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The Landscape of Climate Finance in Germany: Annexes

Climate Policy Initiative

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Overview of Annexes

Annex 1 describes how we derived numbers for the disbursement of climate-specific finance by the federal budget of Germany, the "public bank" KfW, and the EU budget in 2010. Annex 2 describes all assumptions used for the climate finance analysis. In Annex 3 — Annex 7, we provide a detailed break down and discussion of German climate finance by key sector. These sector annexes include key messages, methodological details, and a brief discussion of our findings' implications. The sequence by which the sectors are introduced is determined by the sector's contribution to the German GHG emissions as reported by the Federal Environment Agency (UBA 2011b): energy generation and infrastructure, industry, buildings, transport, and agriculture.

Annex 1. Disbursement by Public Actors

Climate-specific programs and measures of the federal budget of Germany

Annex 1 provides details on how we derived disbursement figures from the federal budget of Germany, the "public bank" KfW, and the EU budget. We introduce our background input data and accompanying assumptions related to each public program and measure included in our report. We include only disbursements that can be potentially regarded as climate-specific incremental costs in tangible assets, in line with the definition and methodology presented in Section 2 of the main report. Intangible investments have been outside the scope of this study and have therefore been excluded from the estimates presented in the main report. Given the missing information on climate-specific investment at the aggregate level, most data is based on an in-depth study of all relevant federal public budgets. The lack of aggregate data also means that the figures rarely include any spending from regional or municipal governments. The figures derived in this way add up to the outflow from the public budget (see Box 1 in the main report for further explanation).

Annex Table 1-1: Federal public spending included in the flows and their underlying assumptions

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
Public spending relating to "Support of Individual Targeted Measures for the Use of Renewable Energies (Chapter 1602, Title Nr: 686 24, GoG 2010b)" which includes the "National Climate Initiative (NKI)" and "Market Incentive Program for Renewable Heat (MAP)"				
Intangibles and overheads	62.4	2010	Disbursement based on BMU (2012a), no investment in tangible assets, therefore excluded.	(BMU 2012a).
Municipality directive (intangible parts)	17.5	2010	Commitment based on BMU (2012b), no investment in tangible assets, therefore excluded.	(BMU 2012b).
Municipality directive (tangible parts)	11.6	2010	EUR 9.5 million (or 81% of total) allocated to Buildings (climate-specific non-incremental; excluded). EUR 2.2 million (or 19% of total) allocated to Transport (climate-relevant; excluded). Commitment and sector allocation based on BMU (2012b).	(BMU 2012b).
Mini-CHP-directive	1.9	2010	EUR 1.9 million (or 100% of total) allocated to Buildings. Disbursement based on BMU (2012a); sector allocation based on discussion with experts. Disbursements only for 2009 installations, in 2010 the program was inactive. Therefore included at the "source" side, but not at the "use" side. See Box 1 of the main report.	(BMU 2012a).
Stimulus program for funding climate protection measures for commercial refrigeration facilities	10.2	2010	EUR 10.2 million (or 100% of total) allocated to Buildings. Disbursement based on BMU (2012a); sector allocation based on BMWi (2011).	(BMU 2012a; BMWi 2011).
Energy efficiency in agriculture and farming	0.2	2010	EUR 0.2 million (or 100% of total) allocated to Agriculture. Disbursement and sector allocation based on BMU (2012a).	(BMU 2012a).
KfW Geothermal Fund	10.0	2010	Disbursement based on BMU (2012a). See Annex Table 1-2 for sector allocation.	(BMU 2012a).
KfW Renewable Energy Premium	72.0	2010	Disbursement based on BMU (2012a). See Annex Table 1-2 for sector allocation.	(BMU 2012a).
Grant support through BAFA	235.1	2010	EUR 235.1 million (or 100% of total) allocated to Buildings Disbursement to BAFA based on BMU (2012a).	(BAFA 2011; BMU 2012a).
Further Public Spending Retrieved from the National Budget				
Chapter 1602, Title Nr: 892 22-629: Support for photovoltaic for "100.000 Solar Roofs Program" [100.000 Dächer-Solarstrom-Programm]	6.9	2010	Disbursement based on GoG (2012c). Relates to support for investments conducted prior to 2010 (see Box 1 in main report).	(GoG 2012b).
Chapter 1225, Title Nr: 661 05-411: Support for existing low-energy buildings	32.3	2010	Disbursement based on GoG (2012c). Relates to support for investments conducted prior to 2010 (see Box 1 in main report).	(GoG 2012b).
Chapter 1225, Title Nr: 661 07-411: Support for CO_2 Rehabilitation Program (loan version)	514.6	2010	Disbursement based on GoG (2012c) mainly relates to support with concessionary loans (including repayment bonuses) for investments conducted prior to 2010 (see Box 1 in main report).	(GoG 2012c).
Chapter 1225, Title Nr: 891 01-411: Support for CO_2 Rehabilitation Program (grant version)	120.0	2010	Disbursement based on GoG (2012c) partially relates to support with grants for investments conducted prior to 2010 (see Box 1 in main report).	(GoG 2012c).

