://www.dlr.de/en 2021 Federal Government Report on Energy Research: https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/federal-government-report-on-energy-research-2021.html						

In its research fields of aerospace, energy, transport and digitalisation, the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt) conducts research into a range of topics that contribute to the federal government's climate goals.

- Aviation: Climate research with impact assessments; eco-efficient production methods with circular economy methods; climate-efficient and climate-neutral fuels and propulsion systems; climate-optimised air traffic routing; designing ultra-efficient aircraft; and noise reduction through optimised flight procedures, aircraft designs and technologies
- Aerospace: Earth observation satellites to quantify biomass and emissions (e.g. CO_2 and methane); completing material cycles; emission prevention in space travel; green/new forms of fuel: future fuels; battery development in the DLReps project; solar panels with supercapacitors (HySeS); hydrogen handling, storage and tanks
- Energy: Solar and wind energy generation; green hydrogen and other synthetic sustainable fuels; energy storage and transportation; decarbonising industry; system analyses and sector coupling to optimise energy systems
- Transport and digitalisation: Development of new mobility strategies focused on climate action and resource conservation; decarbonising transport through the integration of new drive systems and renewable energy in vehicles and the transport system; digitalisation of mobility through automation and "mobility as a service" concepts to protect resources and reduce land take

Examples of projects from the aviation sector
DEPA2050 project: Development Pathways for Aviation up to 2050

The Development Pathways for Aviation up to 2050 (DEPA2050) project was dedicated to the definition and impact assessment of long-term scenarios for the development of aviation (pre-Covid-19) up to 2050. In addition to aircraft types with conventional propulsion technology, the project also focused on disruptive technologies (such as hybrid-electric and hypersonic aircraft). To this end, system and trend analyses were carried out on factors both extraneous and intrinsic to aviation, in particular in the areas of air transport technology/the air transport market, alternative fuels, maintenance and air traffic management. These factors were then used to quantify two technology scenarios: a conservative-evolutionary and a progressive scenario. In combination with demand

forecasts for all aircraft segments in passenger air travel, the long-term impacts were quantified with regard to the objective of demand-driven yet resource-efficient aviation. By its completion, the project showed clear technological potential for the environmental dimension, but also room for improvement in order to achieve the targeted climate neutrality of aviation by 2050. While the relative CO_2 emissions per passenger kilometres decreased significantly in all scenarios, they increased in absolute terms due to the projected growth in air travel. Offsetting this necessitates further technological advances and greater use of alternative fuels.

ECO2Fly project: Sustainable Aviation Fuels (SAF) for climate-friendly air transport – first in-flight measurements in the wake of an A350 with 100% biofuel, by DLR, Airbus, Rolls-Royce and Neste

Sustainable aviation is not just a vision for 2050. Aviation can already be made significantly more climate-friendly in the nearer future. Particulate matter and contrails are a key focus here, as contrails warm the atmosphere far more than the total carbon dioxide emitted by aircraft. Past DLR-NASA measurements showed that when jet fuel blended with clean biofuel is combusted, soot particle emissions are halved, fewer ice crystals form and contrails have a significantly smaller impact on the climate. On top of this direct positive atmospheric effect, SAFs also have a smaller carbon footprint as they are made from regenerative resources. The question was whether even greater positive environmental effects could be achieved with 100% SAF. However, only up to 50% SAF may be added to jet fuel today, whereas running an aircraft on 100% biofuel requires the manufacturer's express approval. The ECLIF3-ECO2FLY project therefore aimed to obtain certification for a large passenger aircraft – an Airbus A350 – for operation with 100% biofuel from fuel producer Neste, to test the Rolls-Royce engines on the ground and in flight and, in a world first, to measure the emissions from 100% SAF with the DLR Falcon as a chaser craft. In this the project was successful: the A350 was certified for use with 100% SAF and the effect of engine parameters on emissions measured in ground tests. During two aircraft test campaigns in April and November 2021, the Falcon completed nine flights over the South of France as a chaser aircraft behind the A350. The engines were fed alternately with SAF free of aromatics and with conventional jet fuel, and the exhaust stream and contrails sampled at intervals of 100 m to 20 km. Taking measurements in the turbulent exhaust stream and contrails is highly demanding and calls for great skill from the pilots and the team. DLR experts are currently evaluating and analysing the data. The initial results are promising and indicate positive atmospheric and air quality effects of SAF in the vicinity of an airport. As a direct technology transfer, the findings will be used by the industry for the climate-friendly design of the future aviation fleet.

EXACT project: DLR contribution towards zero-emission aviation

The EXACT project contributes significantly to zero-emission aviation through the design and life-cycle assessment of high-efficiency aircraft. Applying the necessary breadth of expertise and scientific depth, the project explores the potential of approaches with various different forms of propulsion and fuels. Alongside correctly modelling and integrating the various technology components at vehicle level, a key part of the project is the economic and environmental life cycle assessment of the technology impacts. In this context, the project team views the aircraft as an integral part of the entire complex air transport system. As well as the production, operation, maintenance and end-of-life impacts of the aircraft itself, full account is also given to the production and supply of the various fuels, including the associated infrastructure. In total, 12 promising aircraft configurations were identified and designed, including various innovative technology components. A number of proposals and the life-cycle assessment process chain serve as a blueprint for activities planned in the European Clean Aviation Initiative. Based on the initial results, intensive exchange with industry and research partners is underway with a view to further studies. The concept aircraft designs from the project are used internally at DLR and also far beyond.

Examples of projects from the aerospace sector
CO2Mon project and CO2Image Phase A study

In February 2020, the CO2Image spectrometer instrument was selected for Phase A of the DLR Compact Satellite Programme. The aim of the study is to build an instrument to identify and quantify CO_2 point sources. DLR is also developing additional payloads for active and passive monitoring of CO_2 emissions from space. This requires high-accuracy measurement of atmospheric CO_2 concentrations on a global basis with high temporal and spatial resolution.

Polar Monitor project

Global observation and quantification of changes in snow cover, mass balances, glacier and ice sheet flow rates and the position of ice shelf edges/glacier grounding lines. These processes directly affect sea level rise, water availability and the global radiation budget.

FireBIRD project

Operation of the FireBIRD mission for identification of high-temperature events (primarily wildfires). Large forest fires release CO_2 in huge quantities. Climate change is also a significant risk driver in this connection. The FireBIRD mission formally ended in December 2020.

Reusability in space transportation: the Amadeus, ReFEx and STORT projects

Introducing reusable space transport systems not only has huge cost-cutting potential, but also reduces the environmental impact (circular economy). DLR is therefore researching various technologies for the return of space transport systems. The AMADEUS project looks at components such as the combustion chamber and nozzle. ReFEx is intended to test return flight control in the hypersonic to transonic range. STORT is focused on the management of thermal loads on return flights of launcher stages.

Future Fuels project

The development of future space propulsion systems is no longer solely driven by the desire for higher performance, but increasingly also by secondary requirements such as easy handling and storage, reduced toxicity, improved handling safety and low environmental impact. With this in mind, the project investigates methane/oxygen, liquid nitrous oxide/hydrocarbon blends and green gel propellants.

Examples of projects from the energy sector
HiFlex project: Solar energy for sustainable pasta production

In the HiFlex project, an international team of scientists and engineers is building a pilot plant to provide a pasta producer with a sustainable energy supply. Based on a solar power tower, the plant will generate a reliable round-the-clock supply of electricity and heat from solar energy for the production process. In a receiver developed and patented by DLR, ceramic particles are heated by the sunlight concentrated by mirrors. The particles have high heat resistance and are also inexpensive, environmentally friendly and easy to store. When needed, the heat is used to generate steam for an electricity generator or hot gas for industrial process heat. The cooled particles can then be returned to the receiver and reheated. When there is too little solar radiation, the energy needs can be met with electricity from wind turbines or solar panels or from renewable fuels. DLR is supporting the project with its extensive knowledge in the field of concentrating solar radiation, steam generators and materials.

Hydrogen study

Hydrogen is one of the key elements for the defossilisation of the power and heat sector, transport and industry. DLR is involved along the entire process chain, from production and storage to the use of hydrogen. Based on its broad expertise, DLR has investigated the potential of green hydrogen as an

energy carrier for a climate-neutral energy system in a two-part study. The study identifies success factors for the successful establishment of hydrogen and recommends research priorities. Technologies are presented alongside perspectives for a sustainable and economical hydrogen supply. The study also addresses the great potential of hydrogen for sector coupling.

CoBra[58]

Reducing carbon dioxide emissions while continuing to provide heating and cooling for industry presents a major challenge. The DLR Institute of Low-Carbon Industrial Processes is working on technologies and solutions for an energy system of the future which is sustainable and in which industrial facilities can manage without fossil fuels in their production. It is making a major contribution to the heat energy transition in industry with the new Cobra pilot plant. CoBra is a high-temperature heat pump. Its name is a combination of Cottbus, the city in Brandenburg where it will begin operating in autumn 2022, and the Brayton thermodynamic cycle on which it is based. CoBra works with dry air and consequently offers an alternative to fossil fuels. It has the potential to enable massive CO_2 reductions. With temperatures of up to 300 °C, it supplies heat in a temperature range that meets the process heat requirements of many industrial sectors but for which there has previously been no viable technical solution.

PEGASUS/BaSiS[59]

Effective and economical long-term storage of solar energy is essential if fossil-fuelled power plants with annual operating times in excess of 6,000 hours are to be fully replaced with renewable energy sources. In this context, the two European research projects PEGASUS and BaSiS are investigating a novel process for electricity generation that combines concentrated solar power (CSP) with sulphur as a thermal energy storage medium. This makes it possible to decouple electricity generation in terms of time and place from the availability of solar radiation and provide round-the-clock baseload power throughout the year.

Example of a project from the transport sector

Next Generation Train project

Air conditioning systems in trains play an important role in the mobility transition in passenger transport. As such systems account for between 35% and 50% of total energy consumption, DLR researchers are working to optimise them in the Next Generation Train project. Considerable energy savings are enabled by new ventilation concepts combined with single-seat air conditioning based, for example, on infrared panels. This also improves passenger comfort and significantly reduces the transmission of germs and pathogens via interior air currents in passenger compartments. Rail travel is made more attractive as a result.

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58 Case study 11 in the 2021 Green Bond Investor Presentation, slide 45: https://www.deutsche-finanzagentur.de/fileadmin/user_upload/Institutionelle-investoren/green/presentations/Green_Bond_Investor_Presentation_2021_II.pdf.

59 Case study 10 in the 2021 Green Bond Investor Presentation, slide 44: https://www.deutsche-finanzagentur.de/fileadmin/user_upload/Institutionelle-investoren/green/presentations/Green_Bond_Investor_Presentation_2021_II.pdf.

