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Climate and energy investment map in Germany

Status report 2016

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Project in brief

The EU Member States must mobilise significant capital to achieve EU energy and climate targets for 2030. Many States have limited experience in mobilising private capital and must now build the knowledge and capacity to do so. The project '**Climate investment capacity (CIC2030): climate finance dynamics & structure for financing the 2030 targets**' aims to address this challenge by supporting the development of prototypes to (a) track current climate and energy investment volumes and patterns in a given country; (b) analyse existing investment needs and gaps against energy and climate targets; and (c) develop plans to raise capital and close current funding gaps. This report addresses point (a) and the development of a climate and energy investment map (CEIM) for Germany as a frontrunner in the European energy transition. In parallel, the project focusses on point (b) and the preparation of a prototype for a German investment need and gap assessment (INGA). It will then transfer and adapt this knowledge to national circumstances in selected Member States, namely Czechia and Latvia. Using a learning-by-doing approach, the latter countries will prepare similar prototypes as well as additional plans to raise capital and close existing investment gaps.

Report abstract

This report aims to contribute to the discussion of EU Member States' upcoming National Energy and Climate Plans (NECPs), in which Member States are required to present information on existing investment flows to decarbonisation efforts. The report assesses existing data sources and climate-finance tracking systems to estimate climate and energy investment in Germany in 2016. It presents a map illustrating the volume of climate and energy investment flows – from the financing sources, through the intermediaries and financial instruments, to the recipient sectors (i.e. agriculture, buildings, energy, industry, and transport sectors). The map provides insight into who invests how much into what kind of measures. It is intended to serve as an example for Latvia and Czechia as they seek to replicate this exercise. The report also points to the status of available information and discusses the various methodological and data challenges encountered in the analysis.

Disclaimer

This project is part of the European Climate Initiative (EUKI – www.euki.de) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). It is the overarching goal of the EUKI to foster climate cooperation within the European Union (EU) in order to mitigate greenhouse gas emissions. The opinions put forward in this report are the sole responsibility of the authors and do not necessarily reflect the views of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

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Acronyms

Acronyms in English		Acronyms in German	
BAFA	Federal Office for Economic Affairs and Export	**BAFA**	Bundesamt für Wirtschaft und Ausfuhrkontrolle
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety	**BMU**	Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit
BMVI	Federal Ministry of Transport and Digital Infrastructure	**BMVI**	Bundesministerium für Verkehr und digitale Infrastruktur
BMWi	Federal Ministry of Economics and Technology	**BMWi**	Bundesministerium für Wirtschaft und Technologie
BMEL	Federal Ministry of Food and Agriculture	**BMEL**	Bundesministerium für Ernährung und Landwirtschaft
BNetzA	Federal Network Agency	**BNetzA**	Bundesnetzagentur
CAP	Common agricultural policy	**GAP**	Gemeinsame Agrarpolitik
CEF	Connecting Europe Facility (-E for Energy and Infrastructure, and -T for Transport)		
CEIM	Climate and Energy Investment Map		
CPI	Climate Policy Initiative		
CO_2	Carbon dioxide		
EAFRD	European Agricultural Fund for Rural Development	**ELER**	Europäische Landwirtschaftsfonds für die Entwicklung des ländlichen Raums
EAGF	European Agricultural Guarantee Fund	**EGFL**	Europäischen Garantiefonds für die Landwirtschaft
ECA	European Court of Auditors		
EEA	Renewable Energy Agency	**EEA**	Erneuerbare Energien Agentur
EEG	Renewable Energy Sources Act		Erneuerbare-Energien-Gesetz
EEPR	European Energy Programme for Recovery		Europäisches Energieprogramm zur Konjunkturbelebung

Acronyms in English		Acronyms in German	
EIB	European Investment Bank		Europäische Investitionsbank
ERDF	European Regional Development Fund	**EFRE**	Europäische Fonds für regionale Entwicklung
FIT	Feed-in tariff		Einspeisevergütung
GAK	Joint Task for the Improvement of Agricultural Structures and Coastal Protection	**GAK**	Gemeinschaftsaufgabe Agrarstruktur und Küstenschutz
GFCF	Gross fixed capital formation		
GHG	Greenhouse gas		
IPCC	Intergovernmental Panel for Climate Change		
KfW	Credit Institution for Reconstruction	**KfW**	Kreditanstalt für Wiederaufbau
LFI	Financial institution of a German federal state [*Land*, plural *Länder*]	**LFI**	Landesförderinstitut
NKI	National Climate Initiative	**NKI**	Nationale Klimaschutzinitiative
NECP	National energy and climate plan		
PCI	Projects of Common Interest		
R&D	Research and development		
SME	Small and medium-sized enterprises		
TEN	Trans-European Networks (-E for Energy and -T for Transport infrastructure)		
UBA	Federal Environment Agency	**UBA**	Umweltbundesamt

Contents

Executive summary

Addressing climate change will require the redistribution of investment towards climate-friendly solutions as well as an overall increase in such investment. As one important element in addressing this challenge in the European Union (EU), the Regulation on the Energy Union Governance requires the EU Member States to create national energy and climate plans (NECPs). These must include details on current investment flows to the decarbonisation of Member State economies.

The present report aims to contribute to the discussion of current climate and energy investment in Germany by evaluating recent data for 2016 and comparing it to a similar assessment conducted for 2010 (Juergens et al. 2010). The report is also intended to assess whether the methodological and data challenges encountered in such assessments have changed since 2010.

The principal output of this report is a climate and energy investment map (CEIM) for Germany for the year 2016. This map provides a snapshot of climate and energy investment flows, from the sources of capital, through the relevant intermediaries and financial instruments, to the recipient sectors.

The map was created using a **bottom-up approach,** tracking **actual 2016 disbursements** at a technology level and aggregating them at sector and then country level. We considered only climate-specific **tangible investment** (i.e. energy-efficient equipment, infrastructure, buildings, and renewable energy technologies targeting or resulting in greenhouse gas (GHG) emissions reductions and/or increases in carbon sinks). Soft measures (i.e. research and development, information campaigns, and policy development) play a key role in driving the energy transition and climate-change mitigation; however, these were excluded from our analysis.

The map reflects both total capital investment and incremental investment. The incremental investment represents the additional expenditure necessary to invest in a low-carbon technology rather than a business-as-usual practice. Total capital investment reflects the full cost of a technology or practice.

Based on the climate-specific investment flows traced here, **we observe a 16% increase in the volume in 2016 (EUR 42.7 billion) relative to 2010 levels (EUR 36.7 billion)**. These volumes reflect the share of incremental investment in energy efficiency (EUR 8.5 billion), the total investment cost of renewable energy deployment (EUR 25.0 billion), and the total investment cost of non-energy-related mitigation and cross-cutting measures (EUR 9.3 billion). Relative to 2010 investment, the **volume of flows to renewable energies** decreased by 6%, while **the volume of flows to energy efficiency increased** by 18%.

We calculated total investment[1] in energy efficiency (EUR 29.0 billion) for 2016, as well as the incremental share of investment cost reflected in the comparison above (EUR 8.5 billion). Total investment across all technologies (including energy efficiency, renewable energy, and non-energy-related mitigation and cross-cutting measures) was EUR 63.2 billion in 2016. The report text provides an analysis of the total investment volume, except where stated otherwise.

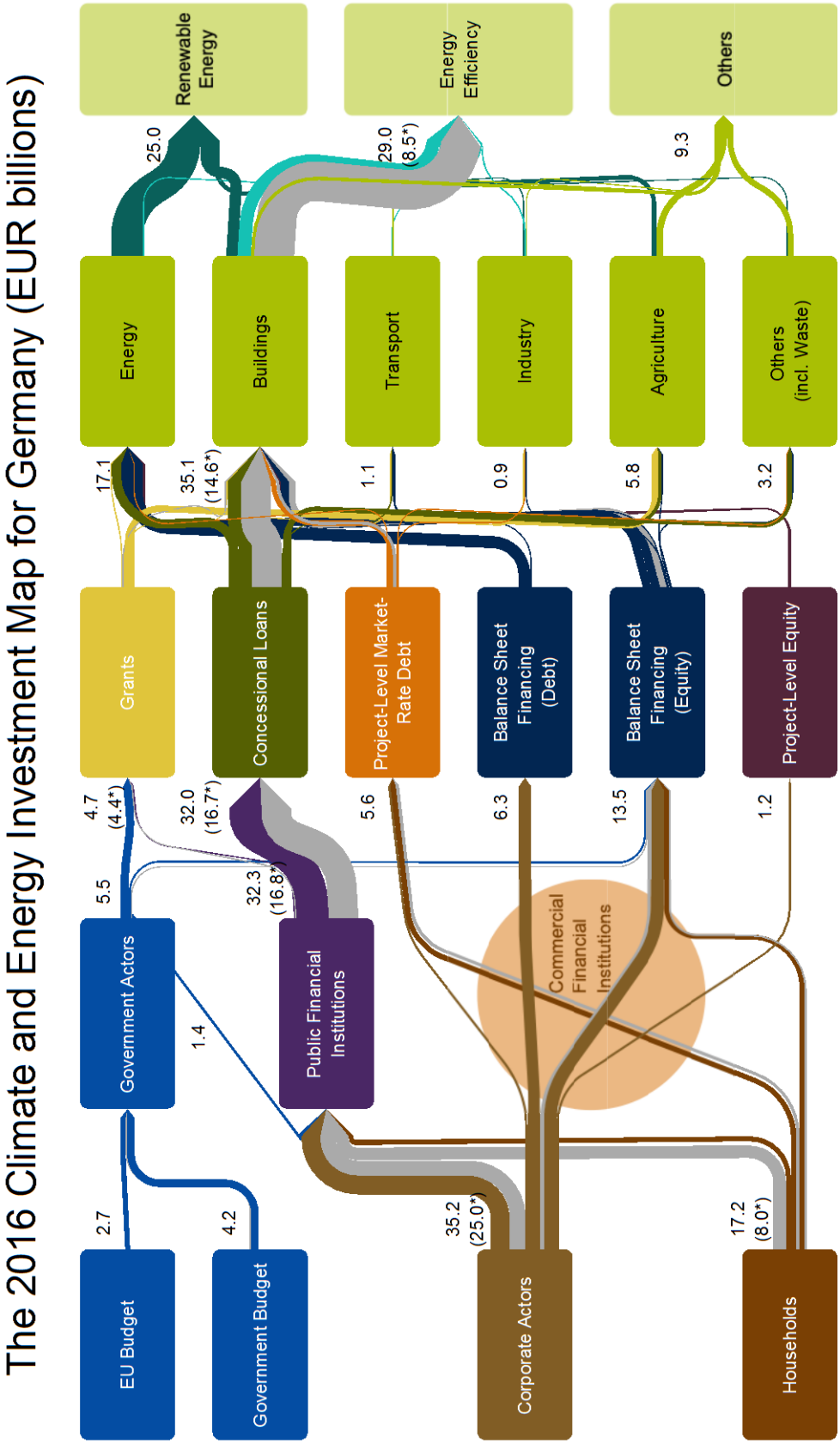
The private sector accounted for 83% of total investment (EUR 52.3 billion); the remaining 17% originated in the public sector (EUR 10.9 billion). Corporate actors remained by far the largest private investors (EUR 35.2 billion), followed by households (EUR 17.2). In the public sector, the German government budget played the largest role (EUR 4.2 billion), followed by the EU budget (EUR 2.7 billion).

Germany is characterised by strong public promotional banks at federal level (e.g. KfW, Rentenbank, sixteen state-level promotional banks, and a large number of commercial banks). Our study indicates that public banks played a large role in providing means to finance climate-change mitigation measures and the energy transition. Altogether, they disbursed EUR 32.3 billion to support climate-specific investment. We were unable to evaluate the role of commercial banks due to the limited availability of relevant data.

In 2016, both **low-cost debt** (EUR 32.0 billion) **and grants** (EUR 4.7 billion) **offered by public actors played an important role in driving climate investment**. Due to the lack of data, there is significant uncertainty around the EUR 26.6 billion delivered through other financial instruments, such as balance-sheet financing, project-level equity, and market-rate debt.

The sectors that attracted **the largest share of investment were the buildings sector** (total: EUR 35.1 billion, incremental: EUR 14.6 billion) **and the energy generation and transmission sector** (total: EUR 17.1 billion). These sectors are also those with the highest sector-specific targets for GHG emission reductions by 2030 (BMU 2016a), namely 66–67% for buildings and 61–62% for energy. However, total investment volumes do not measure effectiveness in actual GHG reductions, and care should be taken in assessing such volumes in relation to GHG emissions-reduction targets. Other sectors that attracted less climate and energy investment include the agriculture (total: EUR 5.8 billion), transport (total: EUR 1.1 billion), and industry (total: EUR 945 million) sectors, as well as cross-cutting measures (total: EUR 3.2 billion).

[1] Except for household electrical appliances in the buildings sector, blast furnaces, or newly built power plants used in manufacturing, for which the incremental cost was included in the total investment figure.



Notes:
a) All financial flows except for the grey ones represent total tangible investment including public support into the reduction of GHG emissions and increase of carbon sinks with two exceptions, namely electrical appliances in the building sector, as well as blast furnaces and new power plants in manufacturing. The grey flows represent incremental investment into energy efficiency of buildings. Financing of intangible measures was excluded.
b) The government budget includes federal budget disbursements and co-financing of EU funds to support the investment in 2016, but it excludes public procurement and administrative costs. Regional and municipal investments are not covered, except when reported in the EU / federal budget, KfW and BAFA programmes.
c) Debt owed does not represent the actual finance flows (e.g. debt repayment), but it is shown to highlight the original investors or asset owners who make use of public and commercial financial institutions as financial intermediaries. The map includes only primary investment flows, e.g. the resources available to investors at the time they had to cover for their capital expenses. . It does not cover therefore such financial instruments as guarantees, green bonds, the cost of capital or debt repayment by investors, the compensation payments from the public budget to energy generators supplying renewable electricity under the feed-in tariff, and others.
The following differences between 2010 and 2016 reports affect the finance volumes:
a) In this report, we account for total and incremental cost of energy efficiency investment into the building sector. This allows to add up investment across sectors and to compare 2010 and 2016 figures.
b) In 2016, investments in non-residential buildings are reflected under "Buildings" instead of consolidating it under "Industry, Tertiary, Transport" as in Jürgens et al. 2012.
c) We acknowledge the application of the climate markers to track climate expenditure of the EU funds targeting the energy, transport and agricultural sectors in 2016, while Jürgens et al. 2012 applied the same definition of climate finance to all sources of finance and sectors. This change leads to an increase of estimated grant volume by EUR 2.3 billion in 2016.
d) The instrument "Equity" used in 2010 is now split up into "Balance Sheet Financing (Equity)", and "Project-level Equity".
e) We now account for investments into technologies and measures related to the waste sector, which adds another EUR 1.0 billion EUR to the total volume reflected in the 2016 CEIM for Germany.

Challenges associated with data availability and format make a comprehensive and unbiased overview of climate finance in Germany impossible. Future climate and energy investment **assessment exercises would benefit from the introduction of systematic tracking procedures for domestic public climate finance that covers federal, regional, and local government budgets and climate programmes implemented by public banks and agencies.** Possible approaches to such procedures include the introduction of climate tagging in public budgets and/or the establishment of annual evaluation procedures. In addition, **investment assessments could be improved by evaluating and streamlining existing private-sector surveys and reporting efforts with the government's climate-investment tracking approaches.**

There is also a need for further debate on **what constitutes climate finance at the domestic level.** The discussion should address **how and to what extent climate-related measures such as infrastructure projects should be accounted for**. Similarly, **practicable approaches to calculating incremental costs of climate investment,** especially in the building sector, should be developed further to prevent over- or underestimating related investment. In establishing a comprehensive and consistent tracking approach for Germany, it will be useful to review the lessons learned from relevant legislation implemented elsewhere, such as in France, and from the application of climate markers by the EU Commission.

1. Introduction

1.1. Background and objective of this report

Global climate assessments (IPCC 2014; IPCC 2018) agree that there is an urgent need to change global patterns of energy production and consumption, land use, and lifestyle to limit warming to 1.5°C relative to pre-industrial levels. Such assessments have also emphasised the importance of adapting to impacts from changes in climatic variability and global warming. These changes will require a redistribution of investments towards climate-friendly solutions, as well as an overall increase in such investment. Even though the European Union (EU) is among the global leaders in energy transition, meeting the targets of the 'Clean Energy for All Europeans' package alone will require the mobilisation of EUR 11.2 trillion of largely private capital by 2030 (EC 2016a).

As one important element in addressing the investment challenge, the Regulation on the Energy Union Governance (EC 2016b) requires the EU Member States to design national energy and climate plans (NECPs) based on a common template. These must include analytical details on current investment flows to the decarbonisation of Member State economies.

The present report aims to contribute to the discussion of current climate and energy investment in Germany by assessing the most recent data available, i.e. for the year 2016. The first and last comprehensive assessment of such investment in Germany was prepared by Climate Policy Initiative's (CPI) Berlin office based on 2010 data (see the German Landscape of Climate Finance, Juergens et al. 2012). The objective of the present report is to update available information, analyse data and draw conclusions, and then compare these with conclusions from 2010. The objective is also to provide an update on whether methodological and data challenges associated with such assessments for Germany have changed since 2010.

1.2. Why is the German case study so interesting?

In 2016, Germany, with roughly 82 million inhabitants, was ranked the 12th richest economy in the world in terms of GDP per capita (OECD 2018). Germany has won international recognition for its leadership in the energy transition, a role that dates back to the 1970s, when it introduced energy efficiency and energy-supply diversification policies. Germany set more ambitious policy goals in 2010 with the adoption of the Energy Concept and *Energiewende* law (BMWi and BMU 2010): it pledged to reduce its GHG emissions by 80–95% by 2050 relative to 1990 levels and to carry out a complete nuclear phaseout.

In 2013, three German political parties (the CDU, CSU, and SPD) came to a coalition agreement defining the country's emissions pathway towards these targets. In 2016, the German cabinet adopted the Climate Action Plan 2030 (BMU 2016a), which presents guiding principles, milestones, and measures for the whole economy. It sets intermediate country-wide and sector-specific targets for 2030, identified in Table 1.

Table 1. 2030 targets for sector and total GHG emissions reductions in Germany

Sector	Target
Energy	- 61 to - 62%
Buildings	- 66 to - 67%
Transport	- 40 to - 42%
Industry	- 49 to - 51%
Agriculture	- 31 to - 34%
Other	- 87%
Total	- 55 to - 56%

Data source: BMU 2016a.

Despite Germany's leadership in the global energy transition, the targets pose a challenge for the country. As the table illustrates, it must reduce its emissions by 55–56% by 2030 relative to 1990 levels. By 2017, Germany had achieved 27.7% of its emissions-reduction target; however, reductions were negligible between 2014 and 2017 (Figure 1). Primary energy demand followed a similar trend, declining from 2010–2014 but rising again in 2015 (BMWi 2018c). If Germany is to achieve its long-term decarbonisation targets, additional investment is needed.

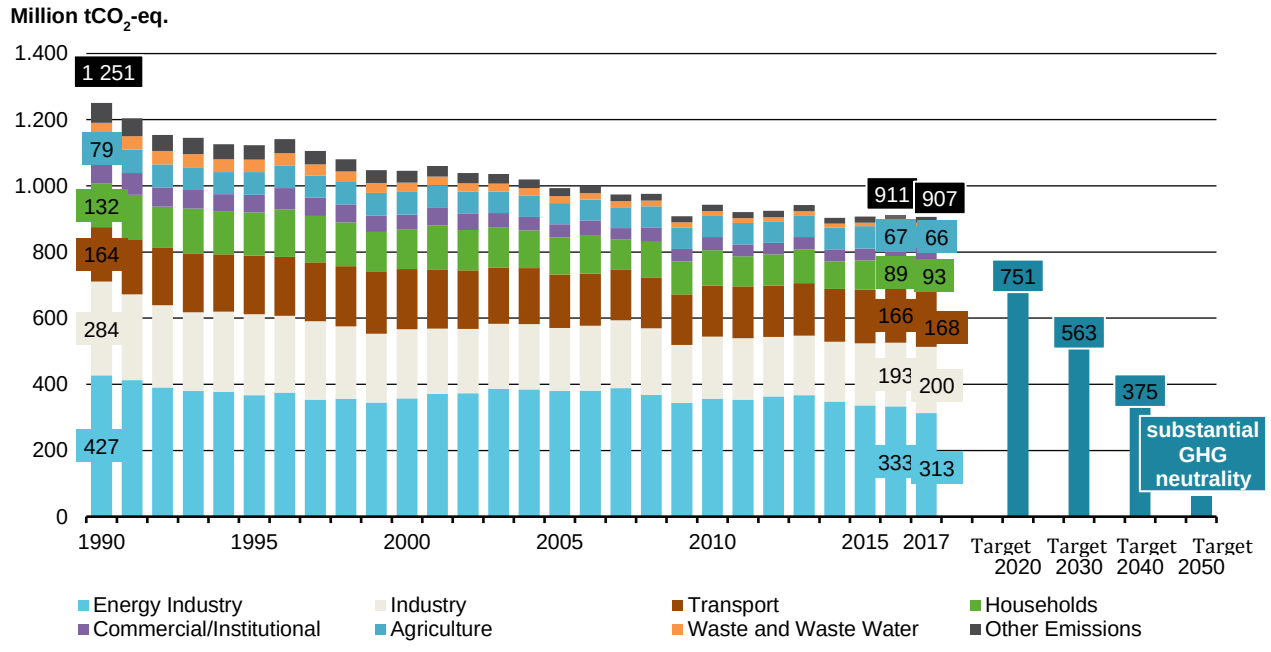


Figure 1. GHG emission trends, excluding land use, land use change, and forestry

Source: UBA 2018a.

1.3. Research output, questions, and structure

The main output of this report is a climate and energy investment map (CEIM). The CEIM identifies the actors investing in climate-change mitigation and the energy transition in Germany in 2016, as well as the amount that they invested, the financial intermediaries and instruments that played key roles in this process, and the sectors and types of technological installations that absorbed these investments. The map replicates the concept of the 'Landscape of Domestic Climate Finance' (see section 2.1). Where possible, our analysis compares current conditions for investment in climate and energy investment with those of 2010. In addition, we discuss the status of climate- and energy-investment tracking in the country.

Specific questions addressed in this report include:

- How much capital was invested in climate and energy transition measures in 2016?
- Who were the main investors?
- What financing instruments were the most common?
- Which sectors and type of technological installation were financed?
- Do the methodological and data challenges observed in 2010 continue to exist or have these been overcome?

This report consists of three chapters. Following this introduction, chapter 2 introduces the analytical and methodological framework for the CEIM; chapter 3 discusses selected results; and the conclusion summarises key findings of our assessment. Annexes provide details on the input data, assumptions, and references for the evaluation.

2. Methodology

2.1. Analytical framework

The principal output of this report is a climate and energy investment map (CEIM) for Germany. In this report, climate and energy investment is defined as spending by public and private actors for gross fixed capital formation (GFCF) that leads to a GHG emissions reduction in line with the German Climate Action Plan 2050 (BMU 2016a). According to EUROSTAT guidelines (ESA 2010), GFCF covers expenditures to acquire physical assets, such as buildings and transport infrastructure. This report also tracks expenditures for durable goods acquired by households that are not covered by GFCF, e.g. individual vehicles. In addition, it assesses expenditures by public actors to support climate-friendly activities (e.g., climate-friendly land management).