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
Chapter 1225, Title Nr: 661 09-411: Infrastructure support for municipalities	6.1	2010	Disbursement based on GoG (2012c) partially relates to support for investments conducted prior to 2010 (see Box 1 in main report). Program partially contains non-climate-specific components. We separated these components for infrastructure programs at KfW level (see Annex Table 1-2), but not at "the source side" itself. Therefore, we took the full EUR 6.1 million as an outflow from public budgets.	(GoG 2012c).
Chapter 1227, Title Nr: 720 11-016: Energy savings program for federal public buildings	80.4	2010	The disbursements based on GoG (2012c) were excluded because they represent full costs and there is no acknowledged study that determines the share of incremental costs for non-residential buildings. See Annex Table 5-2 for more information.	(GoG 2012c).
Chapter 0902, Title Nr: 662 66-634: Interest rate support for the ERP Program	7.9	2010	The total disbursement under the title number is higher. The EUR 7.9 million accounts for the share representing the program "support for energy efficiency" (commitments). For sector allocation see Annex Table 1-2.	(GoG 2010a).
Chapter 1202, Title Nr: 891 61-622: Demonstration projects as part of the national innovation program for hydrogen and fuel cell technology	25.9	2010	Disbursement based on GoG (2012c). For more information see Annex Table 6-2.	(GoG 2012c).
Public Spending Not Retrieved from National Budgets				
Model regions electro-mobility	48.0		Disbursement based on annual report of National Organisation Hydrogen and Fuel Cell Technology (NOW 2011).	Annex Table 6-2.
National co-funding with EU policies	9.8		National co-funding calculated based on annual ERDF reports (2009 and 2010).	Annex Table 1-3.
Public procurement	106.3	2010	We only have data on climate-specific public procurement linked with KfW and BAFA programs.	Annex Table 5-2.
Federal and Länder subsidies as part of the GAK (Joint Scheme "Improving agricultural structures and coastal protection - Gemeinschaftsaufgabe Agrarstruktur und Küstenschutz)	11.5	2010	Three GAK measures: • NRR 4.2.2.1 and NRR 4.2.2.3: "First afforestation of agricultural and other areas" [Erstaufforstung landwirtschaftlicher und sonstiger Flächen]. • GAK NRR 4.3.1.1.1: "Renewable energy" under "Support to investments into diversification" [Einzelbetriebliche Förderung landwirtschaftlicher Unternehmen. Förderung von Investitionen zur Diversifizierung]. • GAK NRR 4.3.2.1.1.2: "Biogas and local heat distribution" [Biogas und Nahwärmeleitungen], under "Integrated rural development" [Integrierte ländliche Entwicklung].	(BMELV 2012a).

Climate-specific programs and measures of the public bank KfW

Annex Table 1-2: KfW programs included in the flows and assumptions

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
KfW Energy-Efficient Refurbishment – Efficiency House [KfW Energieeffizient Sanieren – Effizienzhaus]	1,097.3	2010	The value represents incremental share (1/3) of total loan value (see Annex 5. The Buildings Sector for details). Estimate of split by investor type: households (59%), corporations (37%), public institutions (4%).	(GoG 2012a; KfW-Group 2011b).
KfW Energy-Efficient Refurbishment – Individual Measures [KfW Energieeffizient Sanieren – Einzelmassnahmen]	551.0	2010	The value represents incremental share (1/3) of total loan value (see Annex 5. The Buildings Sector for details). Estimate of split by investor type: households (78%), corporations (21%), public institutions (1%).	Ibid.
KfW Energy-Efficient Construction [KfW Energieefficient Bauen]	3,654.0	2010	Estimate of split by investor type: households (70%), corporations (29%), public institutions (1%).	Ibid.
KfW Energy-Efficient Refurbishment – Grant [KfW Energieeffizient Sanieren – Zuschuss]	147.0	2010	Estimate of split by investor type is based on the same estimates for the loan programs Energy-Efficient Refurbishment – Efficiency House and Individual Measures.	Ibid.
KfW Housing Modernisation [KfW Wohnraum Modernisieren]	48.7	2010	The value represents incremental share (1/3) of total loan value (see Annex 5. The Buildings Sector for details). Only measure "Energy efficiency improvement" ["Verbesserung Energieeffizienz"] was included. Other measures supported by the program are not climate-specific. Estimate of split by investor type is based on the similar estimate for the program KfW Energy-Efficient Refurbishment: households (59%), corporations (37%), public institutions (4%).	Ibid.
KfW Renewable Energies Program - Standard [KfW Erneuerbare Energien Standard]	8,868.9	2010	Renewable Energies Program - Standard includes EUR 8,184 million invested in Germany and EUR 684 million invested abroad. Only domestic lending is accounted for in the flows. Total domestic lending volume was split into investment by: 1) households (43%), 2) tertiary and industry sectors (42%), 3) energy sector (10%), and 4) agriculture (5%). The estimates are based on the share of each sector in the total investment into renewable energy in Germany by type of technology, and eligibility criteria of each program.	(GoG 2012a; KfW-Group 2011b; trend:research 2011; ZSW 2011).
KfW Renewable Energies Program - Supplement [KfW Erneuerbare Energien Erganzung]	386.3	2010		
KfW Renewable Energies Program - Premium [KfW Erneuerbare Energien Premium]	336.9	2010		