3.3.3. Maritime technologies – research, development and innovation

Budget chapters and items:	**0901 683 12**					
Eligible expenditures 2020:	**€9.9 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**289 beneficiaries**					
	467 projects					
Funding share:	**33%**					
EU environmental objectives	a)				e)	
Assumptions and limitations: As a rule, the project duration is three years, hence the funding share is stated as 33%. Third-party financing is not taken into account.						
Links: https://www.ptj.de/projektfoerderung/maritime-forschungsstrategie-2025/maritimes-forschungsprogramm						

Under the funding announcement for the Maritime Research Programme, which entered into force on 1 January 2018, the Federal Ministry of Economic Affairs and Energy (BMWi) funds research and development projects with applications in the maritime sector in Germany.

The Maritime Research Programme[60] provides strategic support to the German maritime industry in securing its technological leadership and international competitiveness and in enhancing its ability to contribute to the achievement of Germany's environment policy goals. Part of the research programme includes eligible green expenditures. Under the MARITIME.green funding priority, for example, innovative technologies are being developed in the areas of alternative fuels, energy systems, emission reduction and increased energy efficiency. The goal of the MariData[61] project, as another example, is to develop integrated technology solutions for ship energy management. The focus here is on reducing the fuel consumption of ship propulsion systems, as these are usually responsible for most of the energy consumption on merchant ships.

This funding priority also covers research into ammonia, methanol and hydrogen as future maritime fuels, innovative energy management systems, and battery and fuel-cell-based energy systems.

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[60] Funding announcement of 1 January 2018: https://www.bmwk.de/Redaktion/DE/Downloads/B/bekanntmachung-zur-foerderung-von-forschung-entwicklung-und-innovation.pdf?__blob=publicationFile&v=4

[61] Case study 2 in the 2021 Green Bond Investor Presentation, slide 36: https://www.deutsche-finanzagentur.de/fileadmin/user_upload/Institutionelle-investoren/green/presentations/Green_Bond_Investor_Presentation_2021_II.pdf.

4. Energy and industry

In order to achieve its climate targets, Germany is undergoing an energy transition. The energy and industry sector covers measures to accelerate the transition to an economy based largely on renewable energy sources and to an eco-efficient use of energy and resources. Energy and industry are responsible for the majority of Germany's total emissions[62]:

- The industrial sector was responsible for around 24% of total emissions in 2021. This corresponds to 184 million tonnes of CO_2 equivalents. Compared to the previous year, industrial greenhouse gas emissions increased by 4.3% or 7.6 million tonnes of CO_2 equivalents. This largely reflects economic catch-up effects following the Covid-19 crisis with a disproportionately large recovery in energy-intensive sectors.
- The energy industry is responsible for the largest share of emissions in Germany, at 32%. In 2021, its greenhouse gas emissions amounted to 245 million tonnes of CO_2 equivalents. The greenhouse gas emissions of the energy industry fell sharply in 2020. Compared to the previous year, the sector's emissions increased by 27 million tonnes of CO_2 equivalents; however, this is still nearly 12 million tonnes of CO_2e less than in 2019.
- The building sector was responsible for just under a 16% of total direct emissions in Germany in 2021. Emissions from the sector fell by approximately 4.2% from 2020 to 2021 to 118 million tonnes of CO_2e. This reduction is mainly due to climate action measures, but partly also reflects reduced purchases of heating oil.

Renewable energy sources are being expanded steadily and reliably. Energy efficiency is being improved in the energy industry as well as in the building sector and in energy-intensive industries. The generation of energy from nuclear energy and coal is being phased out in Germany.

The main funding instrument in this area is the Energy and Climate Fund (EKF). Programmes funded by the EKF play a central role in implementing the energy transition and achieving national and international climate targets.[63] The eligible expenditures of the sector amount to €1,093.2 million and are distributed across nine budget items in the following categories:

- Energy research (1 budget item with €528.1 million in eligible expenditures),
- Renewable energy (1 budget item with €44.2 million in eligible expenditures),
- Energy efficiency (5 budget items with €373.6 million in eligible expenditures) and
- National Climate Initiative (2 budget items with €147.3 million in eligible expenditures).

Impacts are quantifiable for five budget items in the sector, including avoided GHG emissions and energy savings. Targets and impacts are additionally described in qualitative terms for project examples under selected budget items.

In accordance with the Framework, the energy and industry sector's expenditures are categorised under the following UN Sustainable Development Goals:

62 See p. 4 and 5 of the Climate Action Report 2022; data updated on the basis of the final greenhouse gas emissions balance published by the Federal Environment Agency, see https://www.umweltbundesamt.de/en/press/pressinformation/final-2021-greenhouse-gas-emissions-balance

63 In addition, extensive funding programmes for energy-efficient building refurbishment are provided by KfW. These are taken into account for KfW green bonds. Measures earmarked in Germany's Recovery and Resilience Plan (DARP) for the European Commission's Next Generation EU European recovery instrument are excluded as eligible expenditures for Green German Federal Securities.

4.1. Energy research

4.1.1. Energy research

Budget chapters and items:	**0903 683 01**					
Eligible expenditures 2020:	**€528.1 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**4,491 ongoing projects**					
Funding share:	**66%**					
EU environmental objectives	a)					
Assumptions and limitations: The projects running in 2020 had an average funding rate of 66%, meaning that 66% of the total of all project costs was met by the federal government and the remainder by the companies.						
Links: 2021 Federal Government Report on Energy Research: https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/federal-government-report-on-energy-research-2021.html						

The 2021 Federal Government Report on Energy Research transparently presents the goals and measures of energy research for the 2020 reporting period. Note: the Federal Government Report on Energy Research also contains projects whose expenditures are not eligible for Green securities. Project profiles for ten examples of eligible expenditures can be found in the 2021 Federal Government Report on Energy Research:

Example	Report page	**Project name** *(further details directly in the report)*	Total funding (in € million; multi-year)	Identifier
1	23	WPUQ – Energy-Efficient Cities (EnEff:Stadt) joint project: Wind-solar-heat pump neighbourhood – heat pumps operated using renewable energy to minimise primary energy needs	1.3	03ET1444A-D
2	28	MethQuest – Methane-based fuels from renewable energy sources for mobile and stationary applications	18.0	03EIV041A-I; 19I18010A-G; 03EIV043A-B; 03EIV044A-E; 03EIV045A-F; 03EIV046A-D
3	31	P3T – Perovskite-POLO-PERC tandem solar cells and modules	3.6	03EE1017A-G
4	32	Standard building-integrated photovoltaics (BIPV) system – Development of standardised BIPV construction elements with integrated system technology	2.1	03EE1061A-G
5	35	SeeOff – Development of strategies for efficient decommissioning of offshore wind farms	1.1	0324322A-D

Example	Report page	**Project name** *(further details directly in the report)*	Total funding (in € million; multi-year)	Identifier
6	39	GEOmaRE – Optimised control and installation technology with sustainable reservoir management for deep geothermal heating projects in the Munich region	3.1	0324332A-B
7	43	LEITNING – Power converters for robust and reliable energy supply by integrating “green” generators	3.5	03EI6030A-F
8	46	ReserveBatt – System services for secure operation of the energy supply service: Active power reserve with maximum performance batteries and VISMA stack inverters	5.3	03ET6123A-G
9	54	5Gain – 5G infrastructures for cellular energy systems using artificial intelligence	5.4	03EI6018A-H
10	57	NECOC – Creating negative emissions by converting CO_2 contained in ambient air into carbon black that can be used as a resource in industry and O_2	1.5	03EE5009A-C

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4.2. Renewable energy

4.2.1. Energy transition programmes and measures in the areas of renewable energy sources, electricity and power grids, digitalisation and energy infrastructure

Budget chapters and items:	**6092 686 13**					
Eligible expenditures 2020:	**€44.2 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**199 beneficiaries**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: This is a multi-year project (duration: 2016 to 2021). The beneficiaries have received funding over several years.						
Links: https://www.bmwk.de/Redaktion/DE/Dossier/sinteg/						

The challenges faced in the energy transition call for smart, innovative solutions. This was precisely the purpose of the SINTEG[64] funding programme. From 2016 to 2021, 300 companies, universities and local authorities researched and tested the technical feasibility and practicality of new technologies and processes in the areas of system integration, flexibility, system stability, smart energy grids, new market and governance structures, and social participation and acceptance.

Far from the academic ivory tower, SINTEG addressed practical real-life problems. To this end, research centres worked hand in hand with companies and public bodies. Systems were created, interconnected, digitally controlled and monitored. New software solutions were developed, along with smart home applications and storage methods. Digital market platforms and smart grids were created and tested for practicability and cost-efficiency in companies, neighbourhoods and homes.

After four years of intensive work, the project entered the review phase for results to be collated and transferred into scalable blueprints. Following the end of the funding programme, the many findings and blueprints were showcased in five synthesis areas. These help ensure that users – such as energy utilities, industrial enterprises and grid system operators – and policymakers take the key factors into account from the outset when planning and implementing measures to integrate renewable energy sources into the energy system, and that they benefit from the practical application experience gained in the five SINTEG showcase regions. The results of the SINTEG funding programme have been compiled by experts in five comprehensive, thematic synthesis reports that can be found under the above link.

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[64] Case study 12 in the 2021 Green Bond Investor Presentation, slide 46: https://www.deutsche-finanzagentur.de/fileadmin/user_upload/Institutionelle-investoren/green/presentations/Green_Bond_Investor_Presentation_2021_II.pdf.

4.3. Energy efficiency

4.3.1. Energy efficiency in industry and businesses

Budget chapters and items:	**6092 686 08**					
Eligible expenditures 2020:	**€250.5 million**					
GHG emission reduction:	**0.815 million t CO_2e p.a.**					
Other indicators:	**2,493,000 MWh p.a. end-use energy savings**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: The estimate for 2020 is based on the 2021 evaluation report. However, the savings identified in the evaluation report relate to the approved funding volume, which differs from the eligible expenditures that apply here. The savings are therefore converted on the basis of the funding efficiencies identified in the evaluation report for GHG savings or end-use energy savings for the applicable eligible expenditures of €250.5 million. The stated annual GHG savings and end-use energy savings apply from 2020 for an eight-year lifetime.						
Links: Evaluation report for 2021 including results for 2019 and 2020: https://www.bmwk.de/Redaktion/DE/Evaluationen/Foerdermassnahmen/bundesfoerderung-fuer-energieeffizienz-in-der-wirtschaft.pdf?__blob=publicationFile&v=6						

In order to achieve the goals of the energy transition for a comprehensive and far-reaching transformation of the energy supply and energy use in Germany, the federal government supports investment measures in plant and process modernisation with the funding programmes “Energy Efficiency in Industry – Grant and Loan” and “BMWi Energy Efficiency Competition”.

The aim is to promote the efficient use of resources and accelerate the market penetration of highly efficient technologies in the industrial and commercial sectors.

The purpose of the funding programmes is to increase energy efficiency through investments in the economy and to expand the share of renewable energy sources for the provision of process heat.

In addition to other measures, the energy transition also focuses on reducing energy consumption by increasing energy efficiency.

Energy Efficiency in the Economy – Grant and Loan

The “Energy Efficiency in the Economy – Grant and Loan” investment programme improves on already available funding options for promoting energy efficiency in trade and industry in line with user needs. The aim is to promote the investments required to achieve the climate targets and energy efficiency goals for the reduction of greenhouse gases in a more cost-efficient and effective manner.