The map represents climate and energy investment flows – from the sources of capital and the relevant intermediaries, through the instruments used, and ultimately to the recipient sectors. The construction of the diagram uses a bottom-up approach, tracking investment at a technology level and aggregating it at sector and then country level. The map identifies the type of actors who invest, the amount they invest, the sectors and types of technological installations that absorb these investments, and the intermediaries and financial instruments that facilitate these flows.

The approach to tracking climate finance flows was introduced in 2011 by CPI, which tracked these at global level using the Landscape of Climate Finance diagram (Buchner et al. 2011). As discussed in the introduction, CPI tracked climate finance flows in 2010 in Germany, developing the global approach into a framework suitable for analysing national-level data at a meaningful level of sectoral disaggregation (Juergens et al. 2012). Following Germany's know-how, the Institute for Climate Economics (I4CE) adopted and further developed the approach to track climate investment for France on an annual basis, beginning in 2011 (Hainaut et al. 2018). The CEIM represented in this report mirrors the landscape method applied for Germany in 2012, updating these findings with the most recent data and analysing differences between these financial flows and 2010 volumes.

2.1.1. Sources of investment

The CEIM differentiates public and private sources of investment. Public sources include spending from the **EU budget** through EU funds, including the European Agricultural Fund for Rural Development (EAFRD), European Agricultural Guarantee Fund (EAGF), European Energy Programme for Recovery (EEPR), European Regional Development Fund (ERDF), and Connecting Europe Facility (CEF). Other public sources are national **government budgets**, including those at federal, regional, and local

levels. Spending by these entities takes two forms. It can be rendered as a direct investment in low-carbon public assets (e.g. investment in energy efficiency and renewable energy generation deployed in municipal buildings) or as public finances provided to private and public actors as a financial incentive to invest (e.g. grants to purchase electric cars).

Private sources of investment include **households** and **corporate actors** in agriculture and forestry, energy generation and infrastructure, mining and quarrying, manufacturing industries, water supply, etc. (For sector definitions, see section 2.1.4.).

The CEIM excludes German public expenditures for GHG mitigation executed in other countries and private foreign direct investments in Germany.

2.1.2. Intermediaries

Intermediaries enabling investment in climate mitigation are **government actors**, **public financial institutions**, and **commercial financial institutions**. Government actors are federal states, federal ministries, and government agencies, such as the Federal Office for Economic Affairs and Export Control (BAFA). Public financial institutions include the European Investment Bank (EIB), Kreditanstalt für Wiederaufbau (KfW), Rentenbank, and financial institutions of federal states [*Länder*], or LFIs (see Annex 6 for a complete list). Commercial financial institutions represent different actors, such as commercial banks, pension funds, and investment funds. These play an important role in financing climate mitigation, but we did not quantify flows supported by them.

2.1.3. Financial instruments

This report covers a wide range of financial instruments that support investment in climate mitigation, namely **grants**, **concessional loans**, **project-level market-rate debt**, **balance-sheet financing (debt)**, **balance-sheet financing (equity)**, and **project-level equity**.

In keeping with the methodology used in the Landscape of Climate Finance in Germany 2010 (Juergens et al. 2012), we tracked only primary investment flows, e.g. the resources available to investors at the time when they had to cover their capital expenses or resources that they could reliably call in to cover their expenses immediately after the expenses were incurred (I4CE 2019). For this reason, we excluded risk-management instruments, such as guarantees, the cost of capital or debt repayments, repayment grants, feed-in tariffs, or green bonds issued in Germany, although these can play an important role in enabling investment in climate mitigation. Accounting for these flows would lead to an overestimation of climate and energy investments and may result in double-counting. For the definition of financial instrument mentioned, see the recent version of CPI's Global Landscape of Climate Finance (Buchner et al. 2017).

2.1.4. Recipients

In the CEIM, we associate specific climate-mitigation technologies with each of six sector recipients, including energy generation and infrastructure, industry, buildings, transportation, and agriculture (including waste). The sectors were defined according to energy balances of Germany (AGEB 2017), the Federal Statistical Office classification WZ2008 scheme (Destatis 2007) and assumptions, as presented in Table 2.

Table 2. Sector delineation

Sector	Sector boundaries
Energy generation and infrastructure	Covers technologies and practices implemented by WZ2008 classes D 'Electricity, gas, steam, and air conditioning supply', but focusses primarily on D35.1 'Electric power generation, transmission, and distribution'. We account for the deployment of renewable energy technologies as well as infrastructure for the transmission and distribution of gas and electricity from renewables.
Industry	Covers technologies and practices implemented by WZ2008-B (mining and quarrying) and WZ2008-C (manufacturing industry), including the deployment of renewable energies, energy efficiency, activities that reduce emissions from industrial processes, and the use of solvents and other products such as pesticides, lubricants, waxes, and paraffins.
Buildings	Covers technologies and practices implemented in and at buildings that belong to households, public, and commercial actors. The latter largely corresponds to classes WZ2008-F to WZ2008-S (Destatis 2007). Office buildings of the energy, industry, and agriculture sectors are included here, while their barns and production facilities are not. We account for such investment as thermal efficiency improvement of building envelopes, installations of energy efficient building systems, installation of building-integrated renewable energy systems in buildings, and energy-efficiency improvement of appliances and equipment.
Transport	Covers investment in infrastructure such as bike tracks, modal shift (from road to rail), and low-emission modes of transport, such as electromobility and reduced fuel consumption, e.g. by lowering rolling resistance or low-emission motors.
Agriculture including afforestation	Covers technologies and practices implemented by WZ2008 class A (Agriculture, forestry and fishing), including all of agriculture, but excluding fisheries and forestry-related practices except afforestation.
Others incl. cross-cutting and waste	Covers technologies and practices that cannot be clearly attributed to any of the sectors above; this includes investment supported by KfW schemes not clearly associated with the above classifications. In addition, investments by WZ2008 class E (Water supply; Sewage and waste disposal and removal of environmental pollution) are reflected here.

In the CEIM diagram, investment in the sector recipients was further grouped according to three types of technological installations, namely renewable energy, energy efficiency, and others. Annexes 1–6

provide information on all investment flows identified by our assessment, with a detailed breakdown by sector and technology.

2.2. Scope and boundaries

2.2.1. Temporal scope

This report tracks climate and energy investment that were disbursed in 2016, not the investments that were planned or committed for that year. As of today, 2016 is the most recent year for which energy statistics, audited public budget expenditures, annual reports of financial institutions, and monitoring reports of public subsidy programmes are available.

2.2.2. Investment scope: specific versus related

This report relies on the differentiation between climate-specific and climate-related investment used in Juergens et al. (2012). For the purpose of this analysis, these categories are defined as follows:

- Climate-specific investment has energy transition and/or climate change mitigation as its primary objectives, and it targets or results in GHG emission reduction and/or an increase in carbon sinks.[2] Examples are renewable energy investments to replace fossil fuels or energy-efficiency investments to reduce the use of fossil fuels.

- Climate-related investment does not have energy transition and/or climate-change mitigation as its primary objective or effect, but it targets activities that deliver co-benefits in terms of GHG emissions reduction and/or an increase in carbon sinks. One example is investment in organic farming, which can lead to an increase in soil carbon storage and a reduction in nitrous oxide (N_2O) emissions.

For our report, we included climate-specific investment in full and climate-related investment in part, either by extracting the climate-specific components of a climate-related budget line or investment programme, or by applying a scoring strategy, such as the use of climate markers recommended as part of the common methodology for tracking and monitoring climate expenditure in 2014–2020 for the European Structural and Investment Funds (see Box 1 below).

[2] The definition of climate-specific investment used in the literature (OECD 2016) and by the European Commission (EC 2014) includes investments targeting adaptation to climate change. While adaptation investment is outside the scope of the present report, the lack of differentiation (between mitigation and adaptation) in the EU's tracking approach has also been criticised by the ECA (European Court of Auditors 2016). The authors of this report share this criticism, as climate adaptation and mitigation are different policy objectives; corresponding investment should therefore be tracked separately, as the normative justifications vary for each at a given jurisdictional level.

Box 1. Climate markers for tracking climate-related expenditures of EU funds

In 1998, the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD) introduced 'Rio markers' to monitor and systematically track finance flows relevant to the Rio Conventions on biodiversity, desertification, climate-change mitigation, and adaption.

In 2014, the European Commission adopted a climate-marker system based on Rio markers to identify the climate-relevant share of 2014–2020 disbursement from the European Structural and Investment Funds. Climate mitigation can be a 'principal', 'significant', or 'untargeted' objective of policy action, which is then accounted for as 100%, 40%, or 0% climate-relevant. A descriptive table with sectoral examples of how to score against the markers has been published by the Commission and the OECD-DAC (EC 2014, pp. 29–30; OECD 2016, pp. 61–81). Recently, the European Court of Auditors (ECA) published an assessment of the EU's approach to tracking the 20% climate-finance target in the EU's multi-annual financial framework (MFF) and identified considerable room for improvement, not least in relation to the application of climate markers. The ECA identified a significant number of challenges to be addressed for the next MFF in a much-needed reform of the EU's tracking approach (European Court of Auditors 2016).

We applied the climate-marker methodology to track the disbursement of Connecting Europe Facility (CEF) funding in the energy and transport sector; the agricultural funding schemes of the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EAFRD); and the disbursement of the European Regional Development Fund (ERDF) in the transport and energy sector. Our approach follows the application of climate markers in the European budget reports and the Commission's publication of an explicit methodology for climate tracking in the 2014–2020 disbursements from the European Structural and Investment Funds.

We also followed this methodology to track climate-specific finance under the funding schemes of the European Energy Programme for Recovery (EEPR) in the energy sector. Climate markers were derived from relevant fields of the table provided in the common methodology for climate expenditure tracking of the European Commission (EC 2014).

2.2.3. Investment scope: tangible versus intangible

As explained in section 2.1.1, we tracked only tangible energy and climate investment, such as investment in material assets (e.g. machinery, equipment, infrastructure, or buildings). Actors may also spend money on intangible measures, often referred also to 'soft' measures, such as research and development, including feasibility and preparatory studies, information campaigns, training, and capacity-building activities. Due to time constraints, such spending was not included in this report. Where a programme included tangible and intangible components, we accounted only for the tangible components; if the components were impossible to separate, the programme was excluded from our calculation.

2.2.4. Investment scope: total versus incremental

For this report, we tracked total capital investment for all investment flows rather than incremental cost, with two exceptions. The incremental cost reflects the additional expenditure necessary to invest

in low-carbon technology instead of a business-as-usual practice, while total capital investment reflects the full cost of a technology or practice. The flows for which we tracked only the incremental cost represented investment in energy-efficient electrical appliances used in the building sector, as well as in energy-efficient blast furnaces and newly built power plants in the industrial sector (see Table 3).

Table 3: Summary of investment and cost delineations

	Climate-specific investment		Climate-related investment	
	Incremental cost	Total capital investment	Incremental cost	Total capital investment
Tangible	Building sector: energy-efficient electric appliances, thermal efficiency in new and existing buildings* Industry sector: energy-efficient blast furnaces and newly built power plants	Energy sector: renewable energy generation and related transmission grids and distribution networks Industry sector: renewable energy; energy and process efficiency Agriculture/ forestry sector: renewable energy, non-land-based agricultural CO_2 mitigation and agri-environmental practices marked as climate relevant by the European Commission Transport sector: electromobility, fuel switch, and sustainable transport infrastructure Building sector: thermal efficiency* and renewable energy integrated in new and existing buildings		Transport sector: public transport, including railways, cycle tracks, and road transport (includes CEF) Agriculture: sustainable farming practices, such as organic farming methods
Intangible	Policy development, Research and Development (R&D), information policies, training and capacity-building, land management			

Covered in this report Not covered in this report

**Both total and incremental investment was estimated for energy-efficiency investment in new and existing buildings.*

As in the 2010 report (Juergens et al. 2012), we also calculated the incremental share of energy-efficiency investment in buildings. Construction of new buildings and retrofit of existing buildings imply

the use of many non-energy-related technologies and practices (e. g. painting, and plastering), as well as a high share of business-as-usual construction or retrofit costs (e.g. the cost of a double-glazed typical window instead of an efficient triple-glazed window). The total investment cost of building construction and retrofits will therefore overestimate actual efforts towards energy transition. In other sectors, an estimate of total investment could be useful, particularly over time, e.g. to understand the learning cost curve and make market projections for individual renewable energy installations.

Box 2 provides details on how we calculated the incremental investment into the thermal efficiency improvement of existing and new buildings. The estimate of this flow should be treated with caution due to the very limited time available for calculation.

Box 2. Incremental investment in the building sector

In this report, the incremental share of investment in the construction of a new building or the retrofit of an existing building refers to the additional investment made to improve the building performance that is beyond that defined by the 2016 minimum energy performance standard for buildings.

Construction of new buildings
The estimate is relevant to the construction and first purchase of new buildings supported by a range of KfW programs. The same assumption was used to calculate the incremental share of energy-efficiency investment for building-related equipment and systems installed in existing buildings and supported by BAFA programs. The 10% share of incremental investment in its total volume was derived from an analysis conducted by the Institute for Housing and Environment (Institut Wohnen und Umwelt (IWU)). The institute calculated additional energy-relevant retrofit costs per square metre for buildings that exceed the energy-performance standard required under the German energy-performance ordinance for 2016 (IWU 2016). We multiplied this cost by the average ground-floor area for a new house in Germany (Destatis 2018c) to estimate the additional energy-efficiency-related investment per new house. Dividing the latter figure by the average volume of investment in most typical new constructions or building purchase projects supported by KfW programmes yielded a 10% incremental share of energy-efficiency investment in total.

Retrofit of existing buildings
The estimate is relevant to the thermal efficiency retrofits of existing buildings supported by a range of KfW programmes. The same assumption was used to calculate the incremental investment that flowed into the retrofit of building-related equipment and systems supported by BAFA programmes.
The share of incremental investment in its total volume was estimated at 40% based on a study by the same institute, IWU. The study analysed the costs of energy-relevant building components and building systems in the energetic modernisation of old buildings (Hinz 2015, p.112). The share of incremental investment was calculated as a share of the energy-relevant costs of building components, reported as a percentage of the total costs for these components identified in the study. The study provided the costs for two scenarios, high-cost and low-cost; of these, 40% was the average share.

2.2.5. Overview of changes to the analytical framework and methodology

Our assessment applied the same analytical framework and methodology described in Juergens et al. (2012). However, some changes were necessary to improve the readability of this report and to account for the data limitations described in Table 4 and the next chapter.

Table 4. Summary of changes to the methodology of the 2010 study (Juergens et al. 2012)

Dimension	Change to the methodology
Climate-related spending in the EU budget	In this report, we applied the climate markers for climate-related disbursement to Germany from the EU budget, as discussed in Box 1. This approach differs from that used in the 2012 report.
Sources and intermediaries	We renamed and/or eliminated some map categories to increase specificity: • The actors and entities accounted for remained the same, but we renamed the (German) **public budget** category of 2010 to the (German) **government budget** used in 2016. • We did not quantify investment flows related to **capital markets** used in 2010, as data were and are limited. Instead, for 2016, we renamed capital markets as **commercial financial institutions** to make references to related actors more specific**, but we did not quantify related financial flows**. • For 2016, we did not quantify **foreign direct investment** in Germany or climate finance 'leaving' the country, such as through **overseas development assistance** (ODA), **foreign direct investment** (FDI) abroad, or contributions to budgets of multilateral organisations or carbon markets (Emission Trading Scheme – **ETS revenues**), or contributions from **philanthropy,** which were included for 2010.
Instruments	We also renamed certain categories of financial instruments: • The name of the **debt** category was changed to **project-level market-rate debt**. • The **equity** category was split into the following categories: **project-level equity** (covering household and government actors' investments in their own assets, e.g. buildings or cars, while also reflecting corporate share); **balance-sheet financing (debt);** and **balance-sheet financing (equity)**. For 2016 data, the consolidation of these three instruments into one **equity** category may have misrepresented the importance of equity.
Disbursement channels	We excluded this dimension from this report. While highlighting their role as an important element in mapping the flow of climate and energy investment, we did not quantify the contributions made through specific disbursement channels in the 2012 analysis, as no comprehensive or systematic data on these aspects were available.
Recipient sectors	In this report, we included investment in non-residential buildings under 'Buildings' instead of consolidating it into 'Industry, Tertiary, Transport' as in Jürgens et al. (2012). We introduced a new recipient sector, 'Cross-cutting/others', which encompasses all climate-mitigation investments that cannot be attributed to one specific sector, and WZ2008 class E ('Water supply'; 'Sewage and waste disposal and removal of environmental pollution').

2.3. Data sources used, data analysis, and limitations

In order to quantify 2016 climate and energy investment for Germany, we relied on data sources similar to those used in Jürgens et al. (2012). It should be noted that, in 2016, we benefited from new climate-finance tracking methods, e.g. the climate markers applied to the spending in the EU budget. In addition, certain key data sources were no longer available, e.g. data on finance from the National Climate Initiative (NKI) and data on private fuel-switch investment in the energy sector.

In identifying and tracking 2016 climate and energy investment in Germany, the main challenges were as follows (see Jürgens et al. 2012):

- The German government at all levels – from national to local – does not systematically track national budget contributions to climate-specific activities.
- Although there are surveys on annual climate-investment volumes from corporate actors in some sectors, quantifying the climate investment of the entire private sector is difficult.
- Tracking which financial instruments are used by whom for climate-specific activities is especially challenging.

The following sections address the sectoral data used in 2016 compared to 2010; the difficulties associated with the analysis; and the elements needed to prepare a systematic climate and energy investment map.

2.3.1. Energy generation and infrastructure

Energy infrastructure: As in 2010, the largest share of energy-infrastructure investment data was derived from reports by the Federal Network Agency (BNetzA) and was treated under the same assumptions as in 2010 for both the electricity and natural gas sector. In both 2010 and 2016, finances provided by EU funds, and investments supported by them, were estimated based on annual implementation reports of German *Länder*, expenditure reports on EU funds, and email communications. As discussed in Box 1, climate markers were applied to these figures in this report (100% for renewable energy infrastructure).

Renewable energy generation: In both 2010 and 2016, the total investment in renewable energy generation across the whole economy was derived from the statistics of the Renewable Energy Agency (EEA 2018). In both reports, this volume was broken down into sectors based on the ownership structure of renewable energy installations provided in the public domain by trend:research. (For further details, see Annex I on assumptions in the energy generation and infrastructure sector.)

The Federal Statistical Office (Destatis) estimates investment by energy supply companies in energy efficiency, renewable energy, and other, non-energy-related measures that lead to a reduction in GHG emissions (Destatis 2018a). The latter estimate represents much lower financial volumes than that estimated using the Renewable Energy Agency and trend:research data and was excluded from our investment map. We assumed that this difference resulted from a variation in methodology, reporting, and/or coverage.

Energy efficiency: In contrast to 2010, the 2016 investment in fuel switch (coal to natural gas), biomass co-firing, or retrofit/upgrade of power technologies could not be calculated due to limited information for the year 2016. For this report, despite our best efforts, we were unable to locate reliable information on investments by the 'big four' German energy generators (RWE, EON, Vattenfall, and EnBW) that would be comparable to the 2010 data.

2.3.2. Industry

Energy efficiency, renewable energy, and non-energy-related mitigation installations: The 2010 and 2016 reports both used the same statistics from the Federal Statistical Office for the industry sector, i.e. investment by mining/quarrying and manufacturing companies in energy efficiency, renewable energy, and other, non-energy-related measures that lead to a reduction of GHG emissions (Destatis 2018a). We assumed that finances provided by BAFA programs for energy-efficiency improvement in the industry sector, and investment supported by these programmes, were already included in the Destatis statistics.

As described in the previous section, the investment in renewable energy generation for all sectors and investors was estimated based on EEA (2018) and trend:research data. The latter estimates the renewable energy share for the industry and commercial actors combined. We assumed that the share of this volume representing investment in the industrial sector was reflected in the statistics of Destatis (Destatis 2018a), as discussed in the previous paragraph, while the remainder went to the commercial sector (i.e. the commercial building sector, according to our methodology).

Overall, the estimate of the renewable energy investment in the industry sector derived from Destatis is unexpectedly small compared to that of other sectors for which other data sources were used. However, these national statistics were the best available source of information on climate investment by industrial actors and allowed for year-over-year intra-sector comparison. Therefore, despite our use of this official source of statistical data, we acknowledge that it could produce a conservative estimate.

2.3.3. Buildings

Energy efficiency in new and existing buildings: In both 2010 and 2016, we estimated this flow as investment supported by KfW and BAFA programmes based on annual reports of these organisations. We tracked both the total investment volume supported by these programmes and its incremental share, as described in Box 2. For KfW products supporting both energy-efficiency improvement and renewable-energy integration in buildings (KfW-Effizienzhaus), we assumed that 90% of the investment volumes flowed to energy-efficiency technologies. The incremental share of energy-efficiency investment for 2010 was estimated based on considerations similar to those in the present report; however, its value was different.

Renewable energy integrated into buildings: Similar to energy efficiency investment volumes, we estimated the total renewable energy investment supported by KfW and BAFA based on their annual reports in both 2010 and 2016. In addition, as for KfW products supporting both energy-efficiency improvement and renewable-energy integration in buildings, we assumed that 10% of the investment volumes flowed into building-integrated renewable energy technologies. The remaining investment in building-integrated renewable energy was derived from the Renewable Energy Agency and trend:research data, as discussed in sections 2.3.1 and 2.3.2. (The investment supported by KfW and BAFA was subtracted to avoid double-counting.)

Efficient appliances and equipment: The estimates of investment in efficient appliances were calculated in both 2010 and 2016 using the same methodology. The actual investment should be much higher, however, because only a limited number of appliances were covered in both reports.

2.3.4. Transport

Purchase of energy-efficient cars: The approach in the 2010 report – i.e. to calculate incremental investments in energy-efficient cars – was not applicable to the 2016 report due to the concentration of total investment volumes. Instead, the purchases of electric cars derived from a detailed report by BAFA were used to calculate accurate private investments in e-mobility.

Hydrogen and fuel-cell technology: Data from NOW GmbH about investments in e-mobility model regions available in detail in 2010 were lacking in 2016 and therefore not fully replicable. In 2016, we derived the data at project level for all projects resulting in tangible assets (e.g. electric busses, charging infrastructure). Further details on the assumptions made are provided in Annex 4.

Energy-efficient street lighting: In contrast to 2010, investments in the energy efficiency of public street-lighting infrastructure could not be calculated in 2016 because of data missing from the National Climate Initiative (NKI), which was coordinated by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

Infrastructure: In 2016, we calculated the climate-specific share of disbursement for transport infrastructure from EU funds, applying the climate-marker share of 40% (as discussed in Box 1) to all climate-relevant budget lines, except those for road and air transport. We did not include disbursement from the national government in the investment map because it could only be labelled as climate-related, and we did not have an established methodology for calculating a climate-specific share.

If the climate-marker approach used to track climate expenditure in the EU budget were also applied to the German government budget, the climate-specific investment in sustainable transport infrastructure would amount to EUR 2.5 billion (i.e. 40% of the total climate-relevant investment of EUR 6.3 billion). Application of the climate-marker approach to sustainable infrastructure investment at national level could be especially helpful in solving the challenges associated with estimating the share of climate-specific investment in railway-infrastructure spending, which represents a significant volume. Overall, transport infrastructure investment makes up a major share of expenditure in the government budget, but the calculated portion of climate-specific investment cannot be allocated in the present report and therefore reflects only a conservative estimate of the actual investment volume.