Climate-specific programs and measures supported in Germany by the EU budget

Annex Table 1-3: Climate-specific measures supported by European Regional Development Fund (ERDF) in Germany and co-financing from national public and private resources

PROGRAM/MEASURE*	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
EU contribution			• First, we identified climate-specific measure codes of the classification of the EU cohesion policy (European Commission 2010). • Second, we calculated the EU contribution in 2010 under the identified measure codes. For this, we relied on the annual implementation reports on the ERDF programs, submitted by 16 German regions (Länder) in 2009 and 2010. The reports detailed the EU contributions in cumulative volumes by 2009 and by 2010. We calculated the difference between these two volumes to estimate 2010 finance. • Third, we calculated the national investment leveraged by the EU finance. For this, we relied on the ERDF Regulation (European Commission 2006a), which assigned the ratio of EU/national contribution as 75/25 for former Eastern Germany states (neue Bundesländer) and 50/50 for former Western Germany states (alte Bundesländer). • Fourth, we split the national investment into that provided by public budgets (regional and municipal) and private actors. Such a split was made based on the volumes of public/private national investment leveraged by the ERDF as reported by annual implementation reports in 2010. Finally, we concluded that the EU contribution and national public finance were to the largest extent in the form of grants based on our review of the annual implementation reports. We assumed that private investments were made with equity.	(European Commission 2006a; 2010) and 2009/2010 Länder Implementation Reports of ERDF**
39 Wind	3.8	2010		
40 Solar	12.6	2010		
41 Biomass	9.1	2010		
42 Hydroelectric, geothermal, and other renewable energy	1.5	2010		
National public co-financing				
39 Wind	1.6	2010		
40 Solar	3.9	2010		
41 Biomass	4.0	2010		
42 Hydroelectric, geothermal, and other renewables	0.4	2010		
National private co-financing				
39 Wind	1.4	2010		
40 Solar	0.7	2010		
41 Biomass	2.2	2010		
42 Hydroelectric, geothermal, and other renewable energy	0.3	2010		

Notes:

* The number next to the measures is the Cohesion Policy categorization code (European Commission 2010).

** 2009/2010 Länder Implementation Reports of ERDF (Baden-Württemberg Ministerium für Ländlichen Raum und Verbraucherschutz 2010; 2011; Bayerisches Staatsministerium für Wirtschaft 2010; 2011; Berlin Senatsverwaltung für Wirtschaft 2010; 2011; Brandenburg Ministerium für Wirtschaft und Europaangelegenheiten 2010; 2011; Hamburg Behörde für Wirtschaft 2010; 2011; Hessisches Ministerium für Wirtschaft 2010; 2011; Mecklenburg-Vorpommern Gemeinsame Verwaltungsbehörde - Verwaltungsbehörden für den EFRE ESF und ELER 2010; 2011; Niedersächsisches Ministerium für Wirtschaft 2011a; 2011b; Nordrhein-Westfalen Ministerium für Wirtschaft 2010; 2011; Rheinland-Pfalz Ministerium für Wirtschaft 2010; 2011; Saarland Ministerium für Wirtschaft und Wissen schaft 2010; 2011; Sachsen-Anhalt Ministerium der Finanzen 2010; 2011; Sachsen Staatsministerium für Wirtschaft 2010; 2011; Schleswig-Holstein Ministerium für Wissenschaft 2010; 2011; Senator für Wirtschaft und Häfen der Freien Hansestadt Bremen 2010; 2011; Thüringen Ministerium für Wirtschaft 2010; 2011).