In particular, more effective support is provided for investments in more complex and systemic energy optimisation of production processes. This is intended to reduce energy consumption and CO_2 emissions and help enhance the competitiveness of the enterprises receiving the funding. The special needs of small and medium-sized enterprises are taken into account.

Funding is provided for individual investment measures to increase the energy efficiency of industrial and commercial facilities and processes through the use of highly efficient technologies available on the market.

Eligible investments are one or more investments for the replacement or new acquisition of high-efficiency systems or equipment for industrial and commercial use within the following technology criteria:

- Electric motors and drives
- Pumps for industrial and commercial use
- Fans
- Compressed air systems
- Systems for waste heat utilisation or heat recovery
- Insulation of industrial plants or plant components

Funding is also available for measures to provide process heat from solar collector systems, biomass installations and heat pumps.
The following are additionally eligible for funding:

- The acquisition and installation of measurement and control technology and sensor technology for monitoring and efficient control of energy flows for integration into an energy or environmental management system or, for small and medium-sized enterprises, into an alternative system in accordance with the Peak Efficiency System Ordinance
- The purchase and installation of energy management software and the training of personnel by third parties in the use of the software, insofar as they are directly related to plants and processes

Funding is also provided for investment measures to optimise the energy efficiency of industrial and commercial facilities and processes that contribute to increasing energy efficiency or reducing fossil energy consumption in companies.

BMWi Energy Efficiency Competition
The BMWi Energy Efficiency Competition is a further development of and successor to the funding programme “Promotion of electricity savings within the framework of competitive tenders: Exploiting electricity efficiency potential – STEP up!”, which was introduced in 2016. Funding is provided in a competitive procedure for the implementation of energy efficiency projects in companies. It is essentially open to all participants, sectors and technologies.

The aim is to reduce primary energy consumption and CO_2 emissions, strengthen the competitiveness of companies and support the dissemination of high-efficiency technologies.
Funding is available for investment measures to optimise the energy efficiency of industrial and commercial facilities and processes that contribute to increasing energy efficiency or reducing fossil energy consumption in companies.
The central criterion for the funding decision is the CO_2 savings achieved per funding euro per year (“funding efficiency”). For this purpose, all project applications admitted to a competition round are ranked according to their funding efficiency and approved taking into account the funds available per competition round. If the funding efficiency is the same, the project with the higher absolute CO_2 savings is given preference.

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4.3.2. Providing advice on energy efficiency

Budget chapters and items:	**6092 686 14**					
Eligible expenditures 2020:	**€60.7 million**					
GHG emission reduction:	**0.6 million t CO_2e p.a.**					
Other indicators:	**2,319,444 MWh p.a. energy savings**					
	161,360 beneficiaries					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: Evaluation of energy advice to private consumers, for residential buildings, non-residential buildings, installations and systems.						
Links: https://www.bafa.de/SharedDocs/Downloads/DE/Bundesamt/evaluation_energiesparberatung_energiechecks.html https://www.bafa.de/DE/Energie/Energieberatung/Energieberatung_Wohngebaeude/energieberatung_wohngebaeude_node.html https://www.bafa.de/SharedDocs/Kurzmeldungen/DE/Energie/20181214_Evaluierung_EBM_EBK.html						

The federal government provides funding for advisory services on energy consumption and corresponding measures for all end users, such as private households, small and medium-sized enterprises and public authorities. Advice is provided on topics such as increasing energy efficiency and the use of renewable energy (e.g. energy saving, insulation or modern heating technology) or optimising heating systems.

1. Federal funding for independent energy advice for private consumers at consumer advice centres

The energy advice service provided by consumer advice centres constitutes the largest unbiased advisory service on the subject of energy in Germany. Private households have been assisted in this way since 1978, with around 700 energy advisors at some 926 locations (nationwide coverage). In 2020, around 111,000 households received independent and unbiased advice on energy efficiency in buildings, including electricity saving, thermal insulation, modern heating technology and renewable energy. As a result of the funding, in-person, telephone and online energy consulting as well as webinars are free to residential consumers.

2. Federal funding for energy and electricity savings checkups for private households – Energy Checkups

In addition to providing advice at consumer advice centres, energy advisors have been coming to consumers' homes since 2011 in order to better address specific situations on site (building, system technology, equipment, lighting) and the needs of consumers. In 2020, "energy checkups" were carried out in around 32,253 households. The largest category of energy checkups consisted of building checkups, which accounted for 15,000 cases.

3. Federal funding for energy advice for residential buildings (on-site advice, individual renovation roadmap) (EBW)

The funding is aimed at owners of residential buildings (private house or flat owners, housing associations and condominium owners' associations). A qualified energy consultant approved by the Federal Office of Economics and Export Control (BAFA) examines the entire property and prepares a

comprehensive energy consulting report (including an individual refurbishment roadmap). In addition to energy-saving potential, the report also assesses possible uses for renewable energy and the necessary investments, and shows the savings in heating costs and CO_2. Energy advice thus helps residential property owners to include energy efficiency and renewable energy sources in their planning and decision-making processes and to take advantage of energy-saving potentials at the most opportune time for them. Building owners are better informed about the added value of energy modernisation measures and receive a sound basis for decision-making. The funding is provided under funding guidelines. The guidelines on energy advice for residential buildings (on-site advice and individual refurbishment roadmap) were amended as of 1 February 2020 and the subsidies increased from 60% to 80% of the consulting costs. Applications have more than doubled from 10,500 in 2019 to 24,621 in 2020.

4. Federal funding for energy consulting for non-residential buildings of municipalities and non-profit organisations (EBK)

The funding programme provides financial support for advisory services on the energy-efficient refurbishment and new construction of public facilities such as schools, kindergartens and administrative buildings. The aim is to reduce the investment backlog in such buildings and to support municipalities in setting an example for the public sector. Funding is provided for energy consulting for the development of an energy refurbishment plan or refurbishment roadmap for non-residential buildings (for, among other things, coordinated individual measures or for a comprehensive refurbishment) or energy-efficient new buildings (non-residential buildings) such as town halls or schools. Consulting was provided on a total of 1,204 occasions in 2020.

5. Federal funding for energy consulting in small and medium-sized enterprises (EBM)

As part of the federal funding for energy consulting in small and medium-sized enterprises (EBM), funding is provided for refurbishment strategies for buildings, facilities and processes of small and medium-sized enterprises. The enterprise is checked over for energy-related weaknesses and an inspection is made of the operations. Approximately 3,281 consultations took place in 2020. An in-depth energy audit is carried out in accordance with DIN EN 16247-1, containing clear information on potential savings and a detailed action plan.

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4.3.3. Heating Optimisation Programme

Budget chapters and items:	**6092 686 10**					
Eligible expenditures 2020:	**€34.8 million**					
GHG emission reduction:	**0.015948 million t CO_2e p.a.**					
Other indicators:	**54,149.3 MWh p.a. new energy savings in 2020**					
	54,610 funding decisions					
	75,274 installed systems					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: Data from NAPE notification 2020						
Links: https://www.bmwk.de/Redaktion/DE/Evaluationen/Foerdermassnahmen/abschlussbericht-zur-evaluation-der-richtlinie-uber-die-forderung-der-heizungsoptimierung.html						

In accordance with the funding guidelines that entered into force on 1 August 2016, funding was provided for the replacement of heating pumps and hot water circulation pumps with high-efficiency pumps (funding criterion 1) and/or for the implementation of heating optimisation through hydraulic balancing of heating systems that had been installed for more than two years at the time of implementation and supplementary measures (funding criterion 2). The two funding options could be combined. In 2020, a total of around 54,600 approvals were granted.

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4.3.4. Energy efficiency incentive programme

Budget chapters and items:	**6092 686 11**					
Eligible expenditures 2020:	**€12.8 million**					
GHG emission reduction:	**0.27 million t CO_2e**					
Other indicators:	**7,100 funding decisions**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: The GHG reduction figure relates to the lifetime of the systems for which funding was paid out in 2020. The timing of implementation may vary from this. For a detailed description of the assumptions/methodology, please refer to the evaluation report. As the energy efficiency incentive programme (APEE) was part of the market incentive programme (MAP), please refer to the evaluations of the CO_2 building rehabilitation programme and the market incentive programme. The GHG reduction is determined by extrapolating from the funding efficiency of the MAP in 2019.						
Links: https://www.bmwk.de/Redaktion/DE/Evaluationen/Foerdermassnahmen/evaluation-marktanreizprogramms-2019.pdf?__blob=publicationFile&v=8						

A wide range of measures are needed to achieve a near-climate-neutral building stock.

The energy efficiency incentive programme (APEE) was launched at the beginning of 2016 and further contributes to improving energy efficiency in the building sector. Up to the end of 2019, the programme provided funding for the replacement of inefficient heating systems with efficient heating systems (heating package), the installation of ventilation systems (ventilation package) in combination with building envelope refurbishment or the market introduction of innovative fuel cell heating systems for new and existing buildings. These elements complemented and supplemented the funding provision under the CO_2 building rehabilitation programme and were integrated into the application procedure for that programme. From 2020, the APEE solely provided funding for ultra-efficient large heating systems based on renewable energy sources and innovative fuel cell heating systems.

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4.3.5. Industrial production of mobile and stationary energy storage units

Budget chapters and items:	**6092 893 04**					
Eligible expenditures 2020:	**€14.8 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**4 beneficiaries**					
Funding share:	**N/A**					
EU environmental objectives	a)			d)	e)	
Assumptions and limitations: Co-financing of eligible costs under IPCEI rules; project also co-financed by the *Länder*. The stated expenditures relate only to the federal funding. As the programme only started in 2020, it is not yet possible to quantify the GHG reduction impact.						
Links: https://www.bmwk.de/Redaktion/DE/Artikel/Industrie/batteriezellfertigung.html						

Funding of battery cell production supports the development of innovative and sustainable processes for the industrial production of batteries for electric vehicles and other applications, together with the development of re-use and recycling systems. The BMWi funding projects, which are embedded in the Important Projects of Common European Interest (IPCEI) framework, will enable battery cells with a reduced carbon footprint to be produced in Germany and pave the way for large-scale recycling of battery raw materials. Individual projects at different stages of the battery value chain (such as cathode material production, battery cell production and battery module assembly) aim to improve the carbon footprint of batteries in each addressed segment.

A key funding objective in each individual project is an improvement in environmental performance (such as a GHG reduction as well as energy efficiency in battery production, resource input, etc.), which is tracked in project monitoring. The programme is accompanied by research to analyse the effectiveness of the entire funding measure in terms of the environmental objectives. This research has not yet been completed at the time of publication of the 2021 impact report.

One project example is a project by BASF Schwarzheide GmbH that has been funded since 2020 and which uses highly innovative battery materials and battery recycling to help establish a sustainable battery value chain for electric vehicles in Europe. A production facility for innovative cathode materials aims to increase battery performance, cost efficiency and sustainability. Research is also being conducted into efficient recycling technologies to advance the success of climate-friendly mobility.