2.3.5. Agriculture

Agri-environmental measures and non-land-based agricultural mitigation practices:

In 2016, we used EAFRD summary statistics on allocated funding for Germany that were broken down into climate-related and climate-specific measures and published by the Federal Ministry of Food and Agriculture (BMEL). In 2010, such statistics were not available, and we extracted climate-related and climate-specific budget lines to the best of our knowledge.

Another difference between our 2010 and 2016 reports is that, in 2016, we applied the climate markers to estimate the climate-specific share of the disbursement of EU funds, as discussed in Box 1. Thus, to account for climate-specific direct payments from EAGF to farmers, we used the climate markers as they were applied to payments for agricultural practices benefiting the climate and environment in the European Commission's 2016 Draft General Budget (item 05 03 01 11) (EC 2015b). Climate-specific shares from the EAFRD were also derived from climate markers based on the explicit methodology for climate tracking used by the Commission for all European Structural and Investment Funds

(EC 2015a). The climate markers were not yet in use by the European Commission at the time of the 2010 study.

It should be noted, however, that the allocation of climate-specific spending under the EAFRD has been criticised by the European Court of Auditors (2016) for overestimating climate-specific investment due to the full incorporation of priority areas P4 ('Restoring, preserving and enhancing ecosystems related to agriculture and forestry') and P5 ('Promoting resource efficiency and supporting the shift towards a low-carbon and climate-resilient economy in the agriculture, food and forestry sectors'). Both priorities were included with a 100% climate marker as climate-specific, although climate mitigation is not a principal or even secondary objective of all measures covered (e.g. measure M13 under priority P4: 'Payments for areas disadvantaged for natural or other specific reasons').

Energy efficiency: Data used in 2010 to calculate agricultural energy-efficiency investments under the BMU's National Climate Initiative (NKI) were not available for 2016 and therefore could not be incorporated into this report.

Renewable energy: In both 2010 and 2016, we used the Rentenbank annual report to estimate renewable energy investment in the agriculture sector supported by Rentenbank programmes. The total investment by farmers and households in renewable energy installations in the sector, including the investment supported by Rentenbank, was derived from the Renewable Energy Agency and trend:research data, as discussed in section 2.3.1.

Overall, a definition of climate-relevant agricultural support is missing at national level and is an important element to incorporate into future climate-finance maps.

2.3.6. Summary of data available for 2010 and 2016 reports

Table 5 presents an overview of the available data for 2010 and/or 2016 reports. The table indicates that the availability of national-level data has not improved over the past six years. Datasets do not cover all sectors of the economy comprehensively; underlying definitions are not consistent. As the analysis can only be as good as the input data, the availability of data for the preparation of climate and energy-investment maps remains a challenge for Germany.

Table 5: Availability of sectoral data by technology in 2010 and 2016

Sector	Source of data	Availability in 2010	Availability in 2016
Energy	BNetzA annual report on investment in energy-sector infrastructure	Yes	Yes
	Disbursements from the CEF-E for energy-sector infrastructure	No	Yes
	Data of Renewable Energy Agency on total investment volume in renewable energy generation	Yes	Yes
	Breakdown of renewable energy investment by sector	No	No
	Breakdown of renewable energy installations by owner from trend:research reports	Yes	Limited information (full information is only available for payment)
	KfW and BAFA annual reports on its disbursements for renewable energy	Yes, but the support is not split by investor type	Yes, but the support is not split by investor type
	Energy-efficiency investment at national level without KfW/BAFA support	No	No
Agriculture	BMEL statistics on EAFRD disbursements and respective climate markers	No	Yes
	Reporting on EAGF disbursement applying EU climate markers	No	Yes
	BMU calculation of agricultural energy-efficiency investments supported by NKI	Yes	No
	Renewable energy investments	No, but to some extent could be derived from the trend:research reports	No, but to some extent could be derived from the trend:research reports
	Energy-efficiency investment without the support of EU funds	No	No
Transport	BAFA's annual report on private investments in eMobility supported by BAFA	Incremental cost derived from different source	Yes
	Data from the NOW GmbH on investment into hydrogen and fuel cell technology	Yes	No
	BMU reporting of investment into energy-efficient street lighting supported by NKI	Yes	No
	Disbursements for transport infrastructure from the EU Funds and respective climate markers	No	Yes

Sector	Source of data	Availability in 2010	Availability in 2016
	Disbursements for infrastructure from the government budget: no established national methodology to assume a climate-specific share of investment	No	No
	KfW annual report on its disbursements for energy efficiency and other technologies	Yes, but the support is not split by investor type	Yes, but the support is not split by investor type
Buildings	KfW and BAFA annual reports on their disbursements for energy efficiency and renewable energy integrated in buildings	Yes, but the support is not split by investor type	Yes, but the support is not split by investor type
	Total private and/or public investment in energy-efficiency of new and existing buildings	No	No
	Total renewable energy investments integrated in buildings	No, but to some extent could be derived from the trend:research reports	No, but to some extent could be derived from the trend:research reports
	Sales of appliances and equipment by efficiency class: GfK and/or Topten data	Yes, but only for three types of appliances (2009 data)	Yes, but only for three types of appliances (2015 data)
Industry	Investment in renewable energy, energy efficiency and non-energy-related mitigation measures: Destatis 2018a	Yes	Yes
	BAFA annual reports on its disbursements for energy efficiency	Yes	Yes

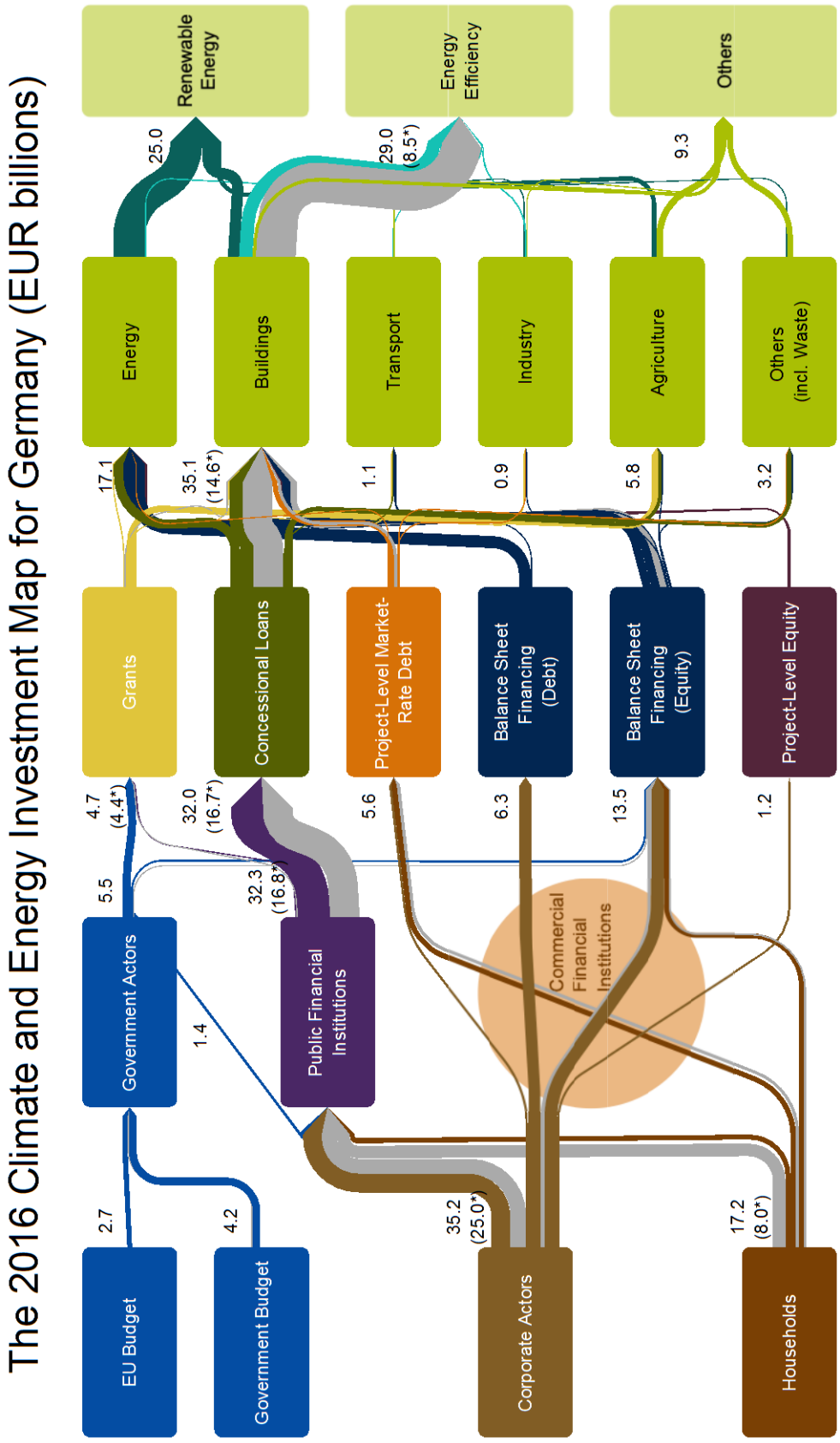
3. Results

Figure 2**Error! Reference source not found.** presents the 2016 climate and energy investment map for Germany. The map reflects both total capital investment[3] (all flows except grey) and incremental investment (grey flows). The incremental investment represents the additional expenditure necessary to invest in low-carbon technology instead of a business-as-usual practice, while total capital investment reflects the full cost of a technology or practice. The map includes only climate-specific **tangible investment**, i.e. energy-efficient equipment, infrastructure, buildings, and renewable energy technologies targeting or resulting in GHG emission reduction and/or an increase in carbon sinks. Soft measures (i.e. research and development, information campaigns, and policy development) play a key role in driving the energy transition and climate-change mitigation but were excluded from our analysis. All investment flows tracked for this report represent actual disbursements in 2010 rather than those planned and/or committed for that year.

With regard to the climate-specific investment flows that we were able to trace as defined above, **we observed a 16% increase in the volumes in 2016 (EUR 42.7 billion) relative to 2010 levels (EUR 36.7 billion)**. These volumes reflect the incremental investment share for energy efficiency (EUR 8.5 billion), the total investment cost for renewable energy deployment (EUR 25.0 billion), and the total investment cost for non-energy-related mitigation and cross-cutting measures (EUR 9.3 billion). Compared to 2010 investment, the **volume flowing to renewable energies** decreased by 6%, while **the volume flowing to energy efficiency increased** by 18%.

We also calculated total investment in energy efficiency (EUR 29.0 billion) for 2016, in addition to the incremental share in investment cost reflected in the comparison above (EUR 8.5 billion). Total investment across all technologies (including energy efficiency, renewable energy, and non-energy-related mitigation and cross-cutting measures) amounted to EUR 63.2 billion in 2016. The text below provides an analysis of the total investment volume except where explicitly stated otherwise.

[3] Except for household electrical appliances in the buildings sector, blast furnaces, and newly built power plants used in manufacturing, for which the incremental cost was included in the total investment figure.



Notes:
a) All financial flows except for the grey ones represent total tangible investment including public support into the reduction of GHG emissions and increase of carbon sinks with two exceptions, namely electrical appliances in the building sector, as well as blast furnaces and new power plants in manufacturing. The grey flows represent incremental investment into energy efficiency of buildings. Financing of intangible measures was excluded.
b) The government budget includes federal budget disbursements and co-financing of EU funds to support the investment in 2016, but it excludes public procurement and administrative costs. Regional and municipal investments are not covered, except when reported in the EU/federal budget, KfW and BAFA programmes.
c) Debt owed does not represent the actual finance flows (e.g. debt repayment), but it is shown to highlight the original investors or asset owners who make use of public and commercial financial institutions as financial intermediaries. The map includes only primary investment flows, e.g. the resources available to investors at the time they had to cover for their capital expenses. . It does not cover therefore such financial instruments as guarantees, green bonds, the cost of capital or debt repayment by investors, the compensation payments from the public budget to energy generators supplying renewable electricity under the feed-in tariff, and others.
The following differences between 2010 and 2016 reports affect the finance volumes:
a) In this report, we account for total and incremental cost of energy efficiency investment into the building sector. This allows to add up investment across sectors and to compare 2010 and 2016 figures.
b) In 2016, investments in non-residential buildings are reflected under "Buildings" instead of consolidating it under "Industry, Tertiary, Transport" as in Jürgens et al. 2012.
c) We acknowledge the application of the climate markers to track climate expenditure of the EU funds targeting the energy, transport and agriculture sectors in 2016, while Jürgens et al. 2012 applied the same definition of climate finance to all sources of finance and sectors. This change leads to an increase of estimated grant volume by EUR 2.3 billion in 2016.
d) The instrument "Equity" used in 2010 is now split up into "Balance Sheet Financing (Debt)", "Balance Sheet Financing (Equity)", and "Project-level Equity".
e) We now account for investments into technologies and measures related to the waste sector, which adds another EUR 1.0 billion EUR to the total volume reflected in the 2016 CEIM for Germany.

Figure 2. The 2016 Climate and Energy Investment Map (CEIM) for Germany (in billions of euros)

3.1. Sources of finance

Of the total investment, private and public sources provided 86% (EUR 52.3 billion) and 14% (EUR 10.9 billion), respectively (see Figure 3). Therefore, as in 2010, the private sector remained by far the largest investor in climate mitigation and the energy transition in Germany in 2016.

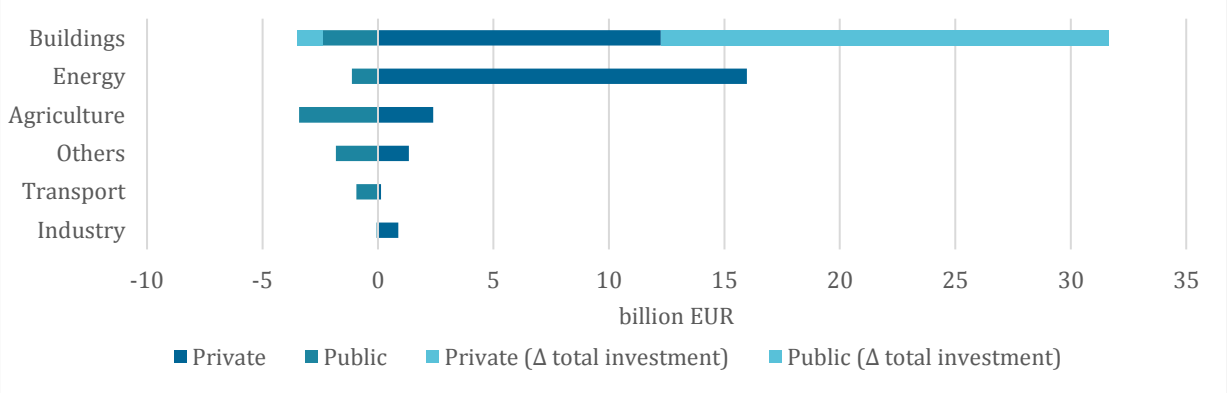


Figure 3. Public and private climate and energy investment by sector in 2016 (in billions of euros)

3.1.1. Public sources

In 2016, the EU funds contributed EUR 2.7 billion in the form of grants to climate-specific investment in the energy, transport, and agriculture sectors. Relevant grants included:

- European Agricultural Fund for Rural Development (EAFRD) support of EUR 1.2 billion for agri-environmental measures and non-land-based agricultural GHG mitigation practices. The government of Germany co-financed these measures with another EUR 1.2 billion;
- European Agricultural Guarantee Fund (EAGF) support of EUR 1.1 billion for agri-environmental measures;
- European Regional Development Fund (ERDF) support of EUR 26.0 million for low-carbon infrastructure in the transport and energy sectors. The government of Germany co-financed these measures with another EUR 17.3 million;
- European Energy Programme for Recovery (EEPR) disbursement of EUR 10.0 million for renewable energy infrastructure, co-financed by EUR 27.8 million from corporate actors;
- Connecting Europe Facility (CEF) support, under the umbrella of the Trans-European Network (TEN) strategy, amounting to EUR 450.6 million for sustainable transport and energy infrastructure.

Of the total federal government budget expenditures of EUR 317 billion (BMF 2017), expenditures for environmental protection and measures with an environmental impact (including expenditures for climate protection, nature conservation, nuclear safety and radiation protection) accounted for EUR 8.7 billion (BMU, 2016b). Of this amount, according to our analysis of the federal government budget, the German government disbursed EUR 4.2 billion to finance or support the financing of climate-specific technologies and practices in 2016:

- Direct investments in public assets, e.g. retrofits of public buildings or purchase of hybrid cars, accounted for EUR 1.3 billion.

- In addition, the German government supported climate-specific investments via grant programmes run by a range of government actors, e.g. BAFA (EUR 0.3 billion), or grant/ concessional loan programmes run by public banks, e.g. KfW (EUR 1.4 billion).

- The German government providing co-financing of EUR 1.2 billion to programmes supported by the EU funds.

3.1.2. Private sources

In the private sector, corporate actors contributed the largest share of investment (EUR 35.2 billion), followed by households (EUR 17.2 billion). More than half of the investment covered by our analysis was supported by programmes of public intermediaries (e.g. KfW, BAFA, and Rentenbank) that offered low-cost debt in the form of concessional loans and grants.

3.2. Intermediaries

Germany is characterised by strong[4] public promotional banks at federal and regional levels, e.g. KfW, Rentenbank, sixteen state-level promotional banks (*Landesförderinstituten,* or LFIs[5]), and a large number of small commercial banks, leading to low concentration in the banking sector. Public banks played a large role in providing means of financing climate-change mitigation and energy transition. In total, they disbursed EUR 32.3 billion to support climate-specific investment.

[4] Indeed, Germany had the lowest Herfindahl index with 277 (range 0 – 10,000) in the EU-28 (average 1122) in 2016 (ECB 2018). The index refers to the concentration of banking business (based on their total assets).
[5] A full list in included in Annex 6.

3.2.1. European Investment Bank

The European Investment Bank (EIB) allocated EUR 2.2 billion to climate action in Germany in 2016. It supported the projects of public and private actors in the areas of research, development, and innovation; transport; and energy efficiency (EIB 2016a). Because the EIB did not report on the actual disbursements for climate action, this amount is not included in our investment map.

3.2.2. KfW (Kreditanstalt für Wiederaufbau)

According to our analysis, in 2016, Kreditanstalt für Wiederaufbau (KfW) provided over EUR 30.0 billion in concessional loans and at least EUR 0.4 billion in grants to support the total climate-specific investment by households, companies, and public entities. Of this, EUR 14.7 billion was the KfW landing volume that contributing to the incremental climate-specific investment. That represented a slight increase as compared to the 2010 volume that was EUR 14.1 billion (Juergens et al. (2012)). Therefore, the bank remained by far the main climate-finance provider in the country. According to our analysis of the federal budget, KfW received EUR 1.4 billion from the German government as programme support.

Whereas KfW programmes typically offer concessional loans in combination with a repayment grant [*Tilgungszuschuss*], the volume of these grants is not reflected in our calculation. The repayment grant represents a particular percentage of the loan value paid by the end of the project if it achieves a certain, ex-post verified energy performance level. This grant element plays an important role in supporting investment by public and private actors; however, because our study only considers disbursements for the purchase or implementation of climate-specific technologies in a single year, assessment of these is outside the scope of our methodology.

It is important to note that KfW works and reports according to its sustainability framework combining social, economic, and ecological challenges, which includes the response to climate change. The numbers presented in this report, however, result from the application of our tracking approach and may therefore vary from those presented elsewhere. Annex 5 identifies the split of KfW programmes by investor and by financial instrument in 2016. As shown in the table, the sector receiving the largest share of financial support was the building sector (75% of total KfW support). In terms of technology type, energy efficiency and renewable energy received EUR 19.8 billion and EUR 6.4 billion respectively, while the remaining EUR 4.3 billion supported other measures.

3.2.3. BAFA (Federal Office for Economic Affairs and Export Control)

In 2016, the Federal Office for Economic Affairs and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA)) provided EUR 293 million in grants, supporting the market uptake of renewable energies in the heating market, optimisation of pumps and heating systems, conditioner and

refrigerating systems, mini-combined heat and power, and cross-cutting technologies. Households, companies, and public entities were the beneficiaries of these grants and invested at least EUR 1.1 billion in these technologies, as BAFA issued grants as a percent support of total investment volume. In addition, BAFA offered subsidised energy advice and audits for renewable energy and thermal efficiency measures, amounting to EUR 7.7 million and EUR 5.8 million respectively (BAFA, 2017). We acknowledge the importance of those intangible measures, but in keeping with our methodology they were not included in the investment map.

3.2.4. Rentenbank

Rentenbank, a specialised public bank for the agriculture sector, provided EUR 1.9 billion in concessional loans for climate-specific, tangible investments in Germany in 2016. The programme 'Energie vom Land' [Energy from the countryside], a credit scheme to support renewable energy, made up the lion's share of a larger programme (EUR 2.2 billion) promoting sustainable agricultural activities, including organic farming practices. Of the EUR 1.9 billion, EUR 1.5 billion were allocated to wind power, EUR 317 million to biogas, and EUR 81 million to photovoltaic (Rentenbank 2017) used in the agriculture sector.

L-Bank, the public bank of the federal state of Baden-Württemberg, is specifically mentioned in the report for its joint commitment with Rentenbank to support renewable energy in the agriculture sector. L-Bank issued EUR 71 million in low-cost debt for environment and consumer protection, sustainability and new energies. L-Bank is refinanced by Rentenbank for 'Energie vom Land', and the EUR 71 million is already included in the investment amount for Rentenbank.

3.2.5. Other financial intermediaries

Regional banks (LFIs) channel substantial funding to support climate and energy investments, but their contribution could not be fully quantified. They use KfW and BAFA programmes for co-financing and provide additional subnational grants and loans, often further reducing the cost of capital (see Figure 4). Information on supported investment volumes and measures by LFIs is generally limited and lacks the detail required for a differentiated assessment of climate finance; as a result, it was not included in the total estimates. Annex 6 summarises the available data for 2016. Transparent reporting (as guidelines or even obligations, considering that these are public institutions) would help quantify the role played by regional banks in climate mitigation and energy transition, which may be significant in some regions.