Annex Table 1-4: Climate-related and intangible measures supported in Germany by European Regional Development Fund (ERDF) and co-financing from national public and private resources

PROGRAM/MEASURE*	EU CONTRIBUTION (EUR MILLION)	NATIONAL PUBLIC CO-FINANCING (EUR MILLION)	NATIONAL PRIVATE CO-FINANCING (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
06 Assistance to SMEs for the promotion of environmentally-friendly products and production processes	15.5	10.5	4.3	2010	• First, we identified climate-related measure codes of the classification of the EU cohesion policy (European Commission 2010). • Second, we calculated the EU contribution in 2010 under the identified measure codes. For this, we relied on the annual implementation reports on programs of the ERDF, submitted by 16 German regions (Länder) in 2009 and 2010. The reports detailed the EU contributions in cumulative volumes by 2009 and by 2010. We calculated the difference between these two volumes to estimate 2010 finance. • Third, we calculated the national investment leveraged by the EU finance. For this, we relied on the ERDF Regulation (European Commission 2006a), which assigned the ratio of EU/national contribution as 75/25 for former Eastern Germany states (neue Bundesländer) and 50/50 for former Western Germany states (alte Bundesländer). • Fourth, we split the national investment into that provided by public budgets (regional and municipal) and private actors. Such split was made based on the volumes of public/private national investment leveraged by the ERDF as reported by annual implementation reports in 2010. • Finally, we concluded that EU contribution and national public finance was to the largest extent in a form of grants based on the review of the annual implementation reports. We assumed that private investments were made with equity.	(European Commission 2006a; 2010) and 2009/2010 Länder Implementation Reports of ERDF**
16 Railways	17.9	4.7	1.8	2010		
17 Railways TEN-T	-	-	-	2010		
18 Mobile rail assets	-	-	-	2010		
19 Mobile rail assets TEN-T	-	-	-	2010		
24 Cycle paths	17.6	4.7	0.7	2010		
25 Urban transport	-	-	-	2010		
26 Multimodal transport	3.4	0.8	0.3	2010		
27 Multimodal transport TEN-T	-	-	-	2010		
28 Intelligent transport systems	-	-	-	2010		
30 Ports	3.5	0.9	1.6	2010		
31 Inland waterways	2	0.3	0.1	2010		
32 Inland waterways TEN-T	-	-	-	2010		
44 Management of household and industrial waste	0.5	0.06	0.02	2010		
46 Water treatment	58.8	19.2	1	2010		
43 Energy efficiency, combined heat and power, energy management	104	50.3	11.2	2010		
49 Mitigation and adaptation to climate change	3.8	1.3	2.4	2010		
52 Promotion of clean urban transport	1.5	0.5	0.1	2010		

Notes:

* The number next to the measures is the Cohesion Policy categorisation code (European Commission 2010).

** 2009/2010 Länder Implementation Reports of ERDF (Baden-Württemberg Ministerium für Ländlichen Raum und Verbraucherschutz 2010; 2011; Bayerisches Staatsministerium für Wirtschaft 2010; 2011; Berlin Senatsverwaltung für Wirtschaft 2010; 2011; Brandenburg Ministerium für Wirtschaft und Europaangelegenheiten 2010; 2011; Hamburg Behörde für Wirtschaft 2010; 2011; Hessisches Ministerium für Wirtschaft 2010; 2011; Mecklenburg-Vorpommern Gemeinsame Verwaltungsbehörde - Verwaltungsbehörden für den EFRE ESF und ELER 2010; 2011; Niedersächsisches Ministerium für Wirtschaft 2011a; 2011b; Nordrhein-Westfalen Ministerium für Wirtschaft 2010; 2011; Rheinland-Pfalz Ministerium für Wirtschaft 2010; 2011; Saarland Ministerium für Wirtschaft und Wissenschaft 2010; 2011; Sachsen-Anhalt Ministerium der Finanzen 2010; 2011; Sachsen Staatsministerium für Wirtschaft 2010; 2011; Schleswig-Holstein Ministerium für Wissenschaft 2010; 2011; Senator für Wirtschaft und Häfen der Freien Hansestadt Bremen 2010; 2011; Thüringen Ministerium für Wirtschaft 2010; 2011).