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4.4. National Climate Initiative

4.4.1. National Climate Initiative

Budget chapters and items:	**6092 686 05**					
Eligible expenditures 2020:	**€138.6 million**					
GHG emission reduction:	**2.04 million t CO_2e over the entire impact period**					
Other indicators:	-					
Funding share:	**N/A**					
EU environmental objectives	a)	b)				
Assumptions and limitations: The GHG emission reduction for 2020 is estimated based on the eligible expenditures for 2020 in the individual programmes of the National Climate Initiative and the net figures for the ex-post funding efficiency (CO_2 reduction per euro) from the 2018/2019 evaluation report.						
Links: Evaluation report 2018 and 2019: https://www.klimaschutz.de/de/ueber-die-initiative						

The National Climate Initiative was launched in 2008 to actively promote climate action in all relevant target groups across society, including industry, public authorities, the education sector and consumers. To this end, it funds both information-based and investment-based greenhouse gas reduction projects. The funding covers a wide range of climate change mitigation activities, from the development of long-term strategies to specific support and financing measures in the energy sector, transport and business/industry that contribute to the reduction of greenhouse gas emissions.[65] In particular, it enables people in civil society, local authorities, the education sector and the scientific community to develop and actively implement innovative approaches to climate action.

The eligible expenditures are distributed among 12 funding guidelines, of which the five largest programmes are as follows:

Funding programme	Eligible expenditures (in € million)	Impact and allocation of the examples below
Guidelines for the funding of climate change mitigation projects in municipalities (municipalities guidelines)	41.9	Approx. 1.70 million t CO_2e over the entire impact period
Guidelines for the funding of measures on refrigeration and air conditioning systems in business enterprises	23.0	Approx. 0.24 million t CO_2e over the entire impact period
Funding of innovative individual climate change mitigation projects in the industry, municipal, consumer and education sectors	20.0	“aktiv” electricity saving checkup only: approx. 0.03 million t CO_2e over the entire impact period
Climate Protection through Cycling funding call	14.0	Approx. 0.04 million t CO_2e over the entire impact period
Field trials of trolleytrucks	10.4	N/A

[65] For individual programmes, see also p. 51 ff. of the 10th Energy and Climate Fund report: https://www.bundesfinanzministerium.de/Content/DE/Downloads/Oeffentliche-Finanzen/10-EKF-Bericht.pdf?__blob=publicationFile&v=2

Example of information projects:

"aktiv" electricity saving checkup (€8.9 million eligible expenditures); advice for 64,000 households and replacement of 5,200 refrigerators in the 2019-2022 funding period; CO_2 reduction of approximately 90,000 tonnes of CO_2e over the entire effective period.[66] The funding share for 2020 is approx. 33%. Funded under the National Climate Initiative funding call for innovative individual climate change mitigation projects.

Examples of investment projects:

Large-scale solar thermal plant for the Ludwigsburg district heating grid[67] (€1.3 million eligible expenditures); the 2017-2020 funding period saw the construction of Germany's (at the time) largest ground-mounted solar thermal plant, with a collector area of 14,800 m^3. The plant is integrated into the expanded district heating grid operated by Ludwigsburg municipal services, Stadtwerke Ludwigsburg-Kornwestheim GmbH. A 2,000 m^3 heat storage tank was additionally installed for load balancing. CO_2 reduction totalling approximately 3,700 tonnes of CO_2e p.a. or approximately 74,000 tonnes of CO_2e over the entire effective period (20 years). The funding share for 2020 is approx. 15%. Funded under the National Climate Initiative funding call for municipal model climate change mitigation projects.

MeGa sewage treatment plant, Hamburg[68] (€0.2 million eligible expenditures); the sludge storage tank at the Hamburg sewage treatment plant was covered over during the 2017-2020 funding period. The collected methane is combusted to generate energy in a combined heat and power plant. CO_2 reduction totalling approximately 4,100 tonnes of CO_2e p.a. or approximately 82,000 tonnes of CO_2e over the entire effective period (20 years). The funding share for 2020 is approx. 11%. Funded under the National Climate Initiative funding call for municipal model climate change mitigation projects.

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66 https://www.klimaschutz.de/de/projekte/stromspar-check-aktiv-klima-und-umweltschutz-im-alltag-fuer-haushalte-mit-geringem

67 https://www.klimaschutz.de/de/projekte/solarheatgrid

68 https://www.euwid-wasser.de/news/wirtschaft/hamburg-wasser-projekt-zur-erweiterten-erfassung-von-methangas-im-klaerwerk/

4.4.2. National climate action measures

Budget chapters and items:	**6092 686 23**					
Eligible expenditures 2020:	**€8.7 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**Ten projects in the mobility competition in 2020**					
Funding share:	**N/A**					
EU environmental objectives	a)					
Assumptions and limitations: In 2020, projects under budget item 1601 892 01 Environmental Innovation Programme were co-financed in the amount of €4.7 million from the eligible expenditures. The impact reported here relates to the €4 million difference. Please see fact sheet 3.2.2 for the impact of the Environmental Innovation Programme.						
Links: --						

This budget item was used to fund measures which contribute to achieving national climate targets but which comprise single projects or pilot projects and/or have a small budget, making it impracticable to assign them a separate budget item. Projects under the Environmental Innovation Programme are also funded.

Projects under the Environmental Innovation Programme

Funding was provided for large-scale demonstration projects that show how plants can be adapted for the first time to an advanced state of the art to reduce pollution, how advanced processes and combinations of processes can be implemented to avoid and reduce pollution, and how environmentally compatible products and environmentally friendly substitutes can be manufactured and used.

Sustainable mobility competitions

The Future of Sustainable Mobility competition aims to help local authorities develop and visualise future mobility in the context of their urban development in as practical a way as possible, and help them take action to realise their vision. The focus is on approaches to environmentally friendly mobility that improve quality of life in cities and rural areas. Leveraging the potential of digitalisation and developments in the field of artificial intelligence, the aim is to develop a vision of what sustainable and environmentally friendly mobility in the community or region concerned could and should look like in 2035, and to derive a detailed action plan for the years ahead.

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5. Agriculture, forestry, natural landscapes and biodiversity

The agricultural and forestry sector, more than any other area of the economy, is under direct pressure to adapt to the impacts of climate change and to protect natural resources, ecosystems and biodiversity. In addition, the sector also plays a central role in climate change mitigation.

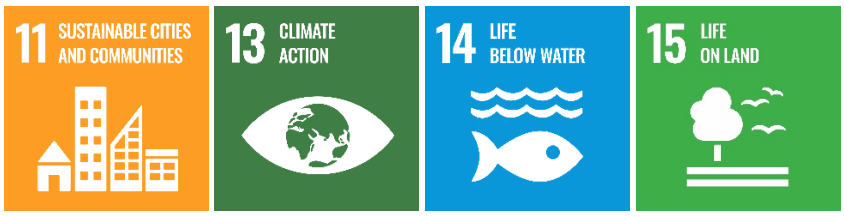
With around 61 million tonnes of CO_2 equivalents, the agricultural sector accounted for 8% of total German emissions in 2021. Compared to the previous year, agricultural emissions fell by 1.7%.[69] The sector also includes land use, land use change and forestry (LULUCF) measures. LULUCF takes into account all land-based sources and sinks of greenhouse gas emissions from inhabited areas, wetlands, forests, arable land and grassland. This includes, for example, the release of greenhouse gases through deforestation, soil cultivation and ploughing-up of grassland, or the removal of carbon dioxide from the atmosphere through biomass growth in forests (sinks) and through wood products. In general, the LULUCF sector acts as a sink for carbon dioxide in Germany. The difference between released and sequestered greenhouse gases results in the emissions balance in the LULUCF sector. In 2021, the emissions balance of the LULUCF sector was 3.4 million tonnes of CO_2 equivalents.[70]

Agriculture and forestry, as a sector of the economy that covers the whole of Germany, thus play a key role in achieving Germany's overall sustainability, land use and climate goals.

The eligible expenditures of the sector amount to €564.0 million and are distributed across 19 budget items in the following categories:

- Agriculture (5 budget items with €81.6 million in eligible expenditures),
- Land use, land use change and forestry (LULUCF) (7 budget items with €182.5 million in eligible expenditures),
- Biodiversity and natural landscapes (3 budget items with €54.2 million in eligible expenditures) and
- Coastal defences and flood protection (4 budget items with €245.7 million in eligible expenditures).

In accordance with the Framework, the agriculture, forestry, natural landscapes and biodiversity sector's expenditures are categorised under the following UN Sustainable Development Goals:



[69] See p. 5 of the Climate Action Report 2022; data updated on the basis of the final greenhouse gas emissions balance published by the Federal Environment Agency, see https://www.umweltbundesamt.de/en/press/pressinformation/final-2021-greenhouse-gas-emissions-balance

[70] See p. 5 of the Climate Action Report 2022; data updated on the basis of the final greenhouse gas emissions balance published by the Federal Environment Agency, see https://www.umweltbundesamt.de/en/press/pressinformation/final-2021-greenhouse-gas-emissions-balance

5.1. Agriculture

5.1.1. Subsidies to fund organic farming and other sustainable forms of agriculture (BÖLN)

Budget chapters and items:	**1005 686 43**					
Eligible expenditures 2020:	**€13.8 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**261 subprojects**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)		d)	e)	f)
Assumptions and limitations: --						
Links: https://www.bundesprogramm.de/ https://www.bundesprogramm.de/was-wir-tun/projekte-foerdern/foerderung-von-forschungs-und-entwicklungsvorhaben						

The Federal Programme for Organic Farming and Other Forms of Sustainable Agriculture (BÖLN) is a key element in promoting and expanding organic farming and other forms of sustainable agriculture. The programme aims to remove impediments to growth along the entire value chain. To this end, a wide range of research projects, knowledge transfer, information and training activities are being developed to promote, for example, high-welfare livestock farming, particularly environmentally friendly and resource-efficient forms of cultivation and the strengthening of regional production, processing and marketing systems.