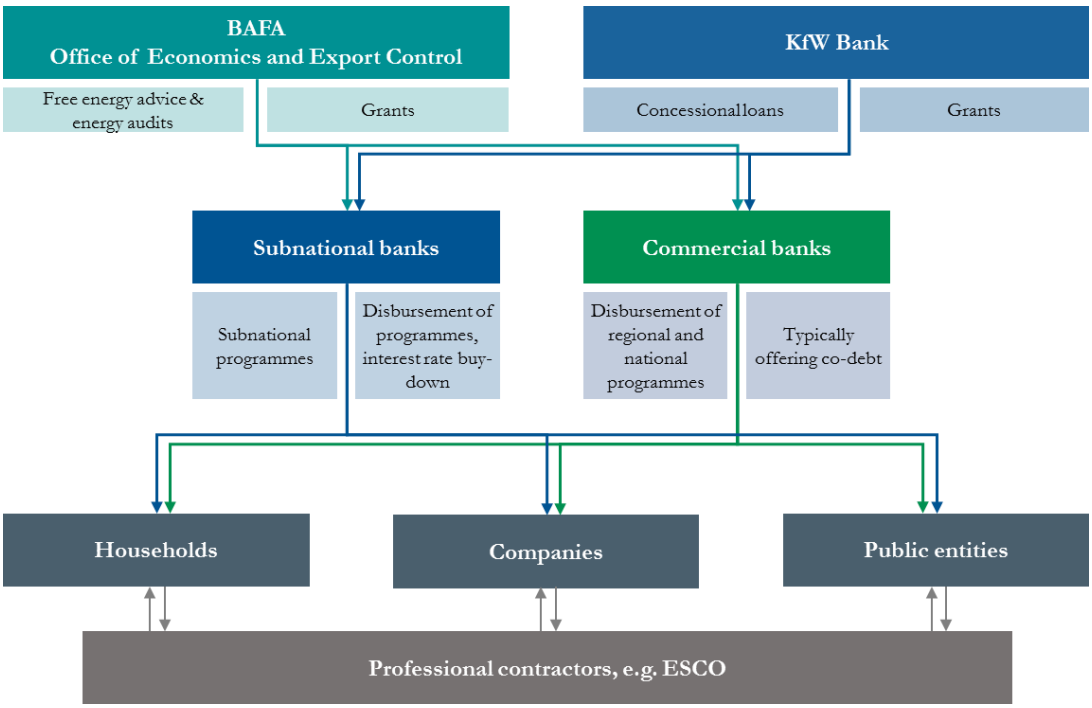


Figure 4. Blending public and private finance under KfW and BAFA programmes

Source: Novikova et al. 2018

Commercial banks are important finance providers and intermediaries across all sectors, but they do not publish their climate-related finance in sufficient detail (McClellan 2018; Ohlsen and Remer 2018). Therefore, this study was not able to quantify their role in full. Commercial banks are involved in financing climate mitigation and energy transition in Germany in two respects. First, they are important 'channels' for disbursing and co-financing KfW and BAFA loan and grant programmes for households and small and medium-sized enterprises (SMEs) (see Figure 4). Second, commercial banks invest directly, via project debt or equity, in large-scale projects, mostly those related to energy or infrastructure. However, commercial banks offer financial products for corporate clients, which typically do not differentiate between climate-specific and business-as-usual investment; these are therefore impossible to track.

Institutional investors are increasingly interested in climate investment but are generally risk-averse in their investment strategies (McClellan 2018; Ohlsen and Remer 2018). Sustainable financial products, more broadly defined, make up only 3% of the German market but it is expected to rise (McClellan 2018). There is also a growing trend towards mainstreaming sustainability criteria across the complete portfolio. However, the definition of sustainability remains very broad (ibid.). Recent policy developments on the sustainability taxonomy and reporting requirements at EU and Germany levels may provide more clarity and additional incentives for green financial products and investment.

Among institutional investors, there is no systematic approach to climate finance (McClellan 2018; Ohlsen and Remer 2018). Renewable energy and sustainable housing are the main asset types favoured by institutional investors. Investment volume in renewable energy infrastructure lags behind: long payback periods of up to 30 years are not attractive to private investors. Policy support is needed to make such investment a business case for institutional investors. Furthermore, a decentralised energy supply and small-scale investments play an important role in the energy transition. To make a large number of these small-scale heterogenous projects more attractive to institutional investors, there is a niche opportunity for one or more intermediaries to integrate these into larger, homogenous project portfolios. For example, the Bulgarian Urban Development Investment Platform blends finances from the European Fund for Strategic Investment (EFSI) with those of the European Structural Investment Funds (ESIF) for Integrated Urban Development Plans. Resulting synergies would allow investments to be financed across a larger pipeline of projects, totalling roughly EUR 360 million. Another example is Troisième Révolution Industrielle in France, which combined funds from the EIB under the EFSI guarantee programme (EUR 20 million) with funding from the ESIF and private sources to finance SMEs and mid-caps operating in the energy and resource-efficiency sector (EIB 2018).

The present study was not able to quantify the role of institutional investors due to large gaps in investment data. Very few German institutional investors are active and vocal proponents of climate-change mitigation efforts or of broader global measures to achieve Sustainable Development Goals (SDG). The 2018 Global Investor Statement to Governments on Climate Change, signed by 415 investors representing over USD 32 trillion in assets, had only twelve signatories based in Germany (The Investor Agenda, n.d.).

3.3. Financial instruments

Of the investments in climate mitigation and energy transition tracked in our study, concessional loans from public banks accounted for the highest share in 2016, followed by balance-sheet financing, project-level market-rate debt, grants, and finally project-level equity (see Table 6). While the 2016 breakdown of instruments differed from that in Jürgens et al. (2012), the relative shares were similar.

In 2016, concessional loans delivered EUR 32 billion and played an important role in climate and energy-transition investment. Of the total volume of concessional loans from public banks that we were able to track, KfW provided by far the largest share (94%), with the remainder issued by Rentenbank .

Table 6. Breakdown of climate-specific investment by financial instrument in 2016 (in billions of euros)

Grants	Concessional loans	Project-level market-rate debt	Balance-sheet financing		Project-level equity
			(Debt)	(Equity)	
4.7	32.0	5.6	6.3	13.5	1.3

Note: Due to data limitations, volumes given for project-level market-rate debt, balance-sheet financing, and project-level equity should be compared with caution due to several limitations. First, balance-sheet finance could be turned into equity due to the possibility of later capitalisation of loans, i.e. recording loan value as assets of a company or its subsidiary. Second, the expenditure reports of public actors were more readily available than those for private investments; therefore, the volume and role of these three instruments may be underestimated here. Overall, the breakdown of investment into these financial instruments was largely estimated based on the Germany-related domestic flows of the Global Landscape of Climate Finance (Buchner et al. 2017).

Grants from the public sector contributed EUR 4.6 billion to climate investment. Typically, grants cover only a small share of total investment and are combined with equity and loans obtained from commercial or public banks. In 2016, EU funds made up the largest share of grants, followed by funding from government actors, including BAFA and KfW.

While volumes for concessional loans and grants were determined from programme documentation, data on the volumes of other instruments were fragmentary. The instrument split calculated for the latter contains many assumptions and uncertainties. Hence, one should compare the volumes of these instruments with care:

- The volume of market-rated debt associated with Rentenbank, KfW, or BAFA support programmes and private-sector projects supported by public funding could be quantified, while the total volume of this instrument, including loans of commercial banks, was unclear.
- Similarly, this study only quantified the equity share accompanying concessional loans instead of the total equity investment.

Jürgens et al. (2012) consolidated balance-sheet financing, including its debt and equity portions and project-level equity, as 'Equity'. Applying this approach to the limited 2016 data, however, would obscure the likely significance of debt in the context of climate-specific investment.

3.4. Recipients

Table 7 and Figure 5 provide an overview of investment by sector and technology type. The sectors attracting the largest share of climate-specific investment were the building sector (total: EUR 35.1 billion, incremental: EUR 14.6 billion) and the energy-generation and transmission sector (total: EUR 17.1 billion). These sectors also have the highest sector-specific targets for GHG emission (GHG) re-

ductions by 2030 (BMU 2016a), namely 66–67% for buildings and 61–62% for energy. However, because total investment volumes do not reflect effectiveness in actually driving GHG reductions, caution should be exercised in comparing them to GHG emissions-reduction targets. Other sectors attracted less climate and energy investment, including the agriculture (total: EUR 5.8 billion), transport (total: EUR 1.1 billion), and industry (total: EUR 0.9 billion) sectors, as well as other/ cross-cutting measures (total: EUR 3.2 billion) (see Figure 5).

Table 7. Breakdown of 2016 total climate-specific investment in Germany by sector and technology type (in billions of euros)

Technology \ Sector	Agriculture	Buildings	Energy	Industry	Transport	Other
Total	5.8	35.1 (14.6*)	17.1	0.9	1.1	3.2
Renewable energy	2.4	5.9	16.6	0.1	0.0	0.1
Energy efficiency	0.0	27.4 (6.9*)	0.5	0.8	0.0	0.0
Other	3.4	1.8	0.0	0.1	0.9	3.0

* Represents incremental (not total) investment in energy efficiency in building envelopes

Of the total amount of EUR 63.2 billion, 40% (EUR 25.0 billion) were invested in renewable-energy generation and transmission and 46% (EUR 29.0 billion) in energy-efficiency technologies. Furthermore, EUR 9.3 billion was invested in non-energy-related mitigation and cross-cutting technologies and practices. Figure 6 provides a more detailed overview of investments in specific mitigation technologies and practices.

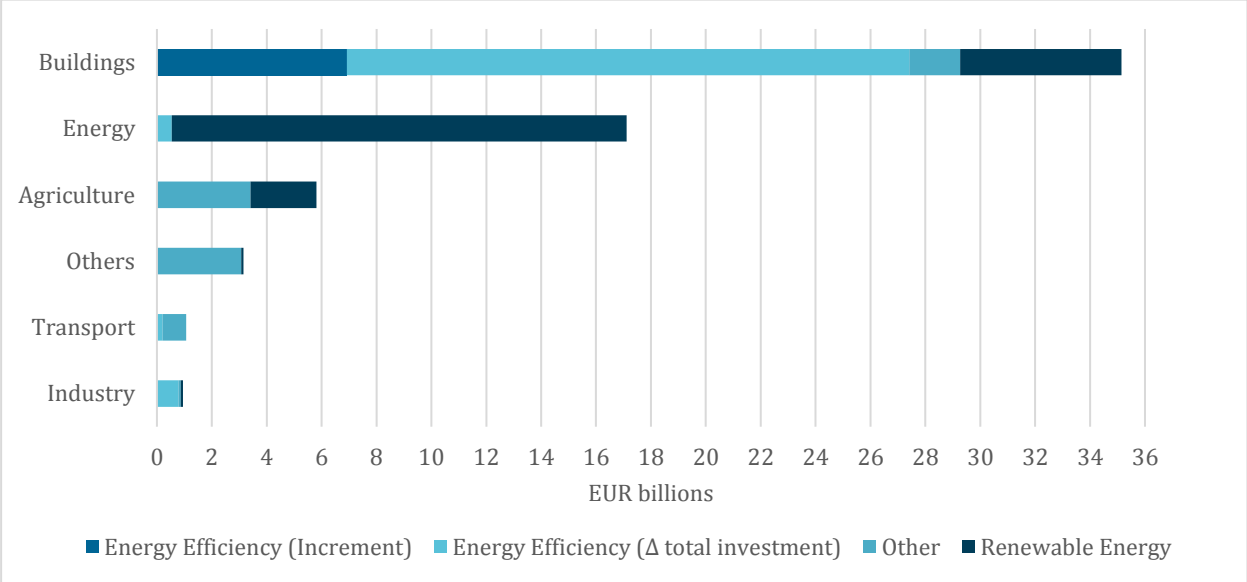


Figure 5. Breakdown of 2016 total investment volume by sector and technology (in billions of euros)

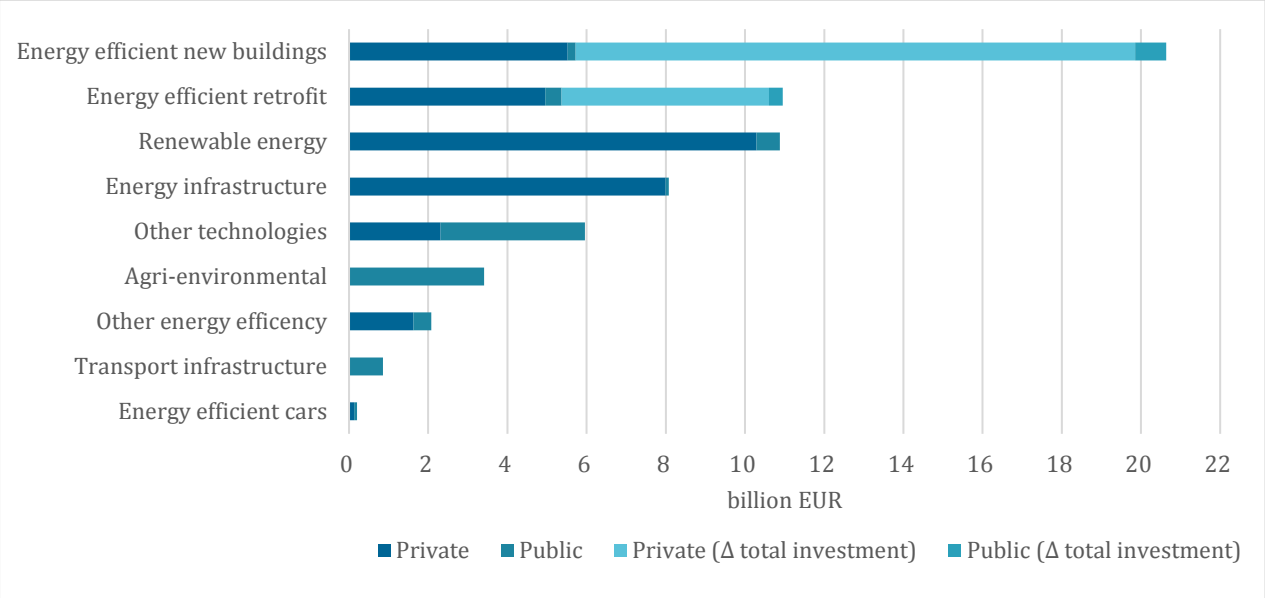


Figure 6. Breakdown of 2016 total climate-specific investment in Germany by specific mitigation technology and source of finance (in billions of euros)

3.4.1. Case study of the building sector

Sector importance to energy transition

In 2016, the building sector was responsible for 129.0 million tCO_2-eq., or 14.2% of Germany's total GHG emissions, excluding land use, land-use change, and forestry (UBA 2018b). Furthermore, residential, commercial, and public buildings accounted for 54% of electricity consumption and 56% of district heat production in Germany (AGEB 2018). While emissions associated with the generation of electricity and district heat are attributed to the energy sector, these energy carriers are consumed in the building sector and therefore account for the building sector's indirect emissions.

The Climate Action Plan 2050 (BMU 2016a) requires the building sector to reduce its GHG emissions by 66–67% by 2030 relative to 1990 levels (Table 1). To reach these targets, newly constructed buildings should be climate-neutral by 2020 and existing buildings by 2050. By 2050, the building sector must reduce its primary energy consumption by 80% relative to 2008 levels. Other targets affecting the sector include an increased share of renewable energy to 60% of the country's total final energy consumption by 2050, 80% of its electricity consumption by 2050, and 14% of its heat consumption by 2020. The electricity consumption should be reduced by 25% by 2050 relative to 2008 levels (BMWi 2016b).

Results of assessment

The figures without brackets in Table 8 report the total climate-specific investment in the building sector in 2010 and 2016 as calculated in our report and in Juergens et al. (2012). This investment

includes financial flows to energy-efficiency technologies, building-integrated renewable energy installations, and other cross-cutting technologies and practices. For both reports, we also estimated the incremental share of energy-efficiency investment in building envelopes and systems (in brackets in Table 8).

Table 8. Climate-specific investment in the building sector as total (as incremental), in millions of euros

Source	Energy efficiency		Renewable energy		Other	Total	
	2010	2016	2010	2016	2016	2010	2016
Public	1,126 (426)	1,440 (315)	293	315	1,757	1,419 (719)	3,512 (2,390)
Private	9,634 (5,373)	25,975 (6,600)	10,181	5,561	92	19,815 (15,554)	31,627 (12,253)
Total	10,760 (5,799)	27,414 (6,915)	10,474	5,876	1,849	21,234 (16,273)	35,139 (14,643)

Source: Juergens 2012; research results.

Note: The figures without brackets indicate the total investment. The figures in brackets indicate the incremental investment.

What was the total climate-specific investment in the sector?

- In our study, the total climate-specific investment in the building sector in 2016 was calculated as at least EUR 35.1 billion; the 2010 total was EUR 21.3 billion. The incremental investment, however, was lower in 2016 (EUR 14.6 billion). This means that, while the total volume of investment in the building sector grew over the period 2010–2016, the incremental investment – the share of total investment that could accelerate the energy transition – actually decreased.

- For existing buildings, the share of incremental investment increased by roughly 50%. However, the climate-specific incremental investment in the construction of new buildings decreased by approximately 40%. For the construction of new buildings, investors typically obtain public support, which covers a progressively larger share of total costs over time. Indeed, investors obtained KfW loans for roughly 50% of residential construction in 2010 (Juergens et al 2012) and for approximately 60% of that in 2016 (Novikova et al 2018). The measure receiving the greatest investments was the construction of residential 'KfW efficiency houses 70'

in 2010 and 'KfW efficiency houses 55' in 2016 (ibid). This means that surpassing the building-code requirements has become an increasingly business-as-usual situation; therefore, based on 2016 data, there was actually a reduction in the share of total investment that could be characterised as incremental or additional investment in the energy transition. This trend indicates that it may be advisable to tighten the minimum energy performance standard for new buildings, make the construction of new buildings eligible for public support if they achieve a higher level of energy performance than they do at present, and/or redirect a portion of this support to other, underfinanced segments that represent a significant obstacle to the reduction of GHG emissions, i.e. through investments in retrofits of existing buildings (see the volume of energy consumed in buildings by age classes in Figure 7).

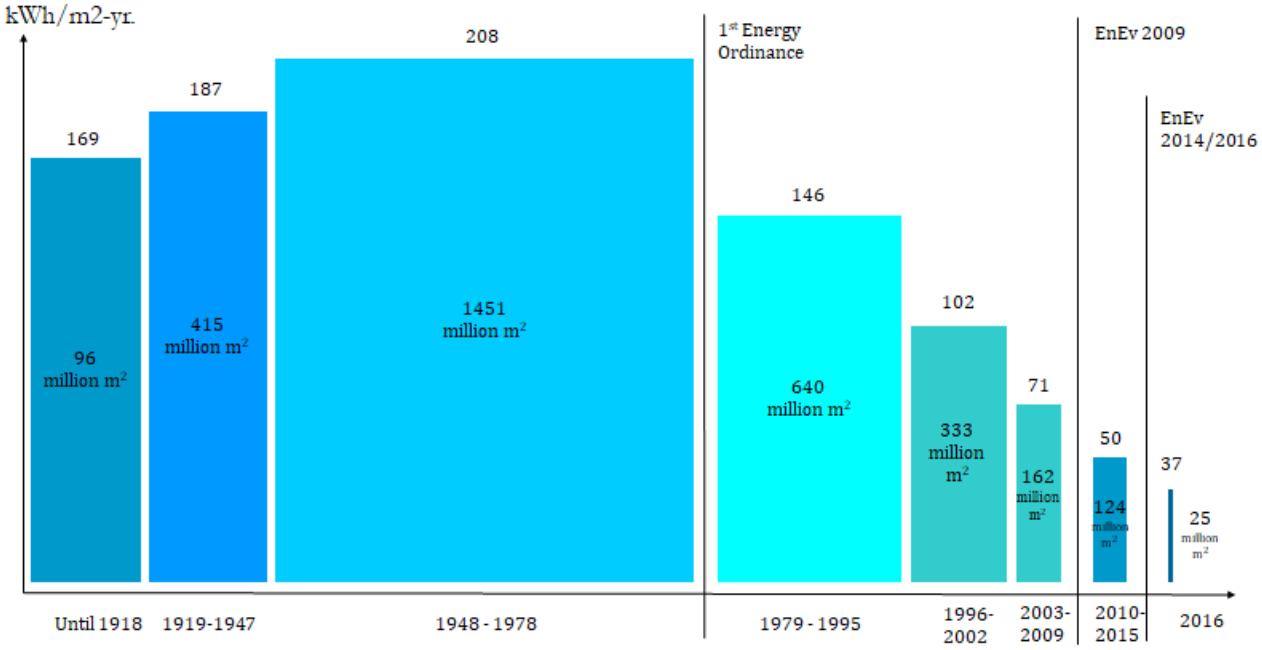


Figure 7. Energy consumption of building stock by building age

Data source: BMWi, 2014; Destatis, 2018; Kersten, 2014; Loga, Diefenbach, Stein, & Born, 2012.

Note: The size of the building stock is shown as millions of square metres on the x-axis and the average energy consumption of the given section as annual kilowatt-hour per square metre (kWh/m2a). Buildings from 1948 to 1978 show the largest energy-saving potential.

Which were the key sector segments, technologies, or practices attracting investment?

- If the total sector investment is broken down by technology, EUR 33.6 billion was invested in the building envelopes and EUR 1.5 billion in domestic appliances. Of the investment in build-

ing envelopes, EUR 25.9 billion (77%) went to energy efficiency, EUR 5.7 billion (17%) to renewable energy, and EUR 2.0 billion (6%) to cross-cutting technologies (see breakdown in Figure 8).

- Of the amount invested in building envelopes, EUR 18.9 billion (57%) went to components and technologies installed in new buildings and EUR 14.4 billion (43%) to the retrofit of existing buildings.

- Of the amount invested in building envelopes, EUR 23.3 billion (69%) went to residential buildings, EUR 2.5 billion (7%) to public buildings, and EUR 7.6 billion (23%) to commercial buildings.

- The latter figures reflect a positive change in support programmes covering more segments of the building-sector stock in 2016 than in 2010. Namely, in 2010, the programmes focussed mainly on the residential sector; 2016 programmes also provided significant funding for non-residential buildings. Non-residential buildings accounted for only 13% of the stock but consumed 38% of the sector's final energy consumption, producing 47% of the sector's GHG emissions (Bollmann et al. 2018).[6]

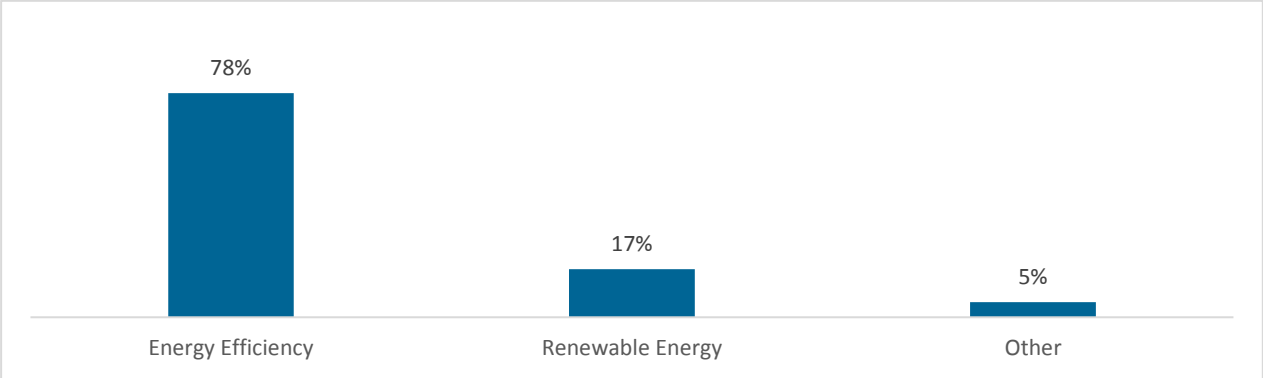


Figure 8. Share of technologies in total building-sector investment

Who were the main investors?

- The private sector invested EUR 31.6 billion in decarbonising the building sector, accounting for 90% of the total climate-specific investment in the building sector in 2016. The remaining funds flowed from the public sector.

[6] Including space and water heating, lighting, and air conditioning. These numbers were calculated by the authors based on seven German data sources from 2011 to 2015.