Annex Table 1-5: Climate-specific measures supported in Germany by European Agricultural Fund for Rural Development (EAFRD) and co-financing from national public and private resources (the information is repeated in Annex 7)

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
EU contribution				
EAFRD 311: "Renewable energy," under "Diversification into non-agricultural activities"	2.4	2010	2010 table was provided directly by BMELV and is available online now (27 November 2012). Correspondence of ELER and GAK budget lines is based on the handbook for ELER/GAK reporting 2007-2013 (p. 20 in Bund-Länder-Unterarbeitsgruppe Monitoring/Indikatoren 2011)	(BMELV 2012a, Table 3.2).
EAFRD 221 and 223: "First afforestation of agricultural land and of non-agricultural land"	1.9	2010		(BMELV 2012a, Table 12).
National co-financing				
GAK NRR 4.3.1.1.1: "Renewable energy" under "Support to investments into diversification" [Einzelbetriebliche Förderung landwirtschaftlicher Unternehmen. Förderung von Investitionen zur Diversifizierung] (corresponds to national co-financing of EAFRD measure 311)	1.3	2010	2010 table was provided directly by BMELV is available online now (27 November 2012).	(BMELV 2012a, Table 3.2).
GAK NRR 4.2.2.1 and NRR 4.2.2.3: "First afforestation of agricultural and other areas" [Erstaufforstung landwirtschaftlicher und sonstiger Flächen] (corresponds to national co-financing of EAFRD measures 221 and 223)	9.8	2010		(BMELV 2012a, Table 12).

Note:
EAFRD measure codes according to European Agricultural Fund for Rural Development (EAFRD) categorization.
NRR Codes according to the national framework of Germany for rural development (Nationale Rahmenregelung der Bundesrepublik Deutschland für die Entwicklung ländlicher Räume).

Annex Table 1-6: Climate-related measures supported in Germany by European Agricultural Fund for Rural Development (EAFRD) and co-financing from national public and private resources (the information is repeated in Annex 7)

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
EU contribution				
EAFRD 214: "Agri-environmental measures"	103.2	2010	• See GAK NRR 4.2.1.4 (below).	(BMELV 2012a, Table 11).
National co-financing				

GAK NRR 4.2.1.4: Measures A1, A2, A3, A4, B2, C and D under "Agri-environmental measures" (corresponds to national co-financing of EAFRD 214)	70.4	2010	• 2010 table was provided directly by BMELV is available online now (27 November 2012). Agri-environmental measures are included under land-use related measures [Markt- und standortangepasste Landbewirtschaftung (MSL)].
			• Measures included under the numbers in this chapter as climate-related:
			  • A.1: Fruchtartendiversifizierung im Ackerbau,
			  • A.2: Anbau von Zwischenfrüchten oder Untersaaten im Ackerbau oder Begrünung von Dauerkulturen,
			  • A.3: Anwendung von Mulch- oder Direktsaat oder Mulchpflanzverfahren im Ackerbau,
			  • A.4 Ausbringung flüssiger Wirtschaftsdünger mit besonders umweltfreundlichen Ausbringungsverfahren,
			  • B.2: Förderung extensiver Grünlandnutzung, Umwandlung von Ackerflächen in extensiv zu nutzendes Grünland,
			  • C: Förderung ökologischer Anbauverfahren,
			  • D: Förderung der mehrjährigen Flächenstilllegung
			• Outside GAK there are further agri-environmental measures that are not covered by the GAK statistics and are hence not covered in this study.
				(BMELV 2012a, Table 11).

Note:
EAFRD measure codes according to European Agricultural Fund for Rural Development (EAFRD) categorization.
NRR codes according to the national framework of Germany for rural development (Nationale Rahmenregelung der Bundesrepublik Deutschland für die Entwicklung ländlicher Räume).

Annex Table 1-7: Climate-specific measures supported in Germany by European Agricultural Guarantee Fund (EAGF)

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
EU contribution				
Aid for energy crops	18.5	2010	The budget line 05030227 "Aid for energy crops" in the 4th Financial Report of the European Agricultural Guarantee Fund (European Commission 2011b). The national co-financing of the measure could not be calculated due to lack of the data.	(European Commission 2011b).

Annex Table 1-8: Climate-specific measures supported in Germany by European Energy Recovery Fund (EEPR) (the information is repeated in 2)

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
EU contribution				
Offshore wind projects	118	2010	EEPR grant for offshore wind projects located in Germany, considered a maximum of EUR 81 million; unknown share was disbursed in 2010.	(Deloitte 2012; European Commission 2011a).
Electricity interconnections	100	2010	Grant for electricity interconnections (Halle/Saale Schweinfurt), considered a maximum of 100 million EUR, unknown share was disbursed in 2010.	(Deloitte 2012; European Commission 2011a).

Annex Table 1-9: Climate-related measures supported by the EU Marco Polo Program in Germany

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
EU contribution				
Modal shift in transport	6.5	2010	Directly taken from the 2010 Financial Report of the European Commission (European Commission 2011a).	(European Commission 2011a).
National co-financing				
Modal shift in transport	6.5	2010	Derived from grant conditions in the 2010 Financial Report of the European Commission (European Commission 2011a).	(European Commission 2011a).