The eligible expenditures in the programme relate to research and development projects, including knowledge transfer. Funding is provided for projects on sustainable and organic cultivation and livestock farming practices. These mainly relate to the following areas:

- Environmentally friendly and organic crop production (including risk mitigation in crop protection, in particular through the use of non-chemical and biological crop protection methods, reducing erosion, soil and nutrient conservation by means of low-tillage cultivation methods, and maintenance of soil fertility, in particular by maintaining humus content on farmed land at levels characteristic of the location)
- Optimising nitrogen and energy input (including through the cultivation of legumes, efficient fertiliser and pesticide use, and reductions in greenhouse gas emissions)
- Breeding research as a basis for breeding varieties that are well-suited to sustainable, organic production, processing and marketing
- Safeguarding and lastingly increasing yields, among other things by exploiting the potential of genetic resources
- Furthering the development of high-welfare, climate-friendly livestock farming practices (such as systems for providing livestock with access to the open air)
- Development of feeding strategies suitable to the species and optimised to reduce emissions of greenhouse gases per unit of animal-based food produced
- Input/output-efficient food processing

Quantification of impacts such as CO_2 reduction potential is not possible for research and development projects where the outcomes will only be applied in the future after project completion. Areas with potential include:

- Increasing sustainability in crop and livestock production
- Resource-efficient, sustainable and climate change-adapted crops
- Soil and nutrient management as a contribution to climate change mitigation

- Reduction in the use of inputs generated on the basis of fossil raw materials (such as peat, fertilisers and pesticides)
- Ensuring sustainable nutrition of farm animals under changing climatic conditions
- Reduction of emissions

The following joint projects can be cited as examples of the eligible expenditures:

Project name (Click on the project name to visit the website)	**Identifier**	**Eligible expenditures (in € million)**	**Number of subprojects**
NutriNet: expert/practitioner network to improve nutrient management in organic farming	2818OE014, 067, 068, 069, 070, 071, 072, 073, 074, 075	0.87	10
ProBio: Studies on the optimum production and agronomic use of compost from organic and green waste in organic farming	2818OE009, 118, 119, 120, 121, 122	0.30	6
TerÖko: Peat-reduced and peat-free substrates for organic herb production – testing, optimisation and knowledge transfer	2819OE070, 140, 141, 142, 146	0.01	5
ÖkoHuhn2: Dual-purpose chickens in organic farming – breeding and identifying the potential of suitable breeds and implementing in practice	2819OE044, 061, 086, 087, 116	0.38	5
KLUFT: Closed nutrient cycles in free-range hen husbandry systems: substrates and additives for vicinity outdoor roaming areas	2819OE050	0.16	1
Total		**1.72**	**27**

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5.1.2. Funding of innovation in the area of food, agriculture and health-related consumer protection

Budget chapters and items:	**1005 686 31 and 893 31**					
Eligible expenditures 2020:	**€42.1 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**903 funded subprojects (beneficiaries)**					
Funding share:	**N/A**					
EU environmental objectives	a)	b)				f)
Assumptions and limitations: --						
Links: --						

The aim of the programme is to support technical and non-technical innovations in Germany.
Funding is provided for projects in thematic areas such as agricultural engineering, crop breeding, crop protection, livestock breeding, livestock farming and livestock health, food safety and quality, nutrition, food production, aquaculture and fisheries.

Quantification of impacts such as CO_2 reduction potential is not possible for research and development projects where the outcomes will only be applied in the future after project completion.

Areas with potential include:

- Increasing sustainability in crop and livestock production and urban farming
- Resource-efficient and climate change-adapted crops
- Soil as a contribution to climate change mitigation
- Reduction in the use of inputs generated on the basis of fossil raw materials (such as peat, fertilisers, pesticides (non-chemical pesticides) and plastic packaging)
- Ensuring sustainable nutrition of farm animals under changing climatic conditions
- Efficiency gains and input reduction through digitalisation and AI in production and the value chain
- Reduction of emissions in livestock farming

The following programmes can be cited as examples of the eligible expenditures:

Joint project name (acronym in brackets, with link if in bold type)	**Eligible expenditures (in € million)**	**Number of projects**
Efficient slurry treatment reduces ammonia and methane emissions and slurry storage capacities while recycling phospherus (ASAP)	0.14	3
Reduction of methane and nitrogen emissions in milk production by innovative control and management of feeding (ReMissionDairy)	0.64	9

Joint project name (acronym in brackets, with link if in bold type)	Eligible expenditures (in € million)	Number of projects
Reduction of greenhouse gas emissions in crop production through site-adapted optimised intercropping systems (THG-ZWIFRU)	0.58	7
Wheat in efficient crop rotations in relation to an idealised acquisition of nutrients (WinEffizient)	0.26	4
Development of indicators to assess the productivity, intensity of use and vulnerability of agricultural soils in Germany (SOIL-DE)	0.42	4
Reduction of GHG emissions and ammoniac by optimised nitrogen management (GreenWindows4_0)	0.17	2
Technical procedures for closed crop production systems to reduce greenhouse gas emissions and climate change-induced abiotic stress (MinTHG)	0.23	4
Optimised nitrogen fertilisation by multi-parametric data fusion and precise real-time application (FuzzyFarmer)	0.14	4
An assessment tool for categories of protection and monitoring of agricultural peatlands based on remote sensing (**BEWAMO**)	0.33	4

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5.1.3. Subsidies to fund measures for improving energy efficiency in agriculture and horticulture

Budget chapters and items:	**6092 686 22 and 6092 893 07**					
Eligible expenditures 2020:	**€25.7 million**					
GHG emission reduction:	**0.046 million t CO_2e p.a.**					
Other indicators:	**1,030 funding beneficiaries for professional energy consulting and investment in climate-friendly technical systems to reduce CO_2 emissions**					
Funding share:	**The federal government funding share for energy consulting is 80% and for investment in climate-friendly technical systems approximately 36% of the beneficiaries' total net expenditures**					
EU environmental objectives	a)					
Assumptions and limitations: The data on GHG reductions and number of beneficiaries refers to the projects for which funding was paid out in 2020, some of which began to be implemented in 2019. The eligible expenditures comprise expenditures to fund energy consulting and investment projects. The sum total of GHG emission reductions are based on calculations or expert appraisals for each individual project and relate to the investment projects. Specific GHG reductions cannot be attributed to the funding of energy consulting for individual enterprises as the consulting only identifies an enterprise's potential reductions. In about 70% of cases, however, the funded consulting led to investment measures applied for and funded under the programme.						
Links: https://www.ble.de/energieeffizienz						

Wide-ranging efforts are needed in order to shift energy and heat use in agriculture and horticulture towards climate neutrality. The federal programme was launched on 1 January 2016 and has been funded out of the Energy and Climate Fund/Climate and Transformation Fund since 1 January 2020. In line with the requirements of the Climate Action Programme 2030, the previously applicable guidelines were closed at the end of February 2020 and the programme revised. Revised funding guidelines entered into effect in October 2020.

Since then, the Federal Programme to Enhance Energy Efficiency and Reduce Carbon Emissions in Agriculture and Horticulture initiated by the Federal Ministry of Food and Agriculture (BMEL) has provided funding incentives for small and medium-sized agricultural and horticultural enterprises to obtain professional energy consulting and to invest in technical systems for climate change mitigation. This includes:

- Cross-sectional technologies for adding or retrofitting certain technical components, including efficiency measures on agricultural machinery using tyre pressure control systems, and alternative propulsion systems for agricultural machinery such as electric tractors
- Major energy-efficiency investments, such as energy-efficient refurbishment of agricultural buildings
- Renewable energy installations for self-sufficient energy supply
- Use of industrial waste heat and energy-efficient district heating or cooling

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5.2. Land use, land use change and forestry (LULUCF)

5.2.1. Forestry measures

- *Grants to fund forestry measures (including investments)*
- *Grants to fund measures that combat the effects of extreme weather events in forests (including investments)*

Budget chapters and items:	**Annex 1 to 1003 (1095): 632 41, 882 41, 632 42 and 882 42**					
Eligible expenditures 2020:	**€124.3 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**58,115 funding cases**					
	6,475 ha reforested area (as part of forest transformation into close-to-nature forest management)					
	90 ha grant-aided area for planting as part of initial afforestation (establishment of new forest)					
	19.7 million m³ of processed infested wood					
	32,043 ha of grant-aided area (as part of contract-based forest nature conservation)					
Funding share:	**60% (federal government funding share)**					
EU environmental objectives	a)	b)				f)
Assumptions and limitations: GAK reporting by the *Länder*, reporting period 2020						
Links: • https://www.bmel.de/DE/themen/laendliche-regionen/foerderung-des-laendlichen-raumes/gemeinschaftsaufgabe-agrarstruktur-kuestenschutz/gak.html • https://bmel-statistik.de/fileadmin/daten/GAB-0002000-2020.pdf • https://bmel-statistik.de/fileadmin/daten/GAT-5000100-2020.pdf • https://www.bmel.de/DE/themen/wald/wald-in-deutschland/duerrehilfen-waldbesitzer.html						

The Joint Task of the federal government and *Länder* for the Improvement of Agricultural Structures and Coastal Protection (GAK) is the most important national funding instrument for efficient, competitive agriculture and forestry geared to future requirements, coastal protection and vibrant rural areas. It contains a wide range of agricultural structure and infrastructure measures and thus largely covers the scope of the European Agricultural Fund for Rural Development (EAFRD).

Details on the principles, objectives and procedural issues are regulated in the Act concerning the Joint Task for the Improvement of Agricultural Structures and Coastal Protection (GAK Act). To fulfil the joint task, a joint framework plan is drawn up by the federal government and the *Länder* for the period of a four-year financial plan. The GAK framework plan identifies the measures and the objectives associated with them, and describes the funding principles, funding recipients, funding requirements, and the type and amount of funding. The GAK framework plan is adopted by the Planning Committee for Agricultural Structure and Coastal Protection (PLANAK), which brings together the federal and *Länder* ministers of agriculture and the Federal Minister of Finance. It is valid for the period of the financial plan and is reviewed annually and adapted to current developments.

With the help of the above-mentioned funds, measures in the following areas were financed in 2020 (federal share: 60%, *Länder* share: 40%) and implemented by the *Länder*:

- **Close-to-nature forest management** (9,382 funding cases; indicator: 6,475 ha reforested area): In the area of woodland restoration forest transformation, which is an element of close-to-nature forest management, measures that are eligible for funding include reforestation and the establishment of undergrowth and the understorey (including natural regeneration) by sowing and planting site-adapted tree and shrub species. This includes crop preparation, forest edge formation, and crop protection and care for the first five years. A sufficient proportion of native tree species must be maintained.
- **Initial afforestation** (7,163 funding cases; indicator: 90 ha grant-aided area for sowing and planting as part of initial afforestation): Initial afforestation includes, for example, sowing and planting, in each case including crop preparation, forest edge formation and securing the crop for the first five years. It also includes surveys such as site assessments carried out in preparation.
- **Combating the effects of extreme weather events in forests** (37,699 funding cases; indicator: 19,740,585 m^3 processed infested wood): Forest protection measures as part of measures to combat the effects of extreme weather events in forests include combating harmful organisms by locating and processing infested timber (e.g. sanitary felling, debarking, bark disposal and extracting and transporting timber) and other measures to reduce the host suitability of timber, timber waste or brushwood so that the material does not pose or ceases to pose a hazard.
- **Contract-based forest nature conservation** (3,871 funding cases, indicator: 32,043 ha of grant-aided area under contract-based nature conservation): Contract-based nature conservation measures aim to protect, conserve and restore forest habitats of wild animal and plant species and to improve the characteristic biodiversity of forest ecosystems. Funding is provided for the management, maintenance or set-aside of land used for, or capable of use for, forestry.

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5.2.2. Forest Climate Fund

Budget chapters and items:	**6092 686 06**					
Eligible expenditures 2020:	**€15.8 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**99 projects newly approved**					
	192 ongoing projects					
Funding share:	**N/A**					
EU environmental objectives		b)				f)
Assumptions and limitations: --						
Links: --						

The Federal Ministry of Food and Agriculture (BMEL) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) use the Forest Climate Fund to support measures to preserve and enhance the carbon reduction potential of forest and timber and to adapt forests to climate change. In the 2020 financial year, the two ministries spent a total of around €15.8 million from the Forest Climate Fund, which is managed jointly.