- The private investment was dominated by households, representing 47% of the total amount (EUR 16.5 billion), followed by companies, which invested EUR 15.4 billion (44%). The share of household investment in 2016 was significantly lower than the 2010 share reported in Juergens et al. for 2010, which found that households contributed 85% at that time. These numbers must be treated with caution due to methodological and data constraints (see section 2.3.3 and 2.3.6 for details).

What was the role of the public and private intermediaries in supporting private and public investment?

- Public intermediaries were pivotal in supporting investment in the building sector. Furthermore, KfW and BAFA played a prominent role in providing finance and facilitating information and advice.

- KfW was the main provider of finance for retrofits of buildings, construction of buildings that surpassed building-code requirements, and renewable energy installations integrated into the sector.

- BAFA financing was especially important for supporting investment in renewable heat and other advanced heating and cooling technologies in the sector.

- Regional state banks and commercial banks also played an important role as intermediaries, but their role could not be quantified. We recorded the role of these intermediaries in Annex 6.

How was the climate investment financed, e.g. through grants, loans, or equity?

- The main financial instrument used by KfW programmes was concessional loans with a grant element (repayment grants) that represented a particular percentage of the loan value paid by the end of the project if it achieved a certain energy performance level. In 2016, KfW loans accounted for EUR 22.3 billion, or 64% of investment volume (see Figure 9 for details on financial instruments in the building sector). This figure excludes repayment grants: because our study only includes disbursements for the purchase or implementation of climate-specific technologies and measures in a single year, such grants are outside the scope of our methodology.

- For BAFA programmes, the main instrument was grants. The BAFA programmes provided EUR 218 million and supported EUR 943 million of investments by private and public actors. Together, grants from BAFA and KfW accounted for 2% of total investment.

- A positive finding was that a range of these grant programmes were introduced to support investment in renewable heat and other advanced heating systems. In 2016, renewable energy represented only 12.6% of the total final energy consumption (Destatis 2017), far below the renewable energy share of 18% or more that must be achieved in 2030; therefore, financing renewable heat is a challenge.

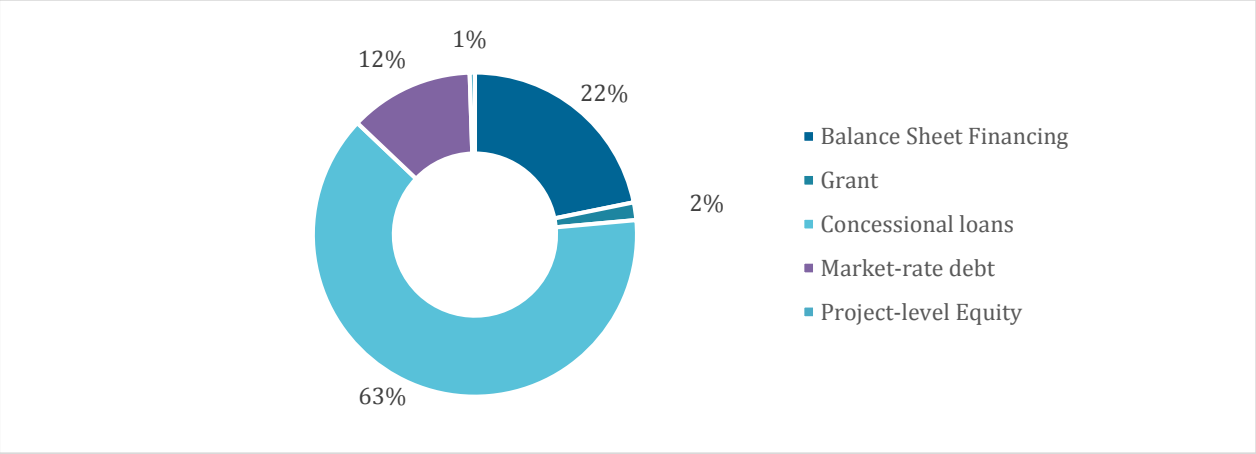


Figure 9. Climate and energy investment in the building sector by financial instrument used (in billions of euros)

Is the sector on track to reach its targets?

- The question cannot be answered at the moment because available assessments of investment needs and the present assessment of actual investments made rely on different methodologies. According to Pehnt and Mellwig (2018), decarbonising the building sector will require EUR 21–28 billion of additional investment annually until 2050. As calculated by our study, in 2016 the incremental energy-efficiency investment was EUR 6.6 billion, and the remaining EUR 7.7 billion was the total investment in renewable energy and other technologies. It is therefore unlikely that the incremental investment in the building sector addresses the investment need.

3.4.2. Case study of the agriculture sector

Sector importance to energy transition

In 2016, the agriculture sector was responsible for 65.2 million tCO_2-eq., or 7.2% of the total country's GHG emissions, excluding land use, land-use change, and forestry (UBA 2018b). In 2015, the GHG emissions from the agriculture sector consisted of 59% methane (CH_4), 80% di-nitrogen oxide (N_2O), and a minor share of CO_2 emissions (7%) (UBA 2018d). The emissions mainly resulted from livestock farming and from agricultural soils (UBA 2018d). The agriculture sector (including forestry and fishery) accounted for a minor share (1.5%) of Germany's total primary energy consumption in 2016 (Destatis 2018b).

The Climate Action Plan 2050 for Germany (BMU 2016a) sets a target to reduce the sector's GHG emissions by 31–34% relative to 1990 levels by 2030. Moreover, the nitrogen concentration in the soil should be reduced from an estimated 102 kg/ha in 2016 (BMEL 2018a) to 70 kg/ha between 2028 and 2032. An additional significant reduction in this concentration should be achieved by 2050. The share of organic farming land in total agricultural lands is to increase from 6.3% in 2014 to 20% by 2030; in addition, a methane from livestock farming should be reduced, although no explicit reduction target has been defined thus far (BMU 2016a).

Results of assessment

Agricultural policy in Germany is framed by the European Common Agricultural Policy (CAP) and national policy framework 'Joint Task for the Improvement of Agricultural Structures and Coastal Protection' (GAK). In 2016, public financing of GHG mitigation measures and an increase in carbon sinks in the agriculture sector flowed from the European Agricultural Fund for Rural Development (EAFRD), GAK, and additional funds at regional and municipal level. For EAFRD finances, GAK designates priority areas of action at regional level.

In addition, direct payments to farmers under the CAP are disbursed from the European Agricultural Guarantee Fund (EAGF). The CAP was reformed in the period 2015–2019. The most significant change is the inclusion of a 'greening' requirement applied to 30% of all direct payments, with standards for crop diversity, permanent grassland, and 5% of organic farming practices (EC 2018d).

Table 9 presents a summary of identified climate-specific investment in the sector. These numbers are interpreted in detail below.

Table 9: Climate-specific investment in the agriculture sector (in millions of euros)

Source	Energy Efficiency		Renewable energy		Other	Total
	2010	2016	2010	2016	2010	2016
Public	NE	2	22	0	24	3,416
Private	NE		5,357	2,393	5,375	2,393
Total	NE	2	5,380	2,393	5,399	5,809

Source: Juergens 2012; research results.

What was the total climate-specific investment in the sector?

- In 2016, the total climate-specific tangible investment in the agriculture sector amounted to EUR 5.8 billion. This is more than the EUR 5.4 billion in 2010, as shown in the table above. Given the decline in EU agriculture funding as a percentage of total EU expenditures and the

change to the direct payment support system in June 2013,[7] this increase can be attributed to our methodological adjustments: in the present report, we applied the climate markers to the disbursements from EU funds, i.e. EAFRD disbursements in this case (details in Section 2.3.5).

What was the total climate-related investment in the sector?

- In addition to the climate-specific investment, we identified the disbursement of EUR 391 million from the EAFRD for organic farming practices as a significant climate-related flow. Organic farming is a climate-adaptation measure; it is therefore not incorporated into the CEIM due to the difficulties in accounting for the precise effects of carbon-mitigation efforts on GHG emissions Juergens et al. (2012).

Which were the key sector segments, technologies, or practices attracting investment?

- Agri-environmental measures were supported by EUR 2.1 billion from grants disbursed from the EAFRD and the EAGF. In calculating this number, we excluded organic farming because it refers to a climate-change adaption and is therefore not covered by our methodology.

- Renewable energy installations on agricultural lands attracted EUR 2.4 billion in private investment, mostly from farmers. In 2016, farmers owned 10.5% of all citizen-owned renewable energy capacity installed in Germany. In particular, 73% of all biomass plants were owned by farmers.

- Non-land-based agriculture, specifically forestry, attracted an investment of EUR 1.3 billion. The main funding source for climate-specific forestry practices was the EAFRD, with national co-financing of 50% of eligible investment costs.

- Energy-efficiency measures were supported by the national government with EUR 1.8 million of direct payment support (see detailed breakdown in Figure 10).

Who were the main investors?

- The major share of flows to the agriculture sector originates from national and European investment support and direct payments to farmers, with a large share from EU funds under the CAP. Thus, expenditures from the EAFRD and EAGF amounted to EUR 2.2 billion and facilitated national public co-financing of EUR 1.2 billion.

[7] Comparing 2013 and 2020 commitments in 2011 constant prices results in a 4.9% decrease in direct payments to farmers in Germany, while total commitments in all agricultural relevant headings of the MFF 07/13 against MFF 14/20 declined by 4.5% (EP 2013).

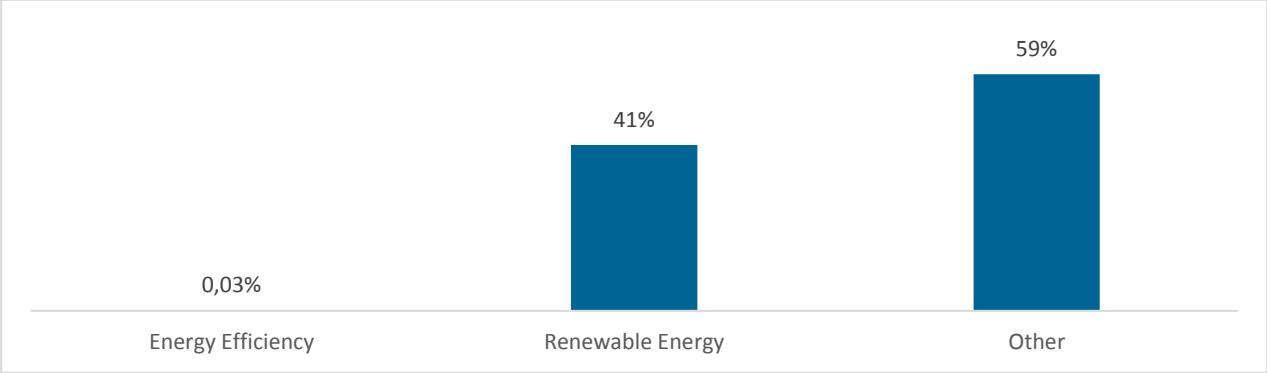


Figure 10. Share of technologies in the total investment volume of the agriculture sector

- Under the EU's multi-annual financial framework, the EU agriculture sector receives the largest share of European subsidies relative to other sectors. In 2016, the CAP expenditure amounted to 41% of the total EU budget (EC 2018a). In Germany, the share of agriculture in total EU funding was 33% (EC 2018b; BMEL 2018b).

- Private-sector investment by farmers and corporate companies, such as renewable power-plant operators on agricultural land, amounted to EUR 2.4 billion.

What was the role of public and private intermediaries in supporting private and public investment?

- Public and federal state banks, in particular Rentenbank, played the most important role as intermediaries. Investment in renewable energy was fully supported by concessional loans from these banks to farmers and corporate investors. These loans contributed EUR 1.9 billion to this investment.

- Regional and federal government actors played an important role in the distribution and administration of expenditures from EU funds and respective national and *Länder* co-financing.

How was the climate investment financed, e.g. through grants, loans, or equity?

- As in 2010, investment grants and direct payments of EU funds were the main stimulus for decarbonisation technologies and practices applied in the agricultural sector (see Figure 11 for details).

What has changed since 2010 and why?

- Investment in other, non-energy-related measures – defined in the present report as agri-environmental and non-land based agricultural measures – increased significantly in 2016 relative to 2010 levels.

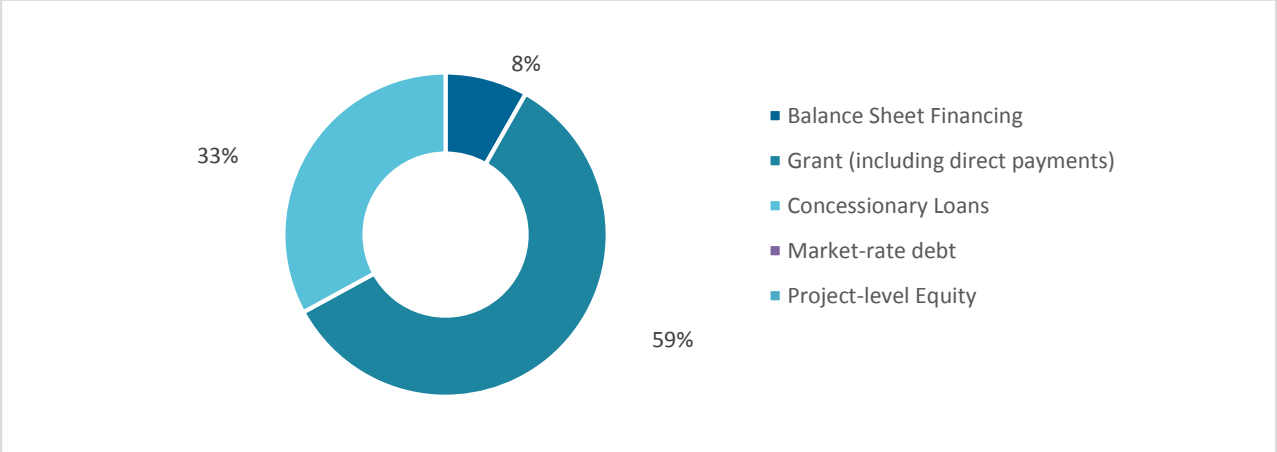


Figure 11. Climate investment in the agriculture sector by financial instrument (in billions of euros)

- Investments in renewable energy installed on agricultural lands decreased by 44%, from EUR 5.4 billion in 2010 to 2.4 billion in 2016.
- Overall investments in the agriculture sector increased slightly but remained relatively more stable than those in other sectors analysed. A shift from renewable energy investments towards agri-environmental measures was noted, but this change could be accounted for by the use of the climate-marker methodology. Without the high climate markers applied to disbursements from the EAFRD, climate-specific tangible investments in the agriculture sector would have decreased from 2010–2016; this decrease is due to the decline in renewable energy investment caused by falling costs of renewable energy power plants, particularly newly installed photovoltaic and biomass installations.

Is the sector on track to reach its targets?

- Achieving a GHG emissions-reduction target in the agriculture sector is challenging because agricultural emissions are directly linked to consumption of farm and animal products by the growing global population. If no change in consumption patterns occur, Germany will likely to achieve the target by 'outsourcing' its emissions to other countries producing these products.

3.4.3. Case study of the transport sector

Sector importance to energy transition

In 2016, the transport sector was responsible for 167 million tCO_2-eq., or 18.3%, of Germany's total GHG emissions (UBA 2018b). It consumed one quarter of the country's total primary energy demand, or 3363 PJ, in 2017(UBA 2018c). After peaking in 1999, GHG emissions declined until 2013. Since then,

emissions have grown again, mainly due to an increase in road cargo traffic and the associated increase in diesel vehicles sales (ibid). The largest share is caused by road traffic, in particular by passenger cars: Germany, with 610 vehicles per 1000 inhabitants, has a higher motorisation rate than the EU average (587) (ACEA 2018). Especially in urban centres, the nitrous oxide emissions have already reached concentrations that pose a serious health risk (UBA 2018c). Of the total final energy consumption in the transport sector, 94% is due to mineral oil combustion, while gas, electricity and renewable heat still play a relatively marginal role (UBA 2018c).

According to the Climate Action Plan (BMU 2016a), by 2030 sector emissions should be reduced by 40–42%, or 95–98 million tCO_2-eq., relative to 1990 baseline levels. The reductions target is to be reached primarily by a shift in modes of transit, sector coupling, and the promotion of alternative driving solutions, such as electric mobility, rail transport, biking, walking, and local public transport. Germany has also committed to EU-wide targets to reach fleet average emissions of 95g CO_2/km by 2021 and increase the passenger transport rate by 19.2% for rail and 6% for public transport between 2010 and 2030 (BMU 2016a).

Results of assessment

The decarbonisation of the transport sector in Germany was mainly supported by the development of electric mobility through various programmes under the Federal Ministry of Transport and Digital Infrastructure (BMVI) and BAFA. European clean transport funding from the CEF and TEN-T programmes also supported transportation infrastructure developments to make GHG mitigation in the sector possible. Table 10 presents a summary of our research findings for the sector, which are interpreted in detail below.

Table 10. Climate-specific investment in the transport sector (in millions of euros)

Source	Energy efficiency		Other		Total	
	2010	2016	2010	2016	2010	2016
Public	85	78	NE	853	85	931
Private	184-767	128	NE	6	476	134
Total	268-851	206	NE	860	561	1,065

Source: Juergens 2012; research results.

What was the total climate-specific investment in the sector?

- In 2016, the total climate-specific tangible investment in the transport sector was EUR 1.1 billion. This volume represents an increase from the EUR 560 million estimated in 2010.[8] This increase is attributed to the growth in support for e-mobility in these years, as well as to methodological change in calculating disbursements from the EU funds (see Box 1 for details).

What was the total climate-related investment in the sector?

- In 2016, the sector investment that was broadly climate-related was EUR 6.3 billion.

- This flow was associated entirely with investment in the infrastructure development related to clean modes of transport. The largest share of the investment, EUR 5.5 billion, flowed to railway infrastructure. The remaining volume of EUR 862 million flowed to cycling (EUR 68 million) and waterway (EUR 795 million) infrastructure.

- The climate-specific investment volume of the sector would increase by EUR 2.5 billion if the climate marker of 40% used to track climate-related disbursements of EU funds to infrastructure investment were also used for disbursements from the German government budget for sustainable infrastructure investment (EUR 6.3 billion).

Which were the key sector segments, technologies, or practices attracting investment?

- The key technology driving the sector investment was e-mobility. The climate-specific tangible investment in this sector segment was EUR 212 million (see detailed breakdown in Figure 12; e-mobility is included in 'Energy efficiency' and 'Infrastructure' included in 'Others').

- As mentioned, the higher total climate-specific investment in 2016 relative to 2010 levels is due to the climate marker of 40% which, in accordance with the European Commission's methodology (see Box 1), was used to account for European infrastructure investment (excluding road and air infrastructure), amounting to EUR 410 million. In 2010, this investment were not accounted in the climate finance landscape due to the absence of methodology.

[8] The midpoint between EUR 268 million and EUR 851 million estimated in the 2010 report (Juergens et al. 2012), also provided in Table 11.

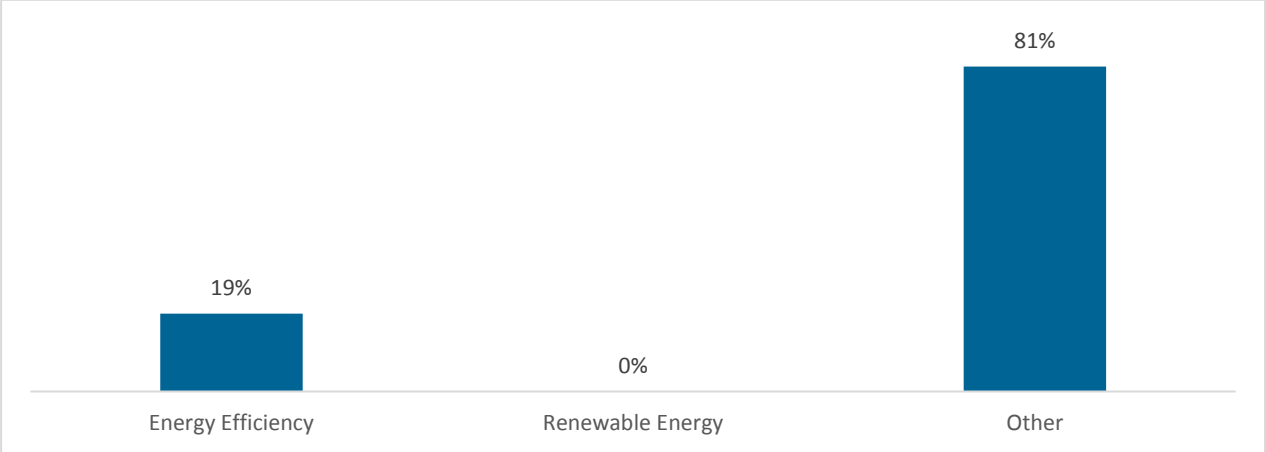


Figure 12. Share of technologies in the transport sector total investment

Who were the main investors?

- The main sources of climate-specific investment were government actors, including the BMU, BMVI, and EU funds, which provided funds of EUR 494 million and facilitated private co-financing for a volume of EUR 125 million.
- The main share of private sector investment of EUR 120 million flowed to the purchase of electric cars, equally split between households and corporations.

What was the role of the public and private intermediaries in supporting private and public investment?

- Regional and federal institutions play an important role in allocating the investment support available as a result of inflow from European and national budgets. In 2016, EUR 938 million were distributed to sector recipients through these public bodies.

How was the climate investment financed, e.g. grants, loans, or equity?

- Investment grants amounting to the EUR 494 million disbursed from the EU and German government budgets were the main financing source for the development of transport infrastructure and e-mobility growth (see Figure 13 for details).

What has changed since 2010 and why?

- The major change since 2016[9] is the large investment volume in e-mobility investments, partly due to public support from the German government budget through the 'Energy and Climate

[9] As noted, the rest of the change in investment volume is due to methodological adjustments.

Fund'. With regard to e-mobility, however, the fund was criticised for serving as an industry subsidy programme without actual GHG-reduction potential (Esch and Kowalzig 2012).

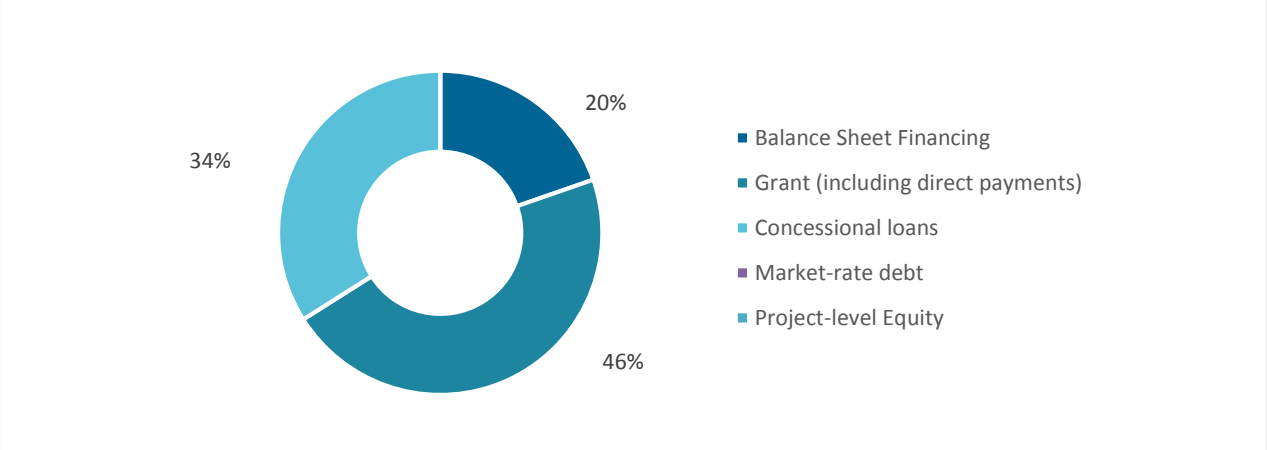


Figure 13. Climate and energy investment in the transport sector by financial instrument used (in billions of euros)

Is the sector on track to reach its targets?