Annex Table 1-10: Climate-related measures supported by Life+ Program in Germany

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
EU contribution				
Municipal waste water project	3.5	2010	The climate-related projects are identified from project descriptions available in the Life+ online project database. The only one project was selected as climate-specific, namely Hamburg Water Cycle - Jenfelder Au. The actual data of the EU finance and national co-financing is available in the database.	Life+ online project database.
National co-financing				
Municipal waste water	13.3	2010	The same as above.	Life+ online project database.

Annex 2. Assumptions of the Finance Analysis

Annex Table 2-1: Assumptions on debt and equity ratios

PROGRAM/MEASURE	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
Large-scale private renewable energy investment	2010	We assume that 25% of total investment in renewable energy is large scale (of installed capacity more than 1 MW), 45% of which was financed through project finance with an average debt/equity split of 65/35, based on the Bloomberg New Energy Finance database. The remaining investment is accounted as balance sheet finance. We assume balance sheet finance to be 100% equity due to possibility of later capitalization of loans, i.e. recording loan value as assets of a company or its subsidiary.	(BNEF 2012; trend:research 2011), Expert interviews.
Small-scale private renewable energy investment	2010	We treat "households" investment as project finance with an average debt/equity split 80/20, based on the co-financing ratio of KfW programs. The remaining investment is accounted as balance sheet finance, i.e. 100% equity.	Expert interviews.
Infrastructure	2010	We assume all investment in these sectors, except for investment by households, to be carried through balance sheet finance, i.e. to be 100% equity.	Expert interviews.
Industry	2010		
Transport	2010		
Agriculture	2010		
Existing buildings energy efficiency investment	2010		
Construction investment	2010		