A total of 99 projects were newly approved in the 2020 reporting year. These are divided among the funding priorities in the funding guidelines as follows:

- Adaptation of forests to climate change (2 projects)
- Ensuring carbon storage and increasing forest CO_2 sequestration (2 projects)
- Increasing timber product storage, CO_2 reduction and substitution with timber products (12 projects)
- Research and monitoring (77 projects)
- Information and communication (6 projects)

At the end of 2020, there were 192 ongoing projects with total funding of €70.3 million.

The Forest Climate Fund is intended to implement measures of special national interest that serve to adapt forests to climate change and maintain the indispensable contribution of close-to-nature, richly structured and biodiverse forests to safeguarding the natural foundations of life in the long term. The BMEL and BMU have used the Forest Climate Fund since 2013 primarily to support research, development and demonstration projects as well as communication and exchange between the scientific community and practitioners on the topics of forest climate change mitigation and adaptation.

Specific GHG reduction figures cannot be quantified and stated due to the indirect impact of research results.

Project name	Brief description	Eligible expenditures (in € million)	Duration
Origin	Provenance – New tests for determination of provenance of forestry propagation material in Europe – a contribution to ensure adaptation to climate change	0.42	2017 – 2021

Project name	Brief description	Eligible expenditures (in € million)	Duration
NaWi	Joint project: Adaptation strategies of beech forests to changing environmental conditions at different management intensities (NaWi); subproject 1: Influence of management intensity on stand development, nutrient availability, soil carbon storage and soil greenhouse gas emissions	0.30	2019 – 2022
PYROPHOB	Joint project: Strategies for the development of pyrophobic and climate change-resilient forests on forest fire areas; subproject 1: Coordination, forest ecology and synthesis	0.30	2020 – 2025
BiWaKli	Joint project: Education Network Forests and Climate – the Climate Experts (BiWaKli); subproject 1: Forest and climate education workshop	0.24	2019 – 2022
KonKlim	Joint project: Assessment of adaptation potentials, growth plasticity of spruce, fir and Douglas fir as regards forecasted climatic changes in the Black Forest; subproject 1	0.24	2018 – 2022
Holzhybrid	Joint project: Convertible timber hybrid for different development stages; subproject 1: Standardised timber construction systems, cross-laminated timber ceiling construction and life-cycle analysis	0.23	2019 – 2022
KliWaBe	Joint project: Climate change mitigation contribution of forests with multifunctional and sustainable management; subproject 1: Addressing social ambassadors with direct or indirect influence on the climate change mitigation performance of managed forests	0.22	2019 – 2024

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5.2.3. Subsidies to fund research, development and demonstration projects in the area of renewable resources and to fund national sustainable forestry projects

Budget chapters and items:	**1005 686 11 and 1005 893 11**					
Eligible expenditures 2020:	**€42.4 million**					
GHG emission reduction:	**N/A**					
Other indicators:	**379 beneficiaries**					
	585 projects					
Funding share:	**N/A**					
EU environmental objectives	a)	b)		d)	e)	f)
Assumptions and limitations: A total of 90 beneficiaries receive funding under the two budget items 686 11 and 893 11 and are therefore counted only once in the sum total.						
Links: --						

The renewable resources funding programme funds research, development and demonstration projects with renewable resources. The funding programme pursues a wide variety of goals, including efficient and environmentally friendly resource use, greenhouse gas avoidance or sequestration and biodiversity conservation.

Quantification of impacts such as CO_2 reduction potential is not possible for research and development projects where the outcomes will only be applied in the future after project completion.

The following projects can be cited as examples of the eligible expenditures under the budget items:

Programme name	Eligible expenditures (in € million)	Number of beneficiaries and projects
Budget item 1005 686 11 – total	**20.5**	**231 beneficiaries** **304 projects**
TAKOWIND II joint project	0.2	6 beneficiaries 6 projects
Budget item 1005 893 11 – total	**21.9**	**238 beneficiaries** **281 projects**
FINAL joint project	1.2	4 beneficiaries 4 projects
MOOSZUCHT joint project	0.4	4 beneficiaries 4 projects
TAKOWIND III joint project	0.3	4 beneficiaries 4 projects
Bio-based lubricants funding call	1.9	25 beneficiaries 30 projects

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5.3. Biodiversity and natural landscapes

5.3.1. Wilderness fund

Budget chapters and items:	**1604 893 02**					
Eligible expenditures 2020:	**€10.0 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**616 ha placed under protection**					
Funding share:	**100%**					
EU environmental objectives						f)
Assumptions and limitations: --						
Links: https://www.bmuv.de/programm/wildnisfonds https://www.z-u-g.org/aufgaben/wildnisfonds/						

The National Strategy on Biological Diversity aims to halt and reverse the decline of biodiversity. This also involves returning more large areas of Germany to wilderness. The strategy sets a specific goal in this regard, under which at least 2% of Germany's land area will be left to develop undisturbed. This applies to areas such as forests, post-mining landscapes, former military training grounds, riparian and coastal land, peatlands and mountains. The federal government has set up the Wilderness Fund to support a range of measures to help achieve the 2% wilderness goal:

- Purchase of wilderness areas or significant portions thereof
- Purchase of land to complete or expand wilderness areas or suitable minimal intervention areas
- Purchase of leases, or financial compensation for permanently relinquishing the economic use of wildness areas or significant portions thereof
- Purchase of leases, or financial compensation for permanently relinquishing the economic use of land to complete or expand wilderness areas or suitable minimal intervention areas

List of projects funded in 2020

Project name (*Länder*)	**Eligible expenditures (in € million)**[71]	**Grant-aided area (in ha)**
Completion of Heidehoff wilderness area (Brandenburg)	0.63	73 ha (land purchase)
Thuringian Highland wilderness area (Thuringia)	3.16	318 ha (land purchase)
Completion of forest wilderness area in Laubacher Wald/Vogelsberg (Hesse)	6.04	225 ha (land purchase or rights of land use)
Total in 2020	**9.83**	**616 ha**

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[71] The shortfall relative to the total amount of the budget item relates to the costs of the project management agency.

5.3.2. Grants for the establishment and long-term protection of areas of nature and landscapes of national importance (chance.natur)

Budget chapters and items:	**1604 882 01**						
Eligible expenditures 2020:	**€13.2 million**						
GHG emission reduction:	**Pursues other objectives**						
Other indicators:	**92,000 ha total area restored in projects ongoing in 2020**						
	18 ongoing projects in 2020						
Funding share:	**See project list** The stated funding share includes multi-year federal funding and third-party funding that is included in the total cost.						
EU environmental objectives							f)
Assumptions and limitations: --							
Links: Click on the project name to visit the website							

The “chance.natur” programme promotes the establishment and protection of areas of nature and landscape of national and conservation importance. Through the programme, the federal government makes an important contribution to the protection of biological diversity and natural heritage in Germany.

The largest projects of 2020 are briefly described in the following (corresponding to 62% of eligible expenditures in 2020).

Project name (*Länder*)	Eligible expenditures (in € million)	Total cost (in € million)	Funding share (in %)	Duration	Area (in ha)
Lower Havel Lowlands II (Brandenburg/Saxony-Anhalt)	2.67	38.32	7.0	2009 – 2025	9,000
	Large, near-natural floodplains (damp meadows and oxbows) either side of the River Havel, with prolonged flooding. The area, much of which is designated as wetlands of international importance (a Ramsar site) and a Natura 2000 site, is an important breeding habitat for numerous meadow and water birds (including the ruff, black-tailed godwit, corncrake, great bittern, red-necked grebe and black tern). It is also one of the most important resting places in Central Europe for cranes, geese, swans and ducks. Other federal Red List vertebrate species found in the area include beaver, otter, fire-bellied toad and nine species of bat. Major threats result from the modern-day, modified state of the Havel, impoundments, land improvement measures and nutrient inputs.				
Allgäu Moor Alliance II (Bavaria)	0.76	8.51	8.9	2012 – 2022	13,811
	The project’s landscapes of peatlands and wetland meadows are among the richest and best endowed with peatlands in Germany. The area contains several nationally significant, in part unimpaired raised bog cores with largely original and complete zonation. The peatlands in Kempter Wald are the largest contiguous peatland area in the Allgäu and are also nationally significant due to the extensive mountain pine bogs. Such mountain pine bogs and former commons peatland pastures are specific to the region. The Allgäu peatlands are a nationwide concentration of glacial relics such as the endangered or critically endangered shrubby birch, dwarf birch, creeping sedge, Davall’s sedge, slender cottongrass and swamp willow.				

Project name (*Länder*)	Eligible expenditures (in € million)	Total cost (in € million)	Funding share (in %)	Duration	Area (in ha)
Natural and cultural landscape between the Siebengebirge and Sieg (chance 7) II (North Rhine-Westphalia)	1.24	15.09	8.2	2015 – 2025	9,752
	Due to its geology and climate, the Siebengebirge region has very rich biodiversity. In the Siebengebirge hill range alone, some 730 plant species are found in an area of 4,800 ha. The project region is distinguished by locally characteristic and nationally representative deciduous woodland of the Siebengebirge range and Leuscheid ridge (Luzulo-Fagetum beech forests, Asperulo-Fagetum beech forests, media-European limestone beech forests of the Cephalanthero-Fagion, Sub-Atlantic oak-hornbeam forests (Stellario-Carpinetum), Galio-Carpinetum oak-hornbeam forests, Tilio-Acerion forests of slopes, screes and ravines, and riparian, bog and swamp forests), of which the indicator species is the black stork; by sparse orchards as part of the historical cultural landscape of the Pleiser Hügelland hill range with breeding populations of little owl; and by the extensive rock and rocky slope habitats marking the northern range limit for nationally vulnerable species such as the common wall lizard. Near-natural rivers, streams and forest springs complete the outstanding natural endowment of the core areas, which since 2015 also extend across the Bonn city boundary.				
Upper Ahr-Hocheifel II (Rhineland-Palatinate)	0.89	8.21	10.8	2012 – 2023	3,287
	The purpose of the project is to safeguard a system of largely intact, natural to near-natural rivers with high water quality and fluvial dynamics and several hundred kilometres of floodplains. As well as developing an interconnected system of floodplains, the aim is to protect over 100 square kilometres of mostly unfragmented large forest habitats that extend over the higher elevations and valley slopes of the project area and are of national importance as territories of indicator species such as black stork, wildcat and hazel grouse.				
Ribbons of life in the Hunsrück I (Rhineland-Palatinate)	0.76	2.62	28.9	2017 – 2022	23,000
	This large-scale nature conservation project aims to develop a large ecological network through the spatial and functional interconnection of the Hunsrück natural and forest landscape with the diverse landscape elements of the cultural landscape in the funded area. For greater acceptance among local stakeholders in agriculture and forestry, a cultivation-based approach is to be taken to conservation of the cultural landscape, in which the target habitat types and cultivation practices are linked to specific products such as firewood, upland meadow hay, honey and beef. The project's primary objectives are to restore, safeguard and enable the development of forest and peatland habitats and of habitats shaped by human influence such as mineshafts and spoil heaps, to enable the development of natural floodplain dynamics for forested stream floodplains and to restore, improve and lastingly safeguard floodplain, herb and orchard meadows.				
Industrial Heritage North II (Saarland)	0.75	13.07	5.8	2013 – 2024	2,362
	The area encompasses a mosaic of the characteristic landscape features found in a post-mining region affected by coal mining and the accompanying mining industry. These features range from industrial wastelands to slag heaps, mud ponds and the corresponding water and land management structures. The four core zones represent distinct landscape and land-use types within the former industrial region, serving as representative examples of the diverse habitats found in this area. Together, they form a unique combination that is unparalleled in such a compact space.				
Hohe Schrecke II (Thuringia)	1.13	12.73	8.9	2013 – 2023	6,030
	Hohe Schrecke is an almost completely uninterrupted forest area. Over centuries of extensive cultivation and 50 years as a restricted military zone, the forest has developed and maintained a richly diverse structure with a significant proportion of old-growth timber. A substantial portion of the forest aligns with the potential natural vegetation characteristic of Central Europe – particularly acidophilous beech forest – and harbours an exceptional array of species characteristic of such habitats.				