- The total investment in decarbonising the transport sector (EUR 1.1 billion) is far below the EUR 4.0 billion per year in incremental investment that is needed, based on the calculations in Schlesinger et al. (2014). Therefore, the transportation sector is unlikely to be on track to meet its decarbonisation targets.

3.4.4. Case study of the energy generation and infrastructure sector

Sector importance to energy transition

In 2016, the energy sector was responsible for 332.2 mil tCO_2-eq., or 36.6% of Germany's total GHG emissions (UBA 2018). The Climate Action Plan 2050 (BMU 2016a) requires the energy sector to reduce its GHG emissions by 61–62% by 2030 relative to 1990 levels (Table 1). Germany also set a target to increase the share of renewable energy sources in gross electricity consumption to 35% by 2020, 50% by 2030, and 80% by 2050 (BMWi 2016a). Other targets are to derive 18% of the country's total final energy consumption from renewables by 2020, 30% by 2030, and 60% by 2050 (ibid). In addition, Germany has committed to raising the renewables share of its heat consumption to 14% (ibid).

There is a comprehensive portfolio of EU and domestic policies driving investment in the energy sector. The key policies are the Renewable Energy Directive, EU Emission Trading Scheme, and the Renewable Energy Act (EEG – 2014 Revision). Public banks, including KfW and Rentenbank, disburse concessionary loans, while BAFA and EU funds provide grants for the energy sector.

Results of assessment

Table 11 reports the total climate-specific investment in the energy sector in 2010 and 2016 as calculated in our report and in Juergens et al. (2012). This investment included flows to energy efficiency, renewable energy generation, and renewable energy infrastructure. Whereas the feed-in tariff remains an important factor in stimulating investment in renewable energy installations, it was not a direct investment flow according to our methodology (see section 2.1.3 for details); it was therefore excluded from the CEIM in this report.

Table 11. Climate-specific investment in energy generation and infrastructure (in millions of euros)

Source	Energy efficiency		Renewable energy		Total	
	2010	2016	2010	2016	2010	2016
Public	0	454	218	678	218	1,131
Private	500	88	9,6	15,984	9,630	15,982
Total	500	541	9,8	16,572	9,848	17,113

Source: Juergens 2012; research results.

What was the total climate-specific investment in the sector?

In 2016, the total climate-specific investment in the energy-generation and infrastructure sector amounted to EUR 17.1 billion. A large volume of investment in (renewable) energy generation also flowed to other sectors, including EUR 5.9 billion to the building sector and EUR 2.4 billion to the agriculture sector.

Which were the key sector segments, technologies, or practices attracting investment?

- If the total investment is broken down by technology, EUR 8.5 billion was invested in renewable energy generation, EUR 8.1 billion in renewable energy infrastructure, EUR 541 million in energy efficiency, and EUR 0.9 billion in other measures (see detailed breakdown in Figure 12).

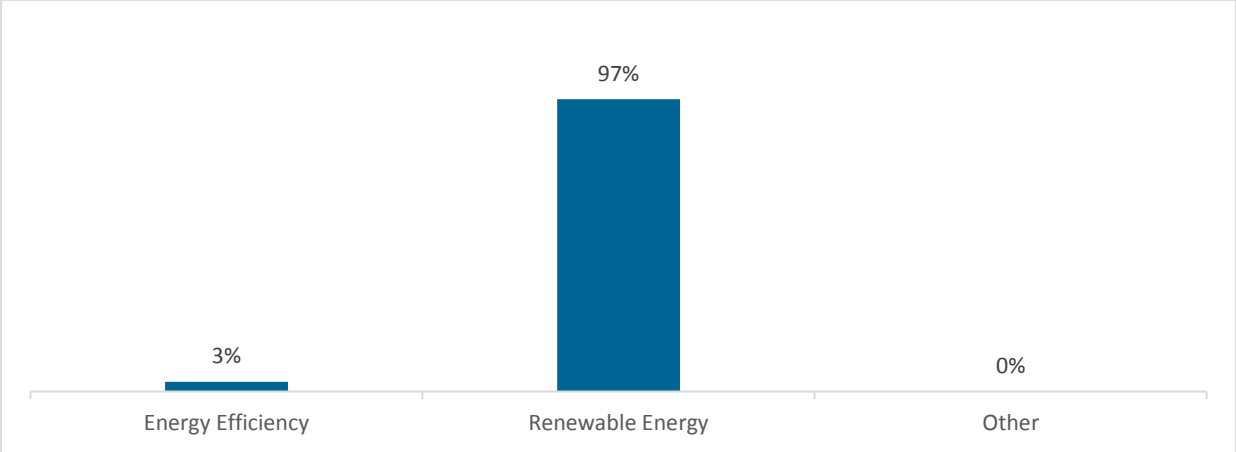


Figure 14. Investments in technology as a share of total investment in the energy sector

Who were the main investors?

- The private sector financed the largest share of investment (93%), including EUR 7.9 billion for renewable energy generation and EUR 8.0 billion for renewable energy infrastructure.
- As in 2010, in 2016 the public sector financed a minor portion of the overall investment (8% in 2016 and 2% in 2010. In 2016, the increased share of public support flowed from the German government budget, while the grant volume from the EU funds declined.

What was the role of the public and private intermediaries in supporting private and public investment?

- Public intermediaries, in particular KfW and the EIB, played a significant role in supporting investment in the energy sector. The EIB committed to loans of EUR 105 million, but this figure could not be incorporated into the investment volume because we only tracked the actual disbursement in 2016.

How was the climate investment financed, e.g. grants, loans, or equity?

- Approximately EUR 4.9 billion flowed to the sector from KfW concessional loans.
- EU funds including ERDF, CEF-E, and EEPR disbursed EUR 94 million in grants for renewable energy generation and infrastructure.

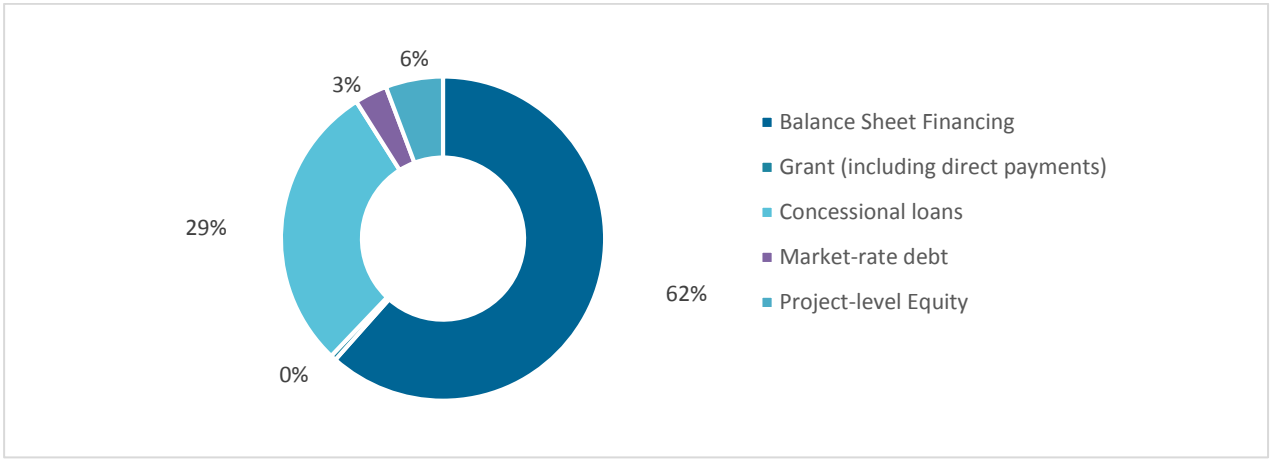


Figure 15. Climate and energy investment in the energy sector by financial instrument used (in billions of euros)

What has changed since 2010 and why?

- Whereas the investment into the renewable energy generation in the energy sector declined from EUR 6.7 billion to EUR 8.5 billion between 2010 and 2016, the investment volume in renewable energy generation across the whole German economy declined from EUR 26.6 billion to EUR 10.9 billion over this period. This could be explained by the decline in investment costs for renewable energy installations (especially photovoltaics – see Figure 16) as well as by the 38% decline in new installed renewable energy capacity between 2012 and 2016 (BMWi 2018c).

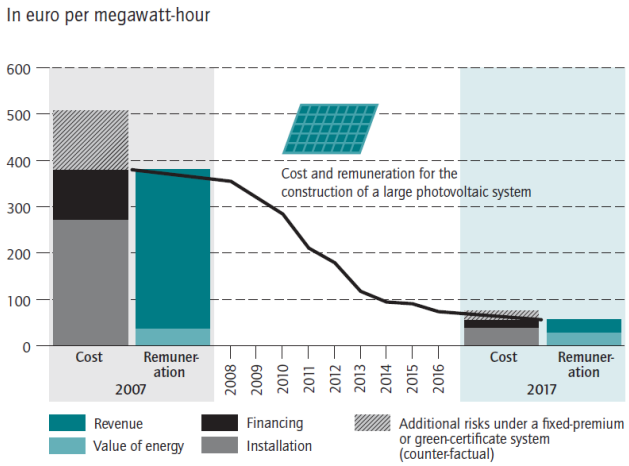


Figure 16. Cost and funding of solar energy installations over time

Source: May et al. 2018.

- As for the renewable energy infrastructure, the investment volume grew to EUR 8.1 billion in 2016 from EUR 3.1 billion in 2010. This may be explained by growing investment in grid expansion and higher maintenance costs of electricity distributors in 2016 than in 2010.

Is the sector on track to reach its targets?

- Nitsch et al. (2012) estimated the total investment need of Germany through 2050, focussing only on renewable energy generation. According to those calculations, EUR 20 billion are needed annually from 2020–2030 and EUR 35 billion from 2040–2050. From a comparison of this investment need with the actual investment, it is clear that greater efforts are needed to close the investment gap. By calibrating the breakdown of the renewable energy investment with the installed capacity status, it becomes clear that the investment category lagging behind is renewable heat, while the investment trend for renewable electricity is on track. In 2016, the share of renewable electricity was 33% of total electricity generation (BMWi 2018b) – only 2% below the target defined in the German Energy Concept, i.e. 35% by 2020. Still, renewable energy represented only 12.6% of total final energy consumption (Destatis 2017), significantly below the 2020 renewables target of at least 18%.

- The investment needed for the onshore and offshore grid was estimated by the European Commission staff document (2015) at EUR 4.2 billion per year. According to the same authors, updating and expanding the transmission and distribution network will require a total investment of EUR 5.7–5.9 billion per year over the period 2013–2020. Comparing this investment need with the actual 2016 investment in renewable energy infrastructure (EUR 8.1 billion) indicates that Germany is indeed on track with its investment in grid infrastructure. Again, however, further efforts are needed.

3.5. Comparison of 2010 with 2016

The **climate-specific investment** flows that we were able to trace indicated an increase in the volume of climate and energy investment in 2016 (EUR 42.7 billion) relative to 2010 levels (EUR 36.7 billion).

A direct comparison of 2010 and 2016 climate and energy investment in Germany is challenging, however, because we were not always able to access the same data sources used in the 2010 assessment (see chapter 2.3 for details). The 2010 and 2016 assessments, though based on the best available data, can only provide a snapshot of climate and energy investment in Germany. As both studies rely on a

limited number of data sources, we cannot fully prevent bias or present full climate and energy investment volumes for the country.

In the energy sector, we saw a large increase in investment in renewable energy infrastructure for transmission and distribution, from EUR 3.1 billion in 2010 to EUR 7.9 billion in 2016. Based on an analysis of the same data sources used in 2010, we observed a decrease in investment for renewable energy generation in 2016. This may be due to decreasing installation prices and the resulting reduction in generation costs. However, further assessment is needed, as an analysis of the reasons for a change in investment patterns is beyond the scope of this report.

In the building sector, total climate and energy investment increased from EUR 21.3 billion in 2010 to EUR 35.1 billion in 2016. This increase resulted in particular from the construction of new buildings. While total investment volumes increased, the incremental share of investment costs in the building sector actually declined, from EUR 16.3 billion in 2010 to EUR 14.6 billion in 2016. That means that, while the total volume of investment grew over the period 2010–2016, there was actually a decrease in the investments that could be considered a contribution to the energy transition.

The slight increase in transport-sector investment mainly resulted from the purchase of electric and hybrid cars. Climate-related infrastructure investments, e.g. for railways, were double the 2010 value. Nevertheless, our CEIM excluded this significant investment (such as investments in public transport infrastructure not captured separately in the national budget). Therefore, the tracked total of transport-sector investment underestimates the actual value. For European funds, the established climate markers were applied, leading to the inclusion of climate-specific shares in European infrastructure support.

The overall amount of climate-specific investment in the agriculture sector has increased since 2010. Since renewable energy investments 2016 (EUR 2.4 billion) in the agriculture sector decreased to less than half of 2010 levels (EUR 5.4 billion), the increase can be attributed fully to the climate-marker overestimation of climate-relevant expenditure under the EAFRD, which was also criticised by the ECA (2016). The incorporation of two full priorities (including all focus areas and measures defined under them) with a 100% climate marker resulted in the incorporation of measures which have no climate-relevant objective (e.g. ‘Payments for areas disadvantaged for natural or other specific reasons’, supported with EUR 242 million).

The decrease in renewable energy investment in the industry sector relative to the 2010 climate and energy investment map is due to our limited access to data for 2016. Based on national statistics (Destatis 2018a), industry-sector investment in renewable energy decreased from EUR 139 million to EUR 77 million; energy-efficiency investment increased from EUR 592 million to EUR 719 million; and

investment in non-energy-related mitigation measures decreased from EUR 207 million to EUR 87 million (see Figure 13 for a comparison of sectoral investment volumes in 2016 and 2010) .

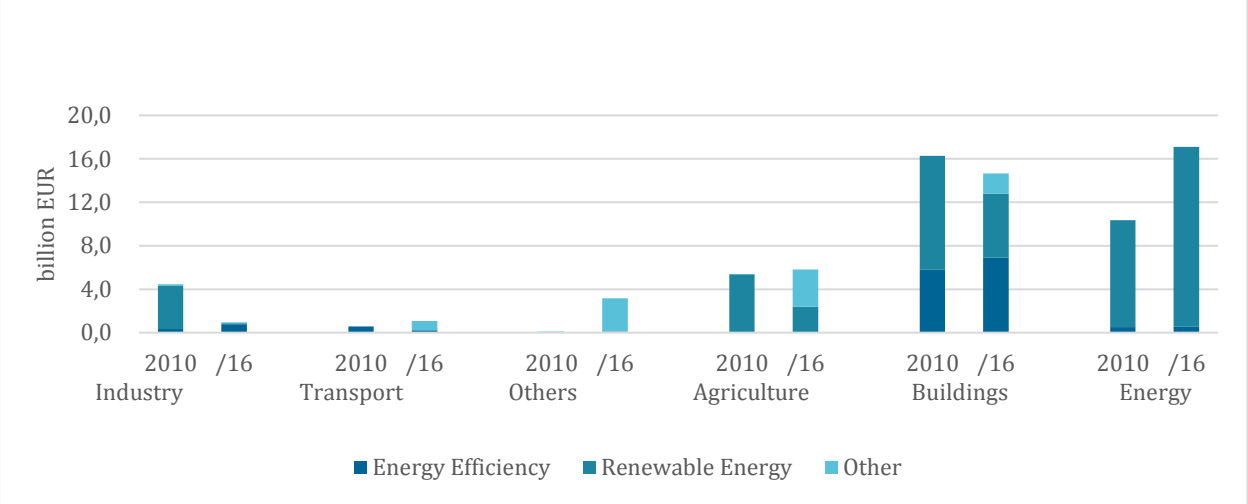


Figure 17. Comparison of sectoral investment volumes by technology in 2010 and 2016 (in billions of euros)

Note: The 2016 incremental shares for building-sector investments were used to make the 2010 and 2016 values comparable.

3.6. How to improve data and methodology for tracking climate financing in Germany

As discussed throughout this report, the key challenges in identifying and tracking climate and energy investment in Germany remain the same as in 2010. There is no common methodology or established system for tracking climate-relevant investment in Germany. The information on private investment is also fragmented and insufficient. When establishing comprehensive and consistent tracking approaches, it will be useful to review the lessons learned from other legislation, such as in France or by the EU Commission.

In France, Article 174 of the Energy Transition and Green Growth Act (LTECV) requires the government to present an annual report to the Parliament which 'quantifies and analyses public finance, assesses private finance, and measures their adequacy with the financial requirements to achieve the objective and transition pace of the law' (Hainaut et al 2017). The Institute for Climate Economics (I4CE) designed a tracking methodology and integrated it into the survey of domestic energy efficiency and renewable energy markets that was conducted annually by the France Energy Management

Agency (ADEME).[10] Using this methodology, the institute has managed to track actual investment and its structure on an annual basis since 2011. The results are used in the budget planning of the French government and in other policy-making processes.

In 2017, the European Commission issued recommendations on tracking climate-related expenditure for the EU budget and its execution in the paper 'Climate mainstreaming in the EU budget: preparing for the next multiannual financial framework' (European Commission 2017). The paper provides an overview of the climate-marker approach applied in the current MFF period (2014–2020) and makes recommendations for potential improvements to this process in the future (see Box 1).

[10] https://www.i4ce.org/publications/

4. Conclusion

The Regulation on the Energy Union Governance (EC 2016b) requires EU Member States to create national energy and climate plans (NECPs), which must include an assessment of current investment flows to the decarbonisation of Member State economies. The present report is intended to contribute to the discussion of these flows in Germany; in addition, using 2016 data, it aims to identify, track, and explain the amount of public and/or private money invested in Germany in technologies and other tangible measures that lead to a GHG emission reductions and an increase of carbon sinks. The methodologies developed, as well as the analytical results, should also serve as a prototype for tracking and evaluating climate investment in other EU Member States, in particular Czechia and Latvia.

Tracked investment in 2016 was higher than in 2010

Based on the **climate-specific investment** flows that we were able to trace, we observe an increase in investment volumes in 2016 (EUR 42.7 billion) relative to 2010 levels (EUR 36.7 billion). These volumes reflect the incremental share in energy-efficiency investment (EUR 8.5 billion), the total investment cost of renewable energy deployment (EUR 25.0 billion), and the total investment cost of non-energy-related mitigation and cross-cutting measures (EUR 9.3 billion). Relative to 2010 investment, the volume of flows to renewable energies decreased by 6%, while the volume of flows to energy efficiency increased by 18%.

We also calculated total investment[11] in energy efficiency (EUR 29.0 billion) in 2016, in addition to the incremental share in investment cost reflected in the comparison above (EUR 8.5 billion). Total investment across all technologies (including energy efficiency, renewable energy, and non-energy-related mitigation and cross-cutting measures) added up to EUR 63.2 billion in 2016. The text provides an analysis of the total investment volume, except where explicitly stated otherwise.

Private investment remains to be key

The private sector provided 83% of the total investment (EUR 52.3 billion), with the remaining 17% originating in the public sector (EUR 10.9 billion). Corporate actors remained by far the largest private investors (EUR 35.2 billion), followed by households (EUR 17.2). In the public sector, the German government budget played the largest role (EUR 4.2), followed by the EU budget (EUR 2.7 billion).

Grants and concessional loans played a key role in driving private investment, while overall finance patterns remained uncertain

[11] Except for household electrical appliances in the buildings sector, blast furnaces, and newly built power plants used in manufacturing, for which the incremental cost was included in the total investment figure.

In 2016, both low-cost debt (EUR 32.0 billion) and grants (EUR 4.7 billion) offered by public actors played an important role in driving climate investments. Due to the limited access to and quality of data, there are significant uncertainties surrounding the EUR 26.6 billion delivered by other financial instruments, such as balance-sheet financing, project-level equity, and market-rate debt.

We identified the building and energy sectors as the main recipient sectors in 2016. These were also the two sectors for which data were most accessible.

The sectors attracting the largest share of climate-specific investment were the building sector (total: EUR 35.1 billion, incremental: EUR 14.6 billion) and the energy generation and transmission sector (total: EUR 17.1 billion). These sectors also have the highest sector-specific targets for GHG emission reductions by 2030 (BMU 2016a), namely 66–67% for buildings and 61–62% for energy. However, total investment volumes do not measure effectiveness in reducing GHGs; therefore, their relationship to GHG emissions-reduction targets should be assessed with caution. Other sectors attracting less climate and energy investment included the agriculture sector (total: EUR 5.8 billion), transport (total: EUR 1.1 billion), industry (total: EUR 0.9 billion), and cross-cutting measures (total: EUR 3.2 billion). Datasets for these sectors were also less comprehensive.

When establishing a comprehensive and consistent tracking approach for Germany, it is useful to review the lessons learned from such legislation (e.g. in France) and from the application of climate markers by the EU Commission.

Data challenges still prevent a comprehensive, unbiased overview of climate finance in Germany. Our analysis relies heavily on a few data sources, including reports from the Bundesnetzagentur, EU funds/CEF, BMEL, BMU (NKI), BAFA, KfW, GfK, NOW GmbH, the Federal Statistical Office, and trend:Research. As underlying methodologies and approaches differed among these reports and sectors were not covered comprehensively, some bias in our overall findings is unavoidable. Future climate and energy investment tracking exercises would benefit from the following:

- Systematically tracking domestic public climate finance covering federal, regional, and local government budgets and climate programmes implemented by public banks and agencies, e.g. by introducing public budget climate tagging and/or establishing annual evaluation procedures.

- Evaluating and streamlining existing private sector surveys/reporting efforts with governmental climate-investment tracking approaches.

Climate-finance tracking approaches have already been implemented elsewhere (e.g. in France and by the EU Commission). These models could provide important lessons for Germany.

There is a need for further discussion on a general concept of climate finance at the domestic level and on the incremental share that actually contributes to the energy transition

By focussing on climate-specific investment in our analysis, we exclude a wide range of climate-related measures with indirect benefits/co-benefits, such as infrastructure projects. This approach may in particular underestimate domestic investment into climate mitigation measures. Further discussion is needed on how and to what extent climate-related measures can be accounted for.

Similarly, further development of practicable approaches to calculating incremental costs of climate investment would prevent an over- or underestimation of related investments, especially in the building sector.