Annex 3. The Energy Generation and Infrastructure Sector

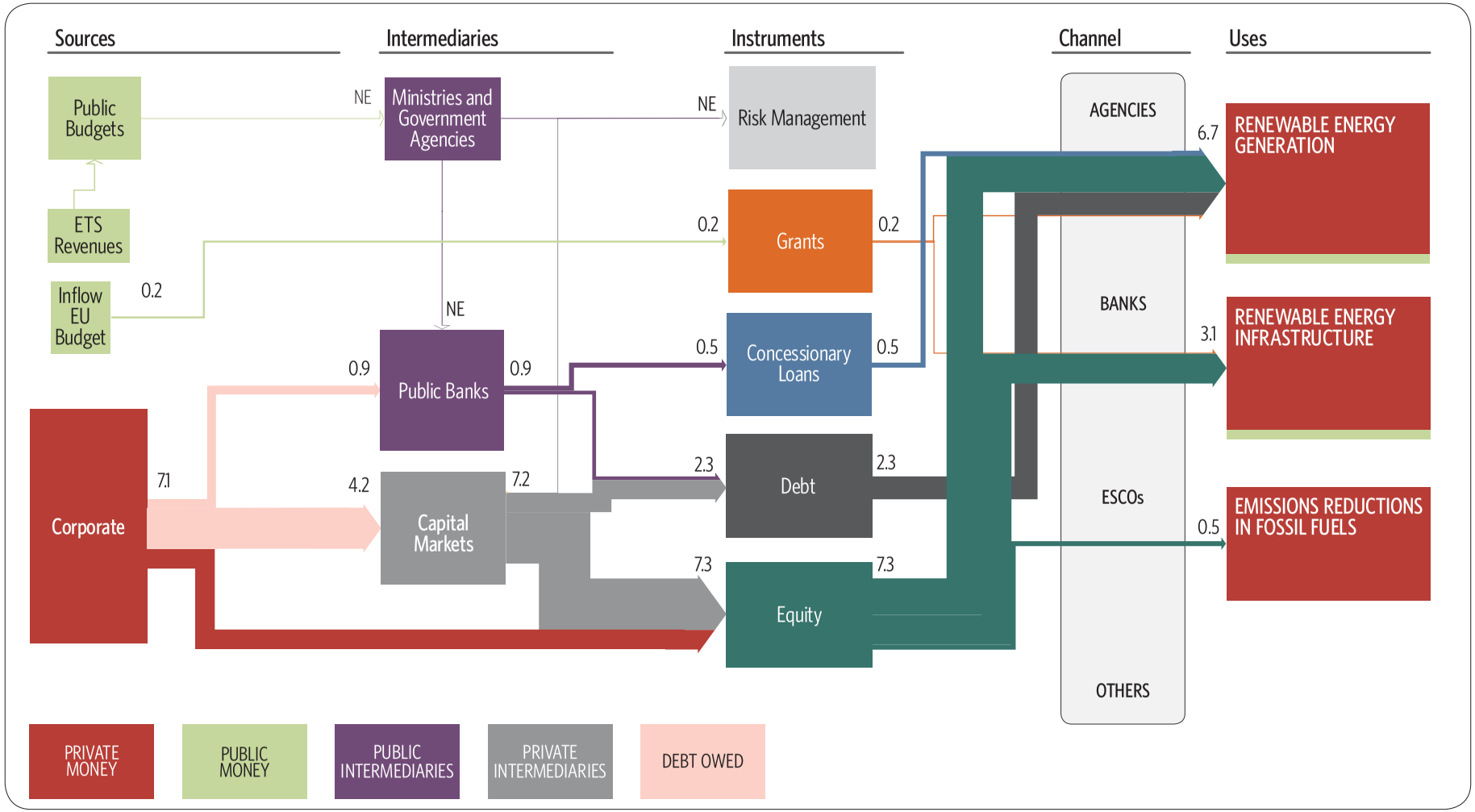
Key Findings

1. **Total capital investment into climate-specific measures in the German energy generation and infrastructure sector in 2010 was EUR 10.3 billion**, 98% of which was from private sources. Public finance came in the form of national and EU grants.
2. **Renewable energy attracted the majority of climate-investment in the energy sector (EUR 6.7 billion renewable energy generation and EUR 3.1 billion in related infrastructure, or 95% of total capital investment in the sector) in 2010.**
   - A further EUR 20 billion was invested into renewable energy in other sectors: buildings, industry, and commercial sectors (14.5 billion) and agriculture (5.4 billion).
   - This brought total renewable energy generation across the economy to EUR 26.6 billion.
   - Energy efficiency received EUR 0.5 billion through fossil fuel emission reductions.
3. **The large majority of investment in new generation in 2010 was in renewable energy sources, accounting for 75-80% of total new installed generating capacity in 2010.**
   - Solar photovoltaic technology attracted large volumes of investment representing 77% of the total EUR 26.6 billion invested in renewable energy.
   - As such, small-scale renewable energy investments were 75% of the overall EUR 26.6 billion invested, mostly from private households.
4. **Tracking climate investments, and the associated investors, was challenging because of data limitations, a lack of agreed-upon reporting processes, and the difficulty in attributing investment to climate-specific measures.**
   - In most cases private sources and their climate-specific investments were established using bottom-up (project-and-technology level) or top-down (aggregate reports) approaches, and in some cases expert judgement.
   - Institutions such as industry associations (BDEW, Eurelectric, VKU)[1] and regulatory agencies (BNetzA)[2] can help improve climate finance tracking in the sector.
5. **Energy policies such as the Feed-in Tariff and the EU ETS target increasing volumes of renewable energy investment and reducing emissions in the generation portfolio.** Germany appears to be on target to reach 35% of its electricity supply from renewable sources by 2020, since in 2010 renewable energy sources supplied 17% of electricity.
   - The Feed-in Tariff has been a leading factor in encouraging private sector investment in renewable energy. Renewable energy investment has significantly exceeded investment in electricity infrastructure (which is a key element to delivering these policy objectives).
   - Policy plays an important role in facilitating an expansion of the network through approval and permitting processes, which are needed to accommodate the expected increase in renewable energy generation.

1 BDEW (Association of German Energy and Water Suppliers), Eurelectric (EU Association of Electricity Suppliers), VKU (German Association of Municipal Utilities).

2 German Federal Network Agency.

Annex Figure 3-1: Energy sector climate finance diagram 2010, billion EUR



Notes:
In the Landscape, figures for renewable energy and fossil fuel emission reduction (energy efficiency) investments represent total capital invested. Sources: Debt owed does not represent the actual flows of climate finance, but is shown to highlight the original investors and asset owners, who make use of public banks or capital markets as financial intermediaries. Intermediaries: Capital markets include finance provided by commercial banks and institutional investors. Uses: Energy includes investment in renewable energy generation, climate-specific energy infrastructure, and efficiency investment in fossil fuel generation.

Sector background: why care about investment?

The energy generation sector directly emitted some 355 million tons of CO_2-equivalent or 38% of the country's total GHG emissions in 2010, all from fossil fuel generation (UBA 2011b). There are no explicit sector targets to reduce emissions, but the European decarbonization trajectory of power generation is expected to be one of the most ambitious (almost 70% reduction in the 1990 level of emissions by 2030) (European Commission 2011c).