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5.3.3. Grants to fund measures within the federal programme for biodiversity

Budget chapters and items:	**1604 685 01**					
Eligible expenditures 2020:	**€31.0 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**259 projects**					
Funding share:	**See project list** The stated funding share includes multi-year federal funding and third-party funding that is included in the total cost.					
EU environmental objectives						f)
Assumptions and limitations: A detailed evaluation is only available for the entire period 2011-2022						
Links: https://www.bfn.de/en/topic/federal-biological-diversity-programme https://www.bfn.de/bpbv-projektevaluation						

Expenditures within the federal programme for biodiversity serve to fund measures under the Federal Biological Diversity Programme to implement the National Strategy on Biological Diversity. Programme funding priorities:

1. Securing ecosystem services
2. German national responsibility species
3. Biodiversity hotspots in Germany
4. Additional measures of particular representative importance for the Strategy.

The largest projects of 2020 are briefly presented in the following (corresponding to 16.6% of eligible expenditures in 2020).

Project name (click on the project name to visit the website)	Eligible expenditures (in € million)	Total cost (in € million)	Funding share (in %)	Duration	Indicator
Luppe	1.05	16.6	6.3	2012 – 2023	River restoration (indicator: species spectrum/numbers of individuals, e.g. southern damselfly); habitat improvement for target species (e.g. great crested newt and smooth newt) (indicator: population sizes); restoration planning (indicator: e.g. submission of planning approval documents); compilation of development scenarios for the Elster-Luppe floodplain (indicator: contributions to the overall floodplain development strategy)
	Project description: Revitalisation of the Elster-Luppe floodplain from Leipzig to Schkeuditz				
Floodplain network	1.0	6.7	15.0	2011-2021	Indicators: Size of secured areas, restored natural floodplains, and new island area as habitat for aquatic flora and fauna species, visitor numbers to environmental education trail Achievements: Well over 100 ha of additional land in the Hohe Garbe Elbe peninsula under ownership of nature conservation agency, over 200 ha of (floodplain)

Project name (click on the project name to visit the website)	Eligible expenditures (in € million)	Total cost (in € million)	Funding share (in %)	Duration	Indicator
					forest permanently secured for nature conservation and climate change mitigation, first interactive floodplain experience site in Germany on the grounds of Burg Lenzen with eight exhibits and 20,000 visitors a year
	Project description: The project revolves around establishing a model, expansive, multiple-*Länder* network of floodplain habitats within a section of the Elbe River Landscape UNESCO Biosphere Reserve spanning Lower Saxony, Brandenburg, and Saxony-Anhalt.				
European flat oyster	0.81	4.4	18.3	2018 – 2024	Ecological indicators (examples): Number of oyster larvae and juvenile oysters reared Quantification of filtration performance (in litres and euros) of the juvenile oysters Socioeconomic indicators (examples): Increase in awareness of biodiversity and ecosystem services by means of educational material developed on the subject of oysters Increase in awareness through knowledge transfer and practical nature conservation work by creating a knowledge platform (online) and with a permanent exhibition on biodiversity and oyster ecosystem services
	Project description: Reintroduction of the European flat oyster in the German North Sea: Establishment of sustainable production of seed oysters for a long-term reintroduction programme				
Southern Harz gypsum karst	0.77	4.5	17.0	2018 – 2023	Habitat improvement for target species (e.g. yellow-bellied toad and common midwife toad) (indicator: habitat extent); conservation and promotion of the development of heaths, dry and limestone grassland, sparse orchards, etc. (indicator: conservation status of delimited habitat types), development of conservation fields (indicator: number of species and segetal flora cover)
	Project description: The remarkable natural features, diverse ecosystems, and inhabitants of the southern Harz region are to be safeguarded for the long term through species conservation measures and landscape management operations.				
Coastal treasure	0.53	9.95	5.3	2014 – 2021	Restoration of 200 ha of coastal floodplain. Indicator: Development of salt marsh flora. Development of recommendations for boating on bodden waters (Baltic coast lagoons) Indicators: Number of local authorities and associations supporting the recommendations, compliance, boat movements in sensitive areas. Construction of a common crane observation platform. Indicators: Number of visitors. Compilation of an information guide on conservation of the grey seal and visitor

Project name (click on the project name to visit the website)	Eligible expenditures (in € million)	Total cost (in € million)	Funding share (in %)	Duration	Indicator
					guidance. Indicator: Use of mobile fencing, knowledge among relevant stakeholders
	Project description: Sustainable development for the protection of biodiversity in the Western Pomeranian Bodden Landscape and Rostock Heath regions				
Ash dieback	0.52	2.4	21.8	2019 – 2025	Fungi (national responsibility species); plants (vascular plants, mosses and lichens) Habitat (soil, light and hydrology), land use, forest continuity (indicator: reference conditions (number of individual/coverage of target species, target species groups and population trends)) Ash dieback stages in old-growth ash trees; health status of ash saplings (indicator: reference conditions); establishment of ash saplings (indicator: establishment success and state of health of ash saplings)
	Project description: The FraDiv project, carried out by Christian Albrecht University Kiel in collaboration with practitioners in Schleswig-Holstein, plays a role in developing and implementing recommendations and measures for conserving biodiversity in the face of ash dieback.				
Garden dormouse	0.52	5.4	9.7	2018 – 2024	Ecological indicators (examples): Number of garden dormice reported via a new reporting website Knowledge of the species' current distribution; Extent of scientific knowledge on causes of decline Quality of the conditions in which garden dormice are kept in wildlife sanctuaries; professional reintroduction Number of connected, previously isolated garden dormouse populations Socioeconomic factors: Knowledge, attitude and action on garden dormouse conservation (examples: species recognition knowledge, attitudes towards nuisance factor, action in terms of willingness to take part in implementing conservation measures)
	Project description: The "Spurensuche Gartenschläfer" ("Tracking the Dormouse") project aims to get to the bottom of the causes for the decline of the garden dormouse. The findings will be used to develop an effective dormouse conservation strategy.				

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5.4. Coastal defences and flood protection

5.4.1. Grants to fund flood protection facilities, the renaturation of dykes, torrent control and the renaturation of water bodies

Budget chapters and items:	**Annex 1 to 1003 (1095) 882 15**					
Eligible expenditures 2020:	**€75.5 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**1,152 funding cases**					
	405,137 ha protected area from construction and reinforcement of flood defences and torrent regulation works					
	38 ha retention area gained by relocation and removal of dykes					
	541 km/1175 ha funding scope in near-natural river development					
Funding share:	**60% (federal government funding share)**					
EU environmental objectives		b)	c)			
Assumptions and limitations: GAK reporting by the *Länder*, reporting period 2020						
Links: • https://www.bmel.de/DE/themen/laendliche-regionen/foerderung-des-laendlichen-raumes/gemeinschaftsaufgabe-agrarstruktur-kuestenschutz/gak.html • https://bmel-statistik.de/fileadmin/daten/GAB-0002000-2020.pdf • https://www.guv-helbe.de/projekte-der-gewaesserentwicklung.html						

For general remarks on the Joint Task for the Improvement of Agricultural Structures and Coastal Protection (GAK), see Section 5.2.1 “Forestry measures”.

The above funding was used in 2020 to support both flood protection measures and near-natural watercourse development measures implemented by the *Länder* (60:40 federal government/*Länder* funding split):

- Construction and reinforcement of flood defences and torrent regulation works (761 funding cases; indicator: 405,137 ha protected area)
- Relocation and removal of dykes (2 funding cases; indicator: 38 ha retention area gained)
- Measures for near-natural watercourse development aim to help improve the ecological and chemical status of surface waters in rural areas. This includes the creation of riverine corridors and improving landscape water retention. (389 funding cases; indicator: 541 km/1175 ha funding scope)

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5.4.2. Grants for funding coastal defence measures

Budget chapters and items:	**Annex 1 to 1003 (1095) 882 61**					
Eligible expenditures 2020:	**€83.6 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**211 funding cases**					
	1,158,443 ha total protected area					
Funding share:	**70% (federal government funding share)**					
EU environmental objectives		b)	c)			
Assumptions and limitations: GAK reporting by the *Länder*, reporting period 2020. The protected area indicated above refers to the total area protected by coastal protection in the German coastal *Länder* and is therefore identical to the figure under point 5.4.4.						
Links: • https://www.bmel.de/DE/themen/laendliche-regionen/foerderung-des-laendlichen-raumes/gemeinschaftsaufgabe-agrarstruktur-kuestenschutz/gak.html • https://bmel-statistik.de/fileadmin/daten/GAB-0002000-2020.pdf • https://bmel-statistik.de/fileadmin/daten/GAT-6500100-2020.pdf						

For general remarks on the Joint Task for the Improvement of Agricultural Structures and Coastal Protection (GAK), see Section 5.2.1 “Forestry measures”.

A wide variety of precautions are taken in order to protect the coasts from excessive wind and wave erosion. They include dykes, breakwaters, groynes, barrages, sluices, pumping stations, seawalls, sand replenishment and dune planting. What measures are most effective in a particular case depends on local conditions, currents, surf and the coastal topography (low-lying or steep coast).

Planning, implementing and maintaining coastal defences is the responsibility of the *Länder*. The German coastal *Länder* each specify their coastal protection strategy in general coastal protection plans.

Due to the major importance of coastal protection, the federal government has contributed 70% of the costs of coastal protection measures carried out since 1973.

The above funding was used in 2020 for various measures to increase safety on the coasts, on the islands and on the flowing surface waters in the tidal area against flooding and land loss due to storm surges and sea attack (70:30 federal government/*Länder* funding split). Implementation is carried out by the coastal *Länder*.