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Annexes

Annex 1: Energy generation and infrastructure – assumptions

Programme / Measure	Amount (EUR million)	Year	Methods / Assumptions / Limitations	References
Renewable Energy generation				
-Total renewable investment volume	15,380	2016	Total as given in the reference	BMWI (2018c), EEA (2018)
--Renewable energy by scale (% of overall installed capacity)				
---Share of renewable investment small-scale (<1 MW installed capacity) (54%)	8,333	2016	Calculated as sum of a small-scale categories: private households, farmers/landowners, industry, other.	Own calculation.
---Share of renewable investment large-scale (46%)	7,046	2016	Calculated as sum of large-scale categories: Funds/Banks, project developers, other generators, and Big 4	As above.
-- Renewable investment by installer				
---Renewable **investment by installer (% of overall installed capacity): electricity**		2016	1. The total renewable investment was split into investment into renewable electricity and investment into renewable heat as provided in BMWI (2018c) and EEA (2018). 2. The investment into renewable electricity was broken down by investor. The investor breakdown was assumed as the breakdown of newly installed renewable electricity capacity in 2016. The latter was estimated based on the change in ownership structure to the newly installed capacity between 2012 and 2016 as provided by trend:research (2013; 2018). 3. Result is proxy for investor share of overall EUR into RE	BMWi (2018c), EEA (2018), trend:research (2018). trend:research (2013)
Private Households (20%)	2,571	2016	The figure also appears in the building and agriculture sector.	As above.
Farmers/landowners (9%)	1,085	2016	The figure also appears in the agriculture sector.	As above.
Industry and commerce (11%)	1,398	2016	The figure includes investment into renewable energy installations by the industry and commercial sector actors. It was further split between these two sectors, see the details in the building sector annex 3. This category was assumed as small-scale.	As above.
Funds/Banks (14%)	1,758	2016	Investment by funds/banks into renewable energy. This category is fully assumed as large-scale.	As above.

Project Developers (15%)	1,878	2016	Investment into renewable energy by large-scale project developers. This category is fully assumed as large-scale.	As above.
Other Generators (22%)	2,612	2016		As above.
Big 4 (7%)	798	2016	Investment into renewable energy by large-scale utilities of Germany's so-called Big 4 utilities (RWE, EON, Vattenfall, and EnBW).	As above.
Other (1%)	120	2016	Here included are public owned renewable energy integrated in public buildings, such as schools. This figure also appears in the building sector.	As above.
---Total Renewable **investment by installer (% of overall installed capacity): heat** **1) solar thermal energy** **2) biomass heat** **3) heat pumps**	3,160	2016	The total renewable investment was split into investment into renewable electricity and investment into renewable heat as provided in BMWI (2018c) and EEA (2018). 2. The investment into renewable heat was broken down by investor based on BAFA annual report 2016/2017 and statistics of the Renewable Energy Agency[12].	BAFA (2017a);BMWi (2018c); EEA (2018)
Private Households	2,738	2016	The figure also appears in the building sector.	As above.
Industry	421	2016	The figure also appears in the industrial sector.	As above.
--**Large-scale total investment in renewable energy** by the private energy sector actors that was not supported by public support programs	9,960	2016	Difference between the total investment estimated based on BMWI (2018c) and EEA (2018) and the investment supported by public support (KfW, BAFA, EU funds). The breakdown into financial instruments, i.e. balance sheet (debt)/balance sheet(equity)/project-level equity/market-rate debt was assumed as 55/15/5/25 based on the Germany-related domestic flows of the Global Landscape of Climate Finance (Buchner et al. 2017).	As above.
Balance sheet debt	1,078	2016	As above	BMWi (2018c), EEA (2018), trend:research (2018), Buchner et al. (2017).
Balance sheet equity	294	2016	As above	As above.
Project-level equity	980			
Market-rate debt	490	2016	As above	As above.
Energy infrastructure				

[12] https://www.unendlich-viel-energie.de/erneuerbare-energie/bioenergie/investitionen-in-erneuerbare-energien-auf-dem-land-legen-leicht-zu

Public				
Renewable energy infrastructure investment supported by EU funds	94	2016	ERDF provided grants for several Länder for renewable energy in the total amount of EUR 42 million, which was co-financed with the national public sources and complemented by the CEF-E (EUR 42 million) and EEPR (EUR 10 million) – climate marker of 100% applied following the general framework for renewable energy infrastructure from budgetary reports for CEF-E and ESIF methodology for ERDF	ERDF Durchführungsberichte, EC (n.d.)
Private				
Corporate Renewable electricity infrastructure investment TSOs/DSOs	7,677	2016	Based on the data used in 2010 report (Juergens et al 2012) for corporate investments into infrastructure: 65%-share of balance sheet (debt) and 35%-share of balance sheet (equity) financing. Extracted from the overall investment amount and assumed a 80% climate-specific investment share for renewable energy infrastructure projects	BNetzA, 2017
Corporate Renewable gas infrastructure investment TSOs/DSOs	288	2016	Based on the data used in 2010 report (Juergens et al 2012) for corporate investments into infrastructure: 65%-share of balance sheet (debt) and 35%-share of balance sheet (equity) financing. Extracted from the overall investment amount and assumed a 10% climate-specific investment share for gas infrastructure projects	BNetzA, 2017
Energy efficiency and renewable energy investment supported by KfW				
KfW concessional loans to households to support renewable energy investment:			Assumed split into instruments: 80% low-interest debt to 10% market-rate debt and 10% private equity	KfW (2016), KfW Programmmerkblätte (n.a)
Concessional loan volume	446,900	2016		As above
Market-rate debt	55,862	2016		As above
Private equity	55,862	2016		As above
KfW concessional loans to the corporate sector to support renewable energy investment:			Assumed split into instruments: 80% low-interest debt to 20% balance-sheet financing (equity)	As above
Concessional loan volume	3,600	2016		As above
Balance sheet equity	900,100	2016		As above
KfW concessional loans to the public sector actors to support renewable energy			Assumed split into instruments: 80% low-interest debt to 20% balance-sheet financing (equity)	As above

investment:				
Concessional loan volume	466,700	2016		As above
Balance sheet equity	116,675	2016		As above
KfW concessional loans to the corporate sector to support energy efficiency investment:			Assumed split into instruments: 80% low-interest debt to 20% balance-sheet financing (equity)	
Concessional loan volume	70,200	2016		As above
Balance sheet equity	17,550	2016		As above
KfW concessional loans to the public sector actors to support energy efficiency y investment:			Assumed split into instruments: 80% low-interest debt to 20% balance-sheet financing (equity)	
Concessional loan volume	362,800	2016		As above
Balance sheet equity	90,700	2016		As above

Annex 2: Industry sector – assumptions

Programme / Measure	Amount (EUR million)	Year	Methods / Assumptions / Limitations	References
Energy Efficiency				
Public				
BAFA: "Querschnitttechnologien – Einzelmahßnahmen und optimierung techn. Systeme" Public expenditure	62	2016	Bafa provided a grant covering 28% of the investment (Bafa 2016/2017 report). Corporate investment 15% of project-based equity and 85% of balance sheet equity.	BAFA (2017a), Email correspondence with Mr Hans-Peter Klein of Bafa,
Private				
BAFA: "Querschnitttechnologien – Einzelmahßnahmen und optimierung techn. Systeme" Private co-financing	161	2016	Corporate investment 15% of project-based equity and 85% of balance-sheet equity.	As above
WZ-C (Industry) WZ-B (Mining & quarrying)	718	2016	Assumed split into financial instruments: 70% balance-sheet financing (debt) and 30% balance-sheet financing (equity) split for corporate investments in energy efficiency	Destatis 2018a
Renewable energy				
Renewable heat generation using biomass: investment by corporate actors excluding that leveraged by Bafa and EU funds	47	2016	The number of total investments by industrial investors into renewable energy is calculated from the BMWI statistic of total investments into RES in Germany (by all sectors and stakeholders) and multiplied with the results of the trend:research statistic about ownership of installs renewable energy in Germany by civil group. 85%/15% breakdown into balance sheet-equity vs project-level equity for corporations was assumed based on the Germany-related domestic flows of the Global Landscape of Climate Finance (Buchner et al. 2017).	BMWi (2018c), EEA (2018), trend:research (2018), Buchner et al. (2017) .
WZ-C (Industry)	77	2016	Assumed a 70% debt and :30% balance-sheet financing (equity) split for corporate investments in renewable energies	As above.
Other				
WZ-C (Industry) WZ-B (Mining & quarrying)	92	2016	Assumed a 70% debt and 30% balance -sheet financing (equity) split for corporate investments in other climate-specific technologies	Destatis 2018a

Annex 3: Building sector – assumptions

Programme/ Measure	Amount (mil EUR)	Year	Methods / Assumptions / Limitations	References
Energy Efficiency				
Private				
Electrical appliances, electronics, and equipment Investments by the residential, commercial, and public sector: **<u>Incremental share</u>**	569	2015	The total investment was calculated as a sum of individual estimates for each appliance. These were determined by multiplying the number of units sold for each energy efficiency class above the BAU energy efficiency class by the difference in price between that class and the price of the BAU energy efficiency class. The BAU energy efficiency class was assumed as a minimum energy performance standard at the EU market in 2016. The next assumptions and limitations were applied: • Only three major domestic appliances are covered, due to data availability: refrigerators, washing machines, and tumble dryers. The estimate represents a lower bound as it does not include appliances and equipment other than those listed. • Sales numbers and structure by energy efficiency classes are tracked for the year 2015 from the latest available publication (Michel, Attali, & Bush, 2016). • BAU classes were assumed as A+ for washing machines (Michel et al , Kreitz, Attali, & Bush, 2017), A+ for refrigerators (Michel et al., 2017), and B for tumble dryers (Michel et al., 2017). • Prices by energy efficiency classes refer for washing machine to 2015 (Michel et al., 2016); for refrigerators to 2017 (EcoTopTen, 2018a); and for tumble driers in A+ class to 2015 (Michel et al., 2016) as well as A++ and A+++ to 2015 (EcoTopTen, 2018c).	(Michel, Attali, & Bush, 2016), (Michel et al , Kreitz, Attali, & Bush, 2017), (Michel et al., 2017), (EcoTopTen, 2018a); (EcoTopTen, 2018c).
Public				
Public expenditure for energy efficiency extracted from German budget Budget lines 9 3 72021 609	1.289	2016	Investment by the public sector categorised as balance-sheet financing (equity) instead of project-level equity to be in line with the definition for households (also balance-sheet financing (equity) as suggested by CPI).	Federal Ministry of Finance (n.d.)

9 13 71101 646 10 16 51802 816 60 92 1712ff 60 2 89134 1706				
Public				
BAFA: Heating optimization grant	2	2016	Grants covering 30% of the investment to support heating optimisation/pump replacement. The investor split is 84% households, 1.5% public investment, 7% from housing companies, and 7% from companies. 100% of investments went to the existing building stock.	BAFA (2017a), Email correspondence with Mr Hans-Peter Klein of Bafa
BAFA: Energy efficiency improvement in cooling and air-conditioning technologies grant	24	2016	Grants covering 19% of the investment to support energy efficiency in cooling. All investment went into the commercial sector. Of this, 50% of investments went to new buildings and 50% to the existing building stock.	As above
BAFA: Grants to support small combined cooling/heating power in the residential and tertiary sector	5	2016	Grants covering 10% of the investment to support small combined cooling/heating power. It is assumed that the investor split is 97.3% households, 1% public entities and 1.7% commercial sector. Of the total, 50% of investments went to construction works and 50% to the existing building stock.	As above
BAFA: Municipality co-financing for total BAFA energy efficiency grants	6	2016	For municipalities, a breakdown into 15% project-based equity and 85% balance-sheet equity is assumed.	As above
Private				
BAFA: Households co-financing for total BAFA energy efficiency grants	44	2016	For households, a 10% debt/90% equity split was assumed for the total co-financing of the BAFA grant.	As above
BAFA: Corporate co-financing for total BAFA energy efficiency grants	97	2016	For corporations, a 15% of project-based equity and 85% of balance-sheet equity split was assumed for the total co-financing of the BAFA grant.	As above
Public				
KfW: Investment of the public sector into energy efficiency in existing residential buildings: through KfW concessionary loans	39	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	KfW (2016), KfW Programmmerkblätte (n.a.), Email correspondence with Ms Bettina Dorendorf of KfW
KfW: Investment of the public sector into energy efficiency in existing residential	11	2016	As above	As above

buildings: through balance sheet financing (equity)				
KfW: Investment of the public sector into energy efficiency in new residential buildings: through KfW concessionary loans	231	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the public sector into energy efficiency in new residential buildings: through balance sheet financing (equity)	58	2016	As above	As above
KfW: Investment of the public sector into energy efficiency in new public buildings: through KfW concessionary loans	392	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the public sector into energy efficiency in new public buildings: through balance sheet financing (equity)	122	2016	As above	As above
KfW: Investment of the public sector into energy efficiency in existing public buildings: through KfW concessionary loans	109	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the public sector into energy efficiency in existing public buildings: through balance sheet financing (equity)	43	2016	as	As above
Private				
KfW: Investment of households into energy efficiency in existing residential buildings: through KfW concessionary loans	1,823	2016	Households cover 80% of total investment costs with the KFW concessionary loan, 20% is covered by 10% co-equity and 10% market-based loan.	KfW (2016), KfW Programmmerkblätte (n.a.), Email correspondence with Ms Bettina Dorendorf of KfW
KfW: Investment of households into energy efficiency in existing residential buildings: co-financing by market-rate debt	1,397	2016	As above	As above
KfW:	395	2016	As above	As above

Investment of households into energy efficiency in existing residential buildings: co-financing by private equity				
KfW: Investment of the corporate sector into energy efficiency in existing residential buildings: through KfW concessionary loans	1,398	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector into energy efficiency in existing residential buildings: through balance sheet financing (equity)	394	2016	As above	As above
KfW: Investment of households into energy efficiency in new residential buildings: through KfW concessionary loans	6,096	2016	Households cover 80% of total investment costs with the KFW concessionary loan, 20% is covered by 10% co-equity and 10% market-based loan.	As above
KfW: Investment of households into energy efficiency in new residential buildings: co-financing by market-rate debt	894	2016	As above	As above
KfW: Investment of households into energy efficiency in new residential buildings: co-financing by private equity	781	2016	As above	As above
KfW: Investment of the corporate sector into energy efficiency in new residential buildings: through KfW concessionary loans	4,052	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector into energy efficiency in new residential buildings: through balance sheet financing (equity)	1,018	2016	As above	As above
KfW: Investment of the corporate sector into energy efficiency in existing commercial buildings: through KfW concessionary loans	2,607	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW:	652	2016	As above	As above

Investment of the corporate sector into energy efficiency in existing commercial buildings: through balance sheet financing (equity)				
KfW: Investment of the corporate sector actors into energy efficiency in new commercial buildings: through KfW concessionary loans	2,235	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector actors into energy efficiency in new commercial buildings: through balance sheet financing (equity)	559	2016	As above	As above
Renewable energy				
Public				
BAFA: Solar thermal grant	58	2016	Grants covering 16% of the investment into solar energy. The investor split is 98.3% households, 0.5% public entities and 1.2% tertiary sector. All investments went to the existing building stock.	BAFA (2017a), Email correspondence with Mr Hans-Peter Klein of Bafa
BAFA: Biomass grant	83	2016	Grants covering 20% of the investment into biomass energy. The investor split is 97.2% households, 0.4% public entities and 2.4% tertiary sector. All investment went to the existing building stock.	As above
BAFA: Heat pump grant	47	2016	Grants covering 24% of the investment into heat pumps. The investor split is 91.9% households, 0.2% public entities and 7.9% tertiary sector. Of the total, 62% of investments went to construction works and 38% to the existing building stock.	As above
BAFA: Municipality co-financing for total BAFA renewable energy grants	3	2016	For municipalities, a breakdown into 15% of project-based equity and 85% of balance-sheet equity is assumed.	As above
Private				
BAFA: Households co-financing for total BAFA renewable energy grants	769	2016	For households, a 10% debt, 90% equity split was assumed for the total co-financing of the BAFA grants.	As above
BAFA: Corporate co-financing for total BAFA renewable energy grants	24	2016	For corporations, a 15% project-based equity, 85% balance-sheet equity split was assumed for the total co-financing of the BAFA grants.	As above
Public				

KfW: Investment of the public sector into renewable energy in new residential buildings: through KfW concessionary loans	26	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	KfW (2016), KfW Programmmerkblätte (n.a.), Email correspondence with Ms Bettina Dorendorf of KfW
KfW: Investment of the public sector into renewable energy in new residential buildings: through balance sheet financing (equity)	6	2016	As above	As above
KfW: Investment of the public sector into renewable energy in existing residential buildings: through KfW concessionary loans	3	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the public sector into renewable energy in existing residential buildings: through balance sheet financing (equity)	1	2016	As above	As above
KfW: Investment of the public sector into renewable energy in existing public buildings: through KfW concessionary loans	9	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the public sector into renewable energy in existing public buildings: through balance sheet financing (equity)	2	2016	As above	As above
KfW: Investment of the public sector into renewable energy in new public buildings: through KfW concessionary loans	44	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the public sector into renewable energy in new public buildings: through balance sheet financing (equity)	11	2016	As above	As above
KfW: Investment of the public sector into renewable energy in new and existing residential buildings: through KfW concessionary loans	13	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above

KfW: Investment of the public sector into renewable energy in new and existing residential buildings: through balance sheet financing (equity)	3	2016	As above	As above
Private				
KfW: Investment of households into renewable energy in new residential buildings: through KfW concessionary loans	677	2016	Households cover 80% of total investment costs with the KFW concessionary loan, 20% is covered by 10% co-equity and 10% market-based loan.	KfW (2016), KfW Programmmerkblätte (n.a.), Email correspondence with Ms Bettina Dorendorf of KfW
KfW: Investment of households into renewable energy in new residential buildings: co-financing by market-rate debt	85	2016	As above	As above
KfW: Investment of households into renewable energy in new residential buildings: co-financing by private equity	85	2016	As above	As above
KfW: Investment of the corporate sector into renewable energy in new residential buildings: through KfW concessionary loans	450	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector into renewable energy in new residential buildings: through balance sheet financing (equity)	113	2016	As above	As above
KfW: Investment of households into renewable energy in existing residential buildings: through KfW concessionary loans	134	2016	Households cover 80% of total investment costs with the KFW concessionary loan, 20% is covered by 10% co-equity and 10% market-based loan.	As above
KfW: Investment of households into renewable energy in existing residential buildings: co-financing by market-rate debt	36	2016	As above	As above
KfW: Investment of households into renewable energy in existing residential buildings: co-financing by private equity	19	2016	As above	As above

KfW: Investment of the corporate sector into renewable energy in existing residential buildings: through KfW concessionary loans	98	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector into renewable energy in existing residential buildings: through balance sheet financing (equity)	25	2016	As above	As above
KfW: Investment of the corporate sector into renewable energy in existing commercial buildings: through KfW concessionary loans	36	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector into renewable energy in existing commercial buildings: through balance sheet financing (equity)	9	2016	As above	As above
KfW: Investment of the corporate sector actors into renewable energy in new commercial buildings: through KfW concessionary loans	248	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector actors into renewable energy in new commercial buildings: through balance sheet financing (equity)	62	2016	As above	As above
KfW: Investment of households into renewable energy in new and existing residential buildings: through KfW concessionary loans	13	2016	Households cover 80% of total investment costs with the KFW concessionary loan, 20% is covered by 10% co-equity and 10% market-based loan.	As above
KfW: Investment of households into renewable energy in new and existing residential buildings: co-financing by market-rate debt	2	2016	As above	As above
KfW:	2	2016	As above	As above

Investment of households into renewable energy in new and existing residential buildings: co-financing by private equity				
KfW: Investment of the corporate sector into renewable energy in new and existing residential buildings: through KfW concessionary loans	106	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector into renewable energy in new and existing residential buildings: through balance sheet financing (equity)	27	2016	As above	as above
Investment into renewable energy of households installed in residential buildings that was not supported by public support programs			Difference between the total household investment in renewable energy estimated based on BMWI (2018c) and EEA (2018) and this investment supported by public support (KfW, BAFA). The breakdown into financial instruments, i.e. market-rate debt to private equit,y was assumed as 85/15 based on the Germany-related domestic flows of the Global Landscape of Climate Finance (Buchner et al. 2017).	BMWi (2018c), EEA (2018), trend:research (2018), Buchner et al. (2017)
Market-rate debt	224	2016	As above	As above
Private equity	39	2016	As above	As above
Market-rate debt	1,001	2016	As above	As above
Private equity	177	2016	As above	As above
Investment into renewable energy of the corporate actors in the commercial sector that was not supported by public support programs			Difference between the total household investment in renewable energy estimated based on BMWI (2018c) and EEA (2018) and this investment supported by public support (KfW, BAFA). The breakdown into financial instruments, i.e. balance sheet (debt)/balance sheet(equity)/project-level equity/market-rate debt, was assumed as 55/15/5/25 based on the Germany-related domestic flows of the Global Landscape of Climate Finance (Buchner et al. 2017).	BMWi (2018c), EEA (2018), trend:research (2018), Buchner et al. (2017)
Balance Sheet Financing (equity)	118	2016	As above	As above
Project-level Equity	201	2016	As above	As above

Balance Sheet Financing (equity)	816	2016	As above	As above
Project-level Equity	144	2016	As above	As above
Other				
Private				
KfW: Investment of households into other measures in residential buildings: through KfW concessionary loans	44	2016	Households cover 80% of total investment costs with the KFW concessionary loan, 20% is covered by 10% co-equity and 10% market-based loan.	KfW (2016), KfW Programmmerkblätte (n.a.), Email correspondence with Ms Bettina Dorendorf of KfW
KfW: Investment of households into other measures in residential buildings: co-financing by market-rate debt	5	2016	As above	As above
KfW: Investment of households into other measures in residential buildings: co-financing by private equity	5	2016	As above	As above
KfW: Investment of the corporate sector into other measures in residential buildings: through KfW concessionary loans	30	2016	Assumed that corporate sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the corporate sector into other measures in residential buildings: through balance sheet financing (equity)	7	2016	As above	As above
Public				
KfW: Investment of the public sector into other measures in residential buildings: through KfW concessionary loans	2	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above
KfW: Investment of the public sector into other measures in residential buildings: through balance sheet financing (equity)	0.4	2016	As above	As above
KfW: Investment of the public sector into other measures in public buildings: through KfW concessionary loans	1,404	2016	Assumed that public sector entities cover 80% of their total investment with the KfW concessionary loan and 20% with their balance sheet (equity).	As above

KfW: Investment of the public sector into other measures in public buildings: through balance sheet financing (equity)	351	2016	As above	As above
KfW: Grants into renewable energy installed in existing residential buildings, for all types of actors	6	2016		As above
KfW: Grants into renewable energy installed in new residential buildings, for all types of actors	0.1	2016		As above
KfW: Grants into energy efficiency installed in existing residential buildings, for all types of actors	345	2016		As above
KfW: Grants into energy efficiency installed in new residential buildings, for all types of actors	39	2016		As above
KfW: Grants into energy efficiency installed in existing public buildings, for all types of actors	6	2016		As above
KfW: Grants into energy efficiency installed in new public buildings, for all types of actors	4	2016		As above

Annex 4: Transport sector – assumptions

Programme/ Measure	Amount (EUR million)	Year	Methods / Assumptions / Limitations	References
Climate-specific				
Electro-mobility				
Public				
National Organization Hydrogen and Fuel Cell Technology – Public funding: Model regions electric mobility:	6	2016	Project budget divided by project time to get value for 2016. Assumed that corporations finance through the capital market over a balance sheet with debt/equity=80/20%, higher education institutions financed for progress evaluation and further research excluded from funding calculation. Only projects used which result in physical assets → Project codes: V03, V05, V07, V08, V10, V11, V13, V14	NOW (2016)
Private				
National Organization Hydrogen and Fuel Cell Technology – Corporate investments: Model regions electric mobility:	5	2016	Corporate investment equals project budget, without R&D (calculated as described above), minus funding volume.	NOW (2016)
Public				
KfW Investment loans for public entities (20%)	355	2016	We calculated investments of municipalities from their own budgets using KfW co-financing rules: 80% to 20% equity/debt split. As we have not analysed municipal budgets and hence could not find any corresponding numbers for our calculations in official documents, we just assume that this financial flow originates in the public budgets.	KfW (2016)), KfW Programmmerkblätte (n.a.), Email correspondence with Ms Bettina Dorendorf of KfW
KfW Co-financing (80%)	89	2016		As above.
Private (Other)				
CO2 mitigation on other means of transport	1	2016	We calculated investments by private actors from their balance sheets using KfW co-financing rules: 80% to 20% equity/debt split.	As above.
KfW Co-financing (80%)	5	2016		As above.
Priavte (Energy Efficiency)				As above.
Highly efficient cars	0.25	2016		As above.
KfW Co-financing (80%)	1	2016		As above.
Acquisition of low-emission commercial vehicles	0.25	2016		As above.