The following measures are supported, to which the above indicators relate:

- Construction and reinforcement of flood defences, including dyke defence tracks and debris clearing tracks (181 funding cases)
- Barrages and other structures in the flood protection (8 funding cases)
- Groynes, breakwaters and other installations in the sea (4 funding cases)
- Foreshore works in front of seawalls up to a depth of 400 m (9 funding cases)
- Sand replenishment (9 funding cases)

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5.4.3. Federal share for funding the special framework programme for preventive flood protection measures

Budget chapters and items:	**Annex 1 to 1003 (1095) 882 82**					
Eligible expenditures 2020:	**€59.8 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**16,675 ha reclaimed floodplain area from the removal of dykes**					
	509,000,073 m³ retention area gained from measures to gain retention areas					
Funding share:	**60% (federal government funding share)**					
EU environmental objectives		b)				
Assumptions and limitations: GAK reporting by the *Länder*, reporting period 2020						
Links: • https://www.bmel.de/DE/themen/laendliche-regionen/foerderung-des-laendlichen-raumes/gemeinschaftsaufgabe-agrarstruktur-kuestenschutz/gak.html • https://bmel-statistik.de/fileadmin/daten/GAB-0002000-2020.pdf • https://rp.baden-wuerttemberg.de/themen/wasser/irp/ • https://www.lebensader-donau.de/verbesserung-hochwasserschutz-straubing-vilshofen/geplante-massnahmen-im-hochwasserschutz/						

For general remarks on the Joint Task for the Improvement of Agricultural Structures and Coastal Protection (GAK), see Section 5.2.1 “Forestry measures”.

In order to strengthen the support for urgent preventive flood protection measures, additional investment funds are made available to the *Länder* under the **GAK special framework plan “Measures for Preventive Flood Protection”**. Rivers regain more space as a result of dyke relocation. Designated retention areas and retention polders reduce the height of flood waves.

The above funding was used to provide additional support for numerous urgent investment measures for preventive flood protection in 2020. These included the following measures, to which the above indicators relate:

- The removal of dykes to improve flood protection, in particular to reclaim floodplains
- Measures to gain retention areas, such as the creation of flood retarding basins and polders

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5.4.4. Grants to fund coastal defence measures to counter the effects of climate change

Budget chapters and items:	**Annex 1 to 1003 (1095) 882 81**					
Eligible expenditures 2020:	**€26.8 million**					
GHG emission reduction:	**Pursues other objectives**					
Other indicators:	**68 funding cases**					
	1,158,443 ha total protected area					
Funding share:	**70% (federal government funding share)**					
EU environmental objectives		b)	c)			
Assumptions and limitations: GAK reporting by the *Länder*, reporting period 2020. The protected area indicated above refers to the total area protected by coastal protection in the German coastal *Länder* and is therefore identical to the figure under point 5.4.2.						
Links: • https://www.bmel.de/DE/themen/laendliche-regionen/foerderung-des-laendlichen-raumes/gemeinschaftsaufgabe-agrarstruktur-kuestenschutz/gak.html • https://bmel-statistik.de/fileadmin/daten/GAB-0002000-2020.pdf						

For general remarks on the Joint Task for the Improvement of Agricultural Structures and Coastal Protection (GAK), see Section 5.2.1 “Forestry measures”. For further information on coastal protection under the GAK, see Section 5.4.2.

Due to the changing climate, sea levels are rising more rapidly than previously predicted. This must be taken into account when dimensioning coastal protection structures. Planned or new coastal protection measures must be implemented more quickly. In order to meet the additional funding needs required for these priority measures, additional funding is made available through the **GAK special framework plan on Coastal Protection Measures in Response to Climate Change**.

The above funding was used to fund the following coastal protection measures in 2020, to which the above indicators relate:

- Construction and reinforcement of flood defences, including dyke defence tracks and debris clearing tracks (51 funding cases)
- Sand replenishment (2 funding cases)
- Bank protection works (15 funding cases)

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III. Methodology

Explanatory notes are provided in the following on the methodology for budget items with GHG estimates at budget item level. The methodology varies according to budget item, programme and project duration, ranging from ex-ante estimates and modelling to ex-post evaluation. For this reason, the figures are only aggregated (e.g. to provide an overview of significant contributions) to the extent that the estimation approaches allow.

Budget items	Eligible expenditures (in € million)	Methodology
1.1.2. Construction cost subsidies for investments in the federal rail infrastructure	1,385.0	For projects under the Federal Transport Infrastructure Plan 2030, ex-ante estimates were made of the change in life cycle emissions, meaning greenhouse gas emissions from the operation of rolling stock and from the construction, maintenance and repair of infrastructure.
1.1.4 Reduction in track access charges for rail freight transport	350.5	Model calculations from the evaluation report for the funding period 1 July 2018 to 31 December 2020. The GHG savings determined for the entire funding period are reported in proportion to the funding volumes.
1.1.6 Subsidies to private companies for investments in combined transport	48.1	Report on the evaluation of the "Guidelines on the promotion of transhipment facilities for combined transport by non-federally owned companies". The relief effect of 40.95 tkm per euro of funding used, on which the calculation is based, is an average figure calculated from the relief effect due to the additional transhipment volume of all CT terminals funded in the period 1998-2019. Applied to 2020 funding volumes and transport performance converted to GHG reduction.
1.1.7 Investment subsidies to private companies for the construction, expansion and reactivation of railway sidings	9.1	The CO_2 reduction figures are based on the findings of a 2019 evaluation of the sidings funding guidelines applied to the 2020 funding volume. The GHG emission reduction was calculated in the evaluation based on a comparison of the emissions of individual modes of freight transport for the reference year 2017, published by the Federal Environment Agency. This shows an average 84 g/tkm potential GHG emission reduction in rail freight compared to road freight. This reduction was multiplied by the transport performance shifted to rail in the verification period (ending 31 December 2018).
1.3.3 Local authority public transport pilot projects from 2018 to 2020 to complement the Immediate Action Programme for Clean Air	49.4	Analysis of the average number of car trips saved by the measures and estimation of the reduction in km travelled and GHG emissions.
1.4.1 Replacement, extension and construction projects relating to federal waterways	138.7	For projects under the Federal Transport Infrastructure Plan 2030, ex-ante estimates were made regarding the change in life cycle emissions, meaning greenhouse gas emissions from the operation of rolling stock and from the construction, maintenance and repair of infrastructure.

Budget items	Eligible expenditures (in € million)	Methodology
2.3.1 Investments to protect the climate and biodiversity abroad	592.5	The GHG reduction relates exclusively to mitigation effects obtained during the project period (ex-post). It does not include projected savings generated by, for example, the ongoing use of new technologies. The International Climate Initiative uses narrow definitions for the indicators in order to obtain plausible and reliable figures. Impacts are only counted if they are directly attributable to a project, arose during the project lifecycle and are sufficiently documented in the project. The figures reported here are relatively small as a result. The real impacts of the International Climate Initiative, including those that arise after the end of a project or indirectly as a result of it, can be assumed to be much higher.
4.3.1 Energy efficiency in industry and businesses	250.5	The savings determined in the evaluation report relate to the approved funding volume. The savings are therefore converted on the basis of the funding efficiencies identified in the evaluation report for GHG savings or end-use energy savings for the applicable eligible expenditures. The stated annual GHG savings and end-use energy savings apply from 2020 for an eight-year lifetime.
4.3.2 Providing advice on energy efficiency	60.7	Evaluations of energy advice to private consumers, for residential buildings, non-residential buildings, installations and systems. The average reductions identified in the evaluations for each consulting format are multiplied by the annual case numbers in the various programmes.
4.3.3 Heating Optimisation Programme	34.8	The reduction figures are based on the final evaluation of the heating optimisation funding guidelines. The data reported here differs from the figures in the final evaluation report due to a different accounting logic in the NAPE notification. The figures are broken down according to the approval date. The cumulative total over all funding years is the same in both reports.
4.3.4 Energy efficiency incentive programme	12.8	The GHG reduction figure relates to the lifetime of the systems for which funding was paid out in 2020. The timing of implementation may vary from this. The GHG reduction is determined by extrapolating from the funding efficiency of the market incentive programme in 2019.
4.4.1 National Climate Initiative	138.6	The GHG emission reduction for 2020 is estimated by approximation based on the eligible expenditures for 2020 in the individual programmes of the National Climate Initiative and the net figures for the ex-post funding efficiency (CO_2 reduction per euro) from the 2018/2019 evaluation report.
5.1.3 Subsidies to fund measures for improving energy efficiency in agriculture and horticulture	25.7	The data on reductions refers to the projects for which funding was paid out in 2020, some of which began to be implemented in 2019. The sum total GHG emission reductions are based on calculations or expert appraisals on each individual project.

IV. Acknowledgements

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- Federal Ministry for Economic Affairs and Energy (BMWi)
- Federal Ministry of Food and Agriculture (BMEL)
- Federal Ministry of Transport and Digital Infrastructure (BMVI)
- Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)
- Federal Ministry of Education and Research (BMBF)
- Federal Ministry for Economic Cooperation and Development (BMZ)

The names and responsibilities of the ministries correspond to the structure of the ministries in the 2020 financial year.[72]

Furthermore, thanks are due to the many project partners, authorities and funding agencies that implement the funding programmes and hence contribute significantly to impact reporting.

[72] Official order according to the announcement of the formation of the government on 14 March 2018 in the Federal Gazette of 16 March 2018: https://www.bundesanzeiger.de/pub/publication/OfWcxTATaMQbtpse55z?0

V. Glossary

a	Year
ABS	*Ausbaustrecke* (rail upgrade)
AI	Artificial intelligence
BAFA	Federal Office of Economics and Export Control
BB	Brandenburg
BY	Bavaria
CO_2	Carbon dioxide
CO_2e	CO_2 equivalents for all greenhouse gases
CT	Combined transport
DAC	Development Assistance Committee (OECD committee)
DB AG	Deutsche Bahn AG
DLR	German Aerospace Center
EKF	Energy and Climate Fund (from 2022 Climate and Transformation Fund (KTF))
FTIP	Federal Transport Infrastructure Plan
GAK	Joint Task for the Improvement of Agricultural Structures and Coastal Protection
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
H_2	Hydrogen
ha	Hectare
HE	Hesse
ICMA	International Capital Market Association
IZB	Infrastructure Condition and Development Report
km	Kilometre
KfW	Kreditanstalt für Wiederaufbau
LPT	Local public transport
LULUCF	Land use, land-use change and forestry
MW	Megawatt
MWh	Megawatt-hour
N/A	Not available
NAPE	National Action Plan on Energy Efficiency
NBS	New rail line
NDC	Nationally determined contributions to Paris climate targets
NIP	National Innovation Programme
NO_x	Nitrogen oxides
NRVP	National Cycling Plan
NW	North Rhine-Westphalia
O_2	Oxygen
PEM	Proton exchange membrane
PHA	Polyhydroxyalkanoates
Pkm	Passenger kilometres
PM	Particulate matter
PTL	Power-to-liquid
PV	Photovoltaic
R&D	Research and development

RP	Rhineland-Palatinate
SAFs	Sustainable aviation fuels
SL	Saarland
SMEs	Small and medium-sized enterprises
ST	Saxony-Anhalt
t	Tonne
TC	Technical cooperation
TH	Thuringia
tkm	Tonne-kilometre
UBA	Federal Environment Agency
USD	US dollars

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