KfW Co-financing (80%)	1	2016		As above.
Public				
BAFA: Environmental bonus for the purchase of electronic cars – public funding	6	2016	Multiplication of all registered applications for the environmental bonus in 2016 and the premium paid by the state and the car seller. EUR 4000 for e-cars and EUR 3000 for hybrid, split 50/50 between BAFA and car seller (BAFA grant is 2000 for e-car and 1500 for hybrid).	BAFA (2017a)
Private				
BAFA: Environmental bonus for the purchase of electronic cars – Car seller share	6	2016	Car seller reduces price of e-car by the same amount as the BAFA Grant. Decided to label as Grant because it is not a real investment by the car seller.	As above
BAFA: Environmental bonus for the purchase of electronic cars – private investments (private purchases of electronic cars)	57	2016	Private investments into e-cars derived from the BAFA Umweltbonus programme (50% of all bought cars where for private use - assumption made from split off after applicant type as in the stated report). From list of bought cars under the programme developed average price from the most-bought 80% electro and hybrid cars (average price is EUR 35668.75). Multiplication of average price and the published number of subsidised cars under the programme in 2016 (1991 e-cars and 1599 hybrid subsidised).	As above.
BAFA: Environmental bonus for the purchase of electronic cars – corporate investments (corporate purchases of electronic cars) (Balance sheet financing: 80% balance sheet debt, 20% balance sheet equity)	57	2016	Corporate investments into e-cars derived from the BAFA Umweltbonus programme (50% of all bought cars were for corporate use; assumption made from split-off after applicant type as in the stated report). From list of bought cars under the programme developed average price from the most-bought 80% electro and hybrid cars (average price is EUR 35668.75). Multiplication of average price and the published number of subsidised cars under the programme in 2016 (1991 e-cars and 1599 hybrid subsidised).	As above.
Infrastructure				
CEF-Transport grants 2014-2017: Railways	390	2016	Calculation from total investment volume in 2016 (EUR 1,217 Mio) under the CEF-T multiplied with different modes of transport and adjusted with the respective climate marker of 40% for all infrastructure besides road and air projects. CEF Transport funding in Mio EUR per transport mode in % from given funding volumes in fact sheet: total 2176,5→ 100.00%; Rail 1,743.6→ 80.11%; Air 213.1→ 9.79%; Road 136.3→ 6.26%; Waterways 30.8→ 1.42%; Multimodal 30.2→ 1.39%; Marine 22.5→ 1.03%	EC (2018c).
CEF-Transport grants 2014-2017: Waterways	7	2016	As above	As above
CEF-Transport grants 2014-2017: Multimodal	7	2016	As above	As above
CEF-Transport grants 2014-2017: Maritime	5	2016	As above	As above

ERDF: Intervention category 043: Promoting environmentally friendly public transport infrastructure (including equipment and vehicles). Funding received: Berlin and Mecklenburg-Vorpommern	1	2016	Data for ERDF funding extracted from laender reports. In Berlin 50% co-financed with laender budget (Total: EUR 1,906,564.33 x 0.5= EUR 953,282.17); EU support is equal share; In Mecklenburg-Vorpommern 20% co-financed with laender budget (Total: EUR 877.203,39 x 0.2= EUR 175,440.68); EU support is 80% of total (= EUR 701,762.71) Adjusted with the respective Rio-Marker of 40%	EFRE-MV (2017); EFRE Berlin (2017); ifS (2017)
Climate related				
Infrastructure investments: Bike	68	2016	Infrastructure investments extracted from German budget Lines: 12 1 74622 12 10 68601 12 10 89102	Federal Ministry of Finance (n.d.)
Infrastructure investments: Railway	5,177	2016	Infrastructure investments extracted from German budget Lines: 12 2 89101 12 2 89103 12 2 89111 12 10 89101 60 2 89131	As above
Infrastructure investments: Waterway	795	2016	Infrastructure investments extracted from German budget Lines: 12 3 52101 12 3 75201 12 3 78001 12 3 78002 60 2 78031	As above
Infrastructure investments: Public transport	275	2016	Infrastructure investments extracted from German budget Lines: 12 6 88202 12 6 89101 12 10 88201	As above

Annex 5: Agriculture sector – assumptions

Programme / Measure	Amount (EUR million)	Year	Methods / Assumptions / Limitations	References
Climate specific				
Agri-environmental (other)				
EARFRD				
CAP and GAP: European Agricultural Fund for Rural Development (EAFRD) Total EU funding:	51	2016	EU Budget 50%, other 50% are nationally co-financed; aggregated data extracted from priorities and focus areas from the BMEL statistic Climate markers following EC methodology: P5: Promoting resource efficiency and supporting the shift towards a low-carbon and climate-resilient economy in the agriculture, food and forestry sectors (all focus areas); Climate marker 100%.	BMEL (2018); EC(2016)
CAP and GAP: European Agricultural Fund for Rural Development (EAFRD) – Total national co-financing	51	2016	National co-financing 50% (20% Laender and 30% Federal budget); approximation because normal national co-financing rate is 53% but two regions in Germany have special status with co-financing of 25% and special national top-ups with 100% federal budget are possible for all regions	As above
EAGF				
CAP and GAP: European Agricultural Guarantee Fund – Direct payments	1,061	2016	As of EU Draft Budget WD I 2016 (p.207): the direct payment for agricultural practices beneficial for the climate and the environment (item 05 03 01 11) is split into three equal tiers, analogous to the three compulsory farming practices applicable. The tiers receive the following climate marker: 1st tier 0% (crop diversification), 2nd tier 40% (ecological focus area), 3rd tier 100% (permanent grassland). Plus, a climate marker of 40% applied to 20% of the remaining direct payments considering cross-compliance (i.e. 8% of budget chapter 0503 direct payments without payment for agricultural practices beneficial for the climate and the environment).	As above.
Non-land-based agricultural CO_2 mitigation practices (other)				
CAP and GAP: European Agricultural Fund for Rural Development (EAFRD) –Total EU funding	1,125	2016	EU budget 50%, other 50% are nationally co-financed; aggregated data extracted from priorities and focus areas from the BMEL statistic. Climate markers following EC methodology: Priority P4: Restoring, preserving and enhancing ecosystems related to agriculture and forestry (all focus areas); Climate marker 100% Focus area 3B: Supporting farm risk prevention and management; Climate marker 40%	BMEL (2018); EC (2016)

			Focus area 6B: Fostering local development in rural areas; climate marker 40%.	
CAP and GAP: European Agricultural Fund for Rural Development (EAFRD) – Total national co-financing	1,125	2016	National co-financing 50% (20% *Länder* and 30% Federal budget); approximation because normal national co-financing rate is 53% but two regions in Germany have special status with co-financing of 25% and special national top-ups with 100% federal budget are possible for all regions	As above
Renewable energy				
Public banks				
L- and Rentenbank: Concessional loan for new energies	1,914	2016	Joint loan programme for renewable energy sources assumed to be 100% relevant because no further split-off is available and environmental protection is stated as a principal objective of the loan. No overlap due to two different financial reports of both banks offering separated numbers for the same program	L-Bank (2017); Rentenbank (2017)
Private Investments				
Total equity shares for L- and Rentenbank loans	496	2016	Assumption that investors borrow 80% for renewable energy source investments from concessional loans offered by L- and Rentenbank. 20% of the total investment is financed through private equity	trend:research (2018); BMWi (2018c).
Renewable energy investments by farmers (20% equity share)	217	2016	The total investment of farmers into renewable energy is amounting to EUR 1,084,870,743 (as explained in Annex 1). (80% of which are borrowed in the form of concessional loans and 20% is farm equity)	
Renewable energy investments by investors (excluding farmers) in the agricultural sector (20% equity share)	261	2016	The rest of the loans offered by L-and Rentenbank are assumed to be taken by households (small investors in the agricultural sector) and also financed with 80% low cost debt and 20% equity. (Taken from total households renewable energy investments as in Annex1)	
Climate related				
CAP and GAP: European Agricultural Fund for Rural Development (EAFRD) – Total EU funding: M11: Payments for the introduction/ maintenance of organic farming methods	392	2016	EU budget 50%, other 50% are nationally co-financed; aggregated data extracted from priorities and focus areas from the BMEL statistic.	BMEL (2018)

Annex 6: Other sectors (waste and wastewater) – assumptions

Programme / Measure	Amount (EUR million)	Year	Methods / Assumptions / Limitations	References
Public				
KfW Investment loans for public entities (20%)	1,454	2016	We calculated investments of municipalities from their own budgets using KfW co-financing rules: 80% to 20% equity/debt split. As we have not analysed municipal budgets and hence could not find any corresponding numbers for our calculations in official documents, we just assume that this financial flow originates in the public budgets.	KfW (2016)), KfW Programmmerkblätte (n.a.), Email correspondence with Ms Bettina Dorendorf of KfW
KfW Co-financing (80%)	363	2016		As above.
Private (Other)				
CO2 mitigation through other focus loans for companies (20%)	243	2016	We calculated investments by private actors from their balance sheets using KfW co-financing rules: 80% to 20% equity/debt split. Households finance their 20% debt share with 10% equity and 10% market rate debt.	As above.
KfW Co-financing (80%)	971	2016		As above.
CO2 mitigation through other focus loans for households (10% equity and 10% market rate debt)	2	2016		As above
KfW Co-financing (80%)	7	2016		As above
WZ-E (Water supply – waste and wastewater)	114	2016	Assumed a 70% debt and :30% balance-sheet financing (equity) split for corporate investments into energy efficiency	Destatis 2018a

Annex 7: Split of KfW programmes by investor and by financial instrument in 2016

in million EUR

	Renewable energy						Energy efficiency						Other						TOTAL
Investor	KfW loan	KfW grant	Balance sheet	Debt	Equity	Total	KfW loan	KfW grant	Balance sheet	Debt	Equity	Total	KfW loan	KfW grant	Balance sheet	Debt	Equity	Total	
TOTAL																			
Public entities	561	6	140	-	-	707	1 135	394	325	-	-	1 854	3 214	-	804	-	-	4 018	6 580
Companies	4 540		1 136	-	-	5 675	10 363		2 640	-	-	13 003	1 006		252	-	-	1 258	19 936
Households	1 271		-	179	162	1 612	7 919		-	2 290	1 176	11 385	50		-	6	6	63	13 060
TOTAL	6 372	6	1 276	179	162	7 994	19 417	394	2 965	2 290	1 176	26 242	4 271	-	1 055	6	6	5 339	39 575
Energy and grid																			
Public entities	467	-	117	-	-	583	363	-	91	-	-	454	-	-	-	-	-	-	1 037
Companies	3 600		900	-	-	4 501	70		18	-	-	88	-		-	-	-	-	4 588
Households	447		-	56	56	559	-		-	-	-	-	-		-	-	-	-	559
TOTAL	4 514	-	117	-	-	583	363	-	91	-	-	454	-	-	-	-	-	-	6 184
Residential & Tertiary																			
Public entities	95	6	24	-	-	124	772	394	235	-	-	1 401	1 406	-	351	-	-	1 757	3 282
Companies	939		236	-	-	1 175	10 291		2 622	-	-	12 913	30		7	-	-	37	14 125
Households	824		-	123	106	1 053	7 919		-	2 290	1 176	11 385	44		-	5	5	55	12 492
TOTAL	1 858	6	259	123	106	2 352	18 982	394	2 856	2 290	1 176	25 698	1 479	-	359	5	5	1 849	29 899
Transport																			
Public entities	-	-	-	-	-	-	-	-	-	-	-	-	355	-	89	-	-	444	444
Companies	-		-	-	-	-	2		0,5	-	-	2,50	5		1	-	-	6	9
Households	-		-	-	-	-	-		-	-	-	-	-		-	-	-	-	-
TOTAL	-	-	-	-	-	-	2	-	1	-	-	3	360	-	90	-	-	450	453
Other																			
Public entities	-	-	-	-	-	-	-	-	-	-	-	-	1 454	-	363	-	-	1 817	1 817
Companies	-		-	-	-	-	-		-	-	-	-	971		243	-	-	1 214	1 214
Households	-		-	-	-	-	-		-	-	-	-	7		-	1	1	9	9
TOTAL	-	-	-	-	-	-	-	-	-	-	-	-	2 432	-	606	1	1	3 040	3 040

Annex 8: Förder- und Landesbanken climate-related finance

Bank	Priorities / measures financed	Volume, EUR mn	Note	Reference
	Baden-Württemberg			
L-Bank	Energieeffizienzfinanzierung – Bauen und Sanieren	621	KfW co-financed program	Jahresbericht, p. 28
	Neue Energien – Bürgerwindparks	15		Jahresbericht, p. 29
	Umwelt- und Verbraucherschutz, Nachhaltigkeit, Neue Energien	71		Jahresbericht, p. 29
	Wohnen mit Zukunft: Erneuerbare Energien	31		Jahresbericht, p. 87
	Mietwohnraumförderung	653	Climate & energy relevance unknown	Jahresbericht, p. 28
	Ressourceneffizienzfinanzierung	671	Not clear if KfW co-financed program	Jahresbericht, p. 28-29
LBBW	Projektfinanzierungen Erneuerbare Energien	1,126	Not clear if KfW co-financed program	Sustainability report 2017, p. 78
	Commercial energy effiecny loans	1,299	Not clear if KfW co-financed program	Sustainability report 2017, p. 75
	Private energy effiecny loans	1,106	Not clear if KfW co-financed program	Sustainability report 2017, p. 75
	LBBW Global Warming	33	Climate & energy relevance unknown	Sustainability report 2017, p. 68
	Bayern			
Bayern-Labo	Energiekredit Kommunal Bayern	97	KfW co-financed program	Jahresbericht, p. 43
	Bayerisches Modernisierungsprogramm	11	KfW co-financed program	Jahresbericht, p. 19
	Bayerisches Modernisierungsprogramm	80	KfW co-financed program	Jahresbericht, p. 19
	Bayerisches Wohnungsbauprogramm	42	KfW co-financed program	Jahresbericht, p. 28
	Förderung von Eigenheimen und selbst genutzten Eigentumswohnungen genutzten Eigentumswohnungen	184	Climate & energy relevance unknown	Jahresbericht, p. 26
BayernLB	Renwable energy	140		Konzernabschluss 2016, p. 150
LFA	Energie und umwelt	49	Not clear if KfW co-financed program	Jahresbericht 2016, p. 13
	Infrastruktur	354	Climate & energy relevance unknown	Jahresbericht 2016, p. 15
	Berlin			
IBB	IBB Energetische GEBÄUDEsanierung	69	KfW co-financed program	Jahresbericht 2016, p. 20
	IBB Wohnraum Modernisieren	5		Jahresbericht 2016, p. 20
	IBB Energetische GEBÄUDEsanierung + IBB Wohnraum Modernisieren co-financing	12		email correspondence with IBB
	IBB Wohnungsneubaufonds	47	Climate & energy relevance unknown	Jahresbericht 2016, p. 20
	IBB Wohnungsneubau	176	Climate & energy relevance unknown	Jahresbericht 2016, p. 20

LBB	n/a	n/a	n/a	
		Brandenburg		
ILB	Modernisierung und Instandsetzung	12		Jahresbericht 2016, p. 34
	Kredit Mietwohnungsneubau und Instandsetzung	24	Climate & energy relevance unknown	Jahresbericht 2016, p. 34
	KfW-kredite	79	KfW co-financed program	Jahresbericht 2016, p. 34
	Kredit Energieeffizienter Wohnungsbau und Instandsetzung	8		Jahresbericht 2016, p. 34
		Bremen		
BAB	BAB-Energieeffizienzkredit: Energie sparen, Kosten senken	n/a	n/a	BAB
	Kredit für Wohnungseigentümergemeinschaften (WEG): klima-freundlich und altersgerecht wohnen	n/a	n/a	BAB
	Modernisierungskredite für Mietwohnungen: Aus alt mach neu!	n/a	n/a	BAB
	Neubaukredite: energieeffiziente und bezahlbare Mietwohnungen	n/a	n/a	BAB
	Neue mietwohnungen (bau)	13	KfW co-financed program	BAB
		Hamburg		
IFB Hamburg	Modernisierung Nichtwohngebäude - Modernisierung von Gebäu-dehüllen und Energieberatung	1		Jahresbericht 2016, p. 20 and 43
	Erneuerbare Wärme	0.6		Jahresbericht 2016, p. 21 and 43
	Hamburger Gründachförderung	0.3		Jahresbericht 2016, p. 21 and 43
	IFB-Programm Modernisierung- Mietwohnungen	0.4		Jahresbericht 2016, p. 23
	Anlage wird als KfW-Effizienzhaus 40 gebaut	7	KfW co-financed program	Jahresbericht 2016, p. 25
	Wohnraumförderung - neu und modernisierung	384	Climate & energy relevance unknown	Jahresbericht 2016, p. 26 and 37
	Wohnraumförderung - neu und modernisierung	176	Climate & energy relevance unknown	Jahresbericht 2016, p. 26
	Energetischen Modernisierungsförderungen	31		Jahresbericht 2016, p. 29
	Eigenheimförderung	100	Climate & energy relevance unknown	Jahresbericht 2016, p. 30
	Eigenheimförderung über Kooperationen mit den Hausbanken und über KfW-Mittel	108	KfW co-financed program	Jahresbericht 2016, p. 39
	Klimaschutz bei kleineren Gewerbebetrieben	0.6		Jahresbericht 2016, p. 43
	Unternehmen für Ressourcenschutz UfR	3.8		Jahresbericht 2016, p. 20 and 40
		Hamburg and Schleswig-Holstein		
HSH Nord-bank	Renewable energy	1,000	Climate & energy relevance unknown	Annual Report 2016, p. 27
		Hessen		
WiBank	Energetische Modernisierung kommunaler Nichtwohngebäude	8		Jahresbericht 2016, p. 96

	Zuschussbereich zur Förderung erneuerbarer Energien	4		Jahresbericht 2015, p. 29
	KfW- und Förderergänzungsdarlehen im Mietwohnungsbau	113	KfW co-financed program	Jahresbericht 2015, p. 35
	Klimaschutz	0.4		Jahresbericht 2015, p. 97
	Hessisches Programm zur Energieeffizienz im Mietwohnungsbau	3		Jahresbericht 2016, p. 36
	Zuschuss Holzfeuerungsanlage Hessisches Energiegesetz	0.6		Jahresbericht 2016, p. 87
Hessen and Thuringen				
Helaba	n/a	n/a	n/a	
Mecklen burg Vorpommen				
LFI MV	Nachhaltige Stadtentwicklung	1,316	Climate & energy relevance unknown	LFI MV
	Wohnraumförderung/Modernisierung/Instandsetzung	3,454	Climate & energy relevance unknown	LFI MV
Niedersachsen				
N Bank	Wohnraum Energetische Modernisierung von Mietwohnungen	3		Förderbericht 2016, p. 32
	Energetische Modernisierung von Wohneigentum	0.2		Förderbericht 2016, p. 32
	Stärkung CO2-armer Verkehrsträger	0.03		Förderbericht 2016, p. 33
	Energieeinsparung bei öffentl. Trägern, Kultureinrichtungen	10		Förderbericht 2016, p. 30
	Optimierung des betriebl. Ressourcen- und Energiemanagements	0.4		Förderbericht 2016, p. 33
	Niedersachsen-Kredit Energieeffizienz Gebäude und Produktion	14		Förderbericht 2016, p. 30
DBU	Erneuerbare Energien	2	Support for intablibe measures	Jahresbericht, p. 80
	Klima- und ressourcenschonendes Bauen	2	Support for intablibe measures	Jahresbericht, p. 80
	Energie und ressourcenschonende Quartiersentwicklung und Erneuerung	2	Support for intablibe measures	Jahresbericht, p. 80
	Verminderung von CO2-Emissionen in energieintensiven Branchen	3	Support for intablibe measures	Jahresbericht, p. 80
	Reduktion von Stickstoffemissionen in der Landwirtschaft	1	Support for intablibe measures	Jahresbericht, p. 80
NordLB	Erneuerbare Energien	11,562	Climate & energy relevance unknown	Nachhaltigkeitsbericht 2016, p. 60
Nordrhein-Westfalen				
NRW Bank	NRW.BANK.Gebäudesanierung	37	Refinanced with green bonds	Sustainability report 2016, p. 36
	Green bonds issued in 2016	410	Renewables and energy efficiency	Sustainability report 2016, p. 33
	Verbesserung der Energieeffizienz in der Wohnraumförderung	42		Email communication
	NRW BANK.Effizienzkredit	8		Email communication
	NRW.BANK.Energieinfrastruktur	471		Sustainability report 2016, p. 27
	NRW.BANK.Infrastrukturfinanzierungen	50		Email communication
	NRW.BANK.Moderne Schule	55	Climate & energy relevance unknown	Sustainability report 2016, p. 27
	NRW.BANK Social Infrastructure	604	Climate & energy relevance unknown	Sustainability report 2016, p. 26

	NRW.BANK.Elektromobilität	3		Email communication
	Promotional theme “Environment/Climate/Energy”	853		Financial report 2016, p. 5
Rheinland-Pfalz				
ISB	Modernisierung von Mietwohnungen	45	Climate & energy relevance unknown	ISB Geschäftsbericht 2016, p. 45
Saarland				
SIKB	Investitionen und Sanierungen im Wohnungsbestand	12	KfW co-financed program	jahresbericht 2016, p. 16
SaarLB	n/a	n/a	n/a	
Sachsen				
SAB	Wohnungsbau	325	Climate & energy relevance unknown	jahresbericht 2016, p. 8
	Infrastruktur und kommunales	507	Climate & energy relevance unknown	jahresbericht 2016, p. 8
	Umwelt und landwirtschaft	464	Climate & energy relevance unknown	jahresbericht 2016, p. 8
Sachsen Anhalt				
IBS	Programm Sachsen-Anhalt ENERGIE	n/a	n/a	jahresbericht 2016, p. 15
	Förderprogramm Sachsen-Anhalt MODERN	18	Climate & energy relevance unknown	jahresbericht 2016, p. 13
	IB-Wohneigentumsprogramm	18	Climate & energy relevance unknown	jahresbericht 2016, p. 14
Schleswig-Holstein				
IB SH	n/a	n/a	n/a	
Thüringenn				
TAB	Programms „Sanierungsbonus“	2	Climate & energy relevance unknown	Jahresbericht 2016, p. 8
	Förderprogramms „GREEN invest“	7		Jahresbericht 2016, p. 7