The energy generation sector represents a significant portion of Germany's emissions, but offers many emission reduction opportunities on the supply-side (e.g. switching from to lower-carbon generation, deploying renewable energy), or the demand-side (e.g. increasing the level of demand-side participation to reduce supply-side generation). In addition, energy infrastructure plays an important role in decarbonizing the sector by accommodating renewable energy generation, and offering flexibility in operating the national energy network.[3]

Driven largely by national and EU climate and energy policy, the generation portfolio and resulting emissions intensity is undergoing a period of significant transition. The German energy sector is rich in policies that aim to incentivize investment or encourage a transition to lower-carbon intensities. With a majority fossil-fuel-based energy portfolio, the deployment of renewable energy is the main instrument to reduce the emissions intensity of the sector. In 2010, 17% of all electricity was generated from renewable energy sources, with an aim to scale up to 35% by 2020, 50% by 2030, and 80% by 2050 (BMU and AGEE-Stat 2012). There are several key EU and German national policies that greatly influence the energy generation and infrastructure sector.

- **Renewable Energy Directive:** demands that 20% of all energy use is from renewable sources by 2020, which is adjusted to each member state. For Germany, this means renewables must account for 18% of energy, or 35% of electricity by 2020.
- **Emissions Trading Directive:** the EU emissions trading scheme targets the reduction of emissions from all large industrial installations. In Germany, around 1,600 installations (industry and energy generators) are subject to emissions trading, accounting for about half of the country's emissions (UBA 2011b).
- **Energy Concept:** Decarbonizing Germany's energy generation and its associated energy infrastructure is central to Germany's Energy Concept; by 2020, 35% of electrical energy must be from renewable sources.
- **Renewable Energy Act** (Erneuerbare-Energien-Gesetz, EEG) facilitates German investment into renewable energy by introducing a Feed-in Tariff, which has been a leading incentive for private sector investment. It also obliges the network operator to 1) connect to renewable energy sources, and 2) accept the resulting energy generated.

3 Outside the scope of this report. See CPI's 2011-2012 Smart Power Market project reports for more information: http://climatepolicyinitiative.org/publication/smart-power-market-project/

Annex Box 3-1: Role of Generation and Infrastructure in Germany's Energy Sector

Role of fossil fuels in energy generation and emissions. Fossil fuel generation accounts for all emissions in the sector. Of the net 530 TWh energy fed into electricity networks in 2010 (BNetzA 2011), conventional (non-renewable/non-nuclear) generation accounted for 55%. Being the largest producer of coal in the EU (World Coal Association 2012), Germany has access to large quantities of coal/lignite reserves, leading to a carbon intensive fossil-fuel generation fleet.

Annex Table 3-1: Energy fed into transmission and distribution network in 2010

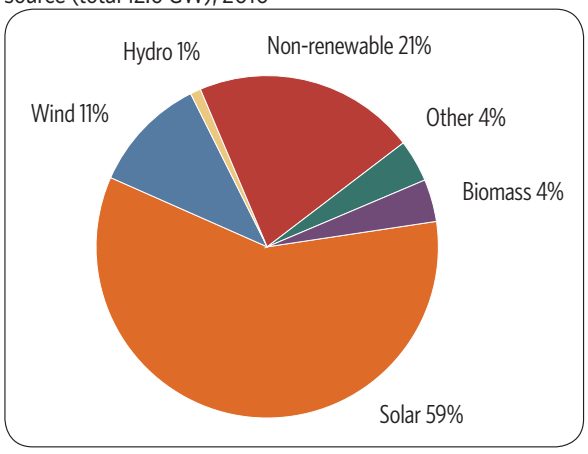
CATEGORY	2010 INSTALLED CAPACITY (MW)	SHARE OF TOTAL INSTALLED CAPACITY	2010 NET ELECTRICITY FED INTO NETWORK (MWh)	SHARE OF TOTAL ELECTRICITY GENERATED	2010 EMISSIONS FROM ENERGY SOURCE (thousand tons CO_2e)	SHARE OF TOTAL SECTOR EMISSIONS
Fossil	78,486	48.60%	293,100	55%	354,500	100%
Nuclear	20,778	12.87%	134,700	25%		
Renewable	62,233	38.54%	103,300	18%		
Total	161,497		531,100			

Sources: (BMWi 2012; BNetzA 2011; UBA 2011b)
Note: renewable share of electricity generated excludes pumped storage hydro electricity.

Role of nuclear energy. Our focus year is 2010, when the nuclear industry was not yet affected by the Fukushima nuclear disaster of March 2011. Six months prior to this, the government extended the lives of the 17 existing nuclear plants by an average of 12 years beyond a legally-mandated phase-out by 2022, a policy later cancelled because of Fukushima. In 2010, nuclear sources provided 25% of annual energy supply (with 21 GW of installed capacity).

Role of renewable energy sources. Renewable energy generation has played an increasingly important role in Germany over the past two decades. A generous support mechanism and growing demand for low(er)-carbon technology has helped to facilitate massive increases in deployment of wind and solar technologies. The sharp uptake of solar photovoltaic accounted for some 60% of new capacity investment. As such, of the 12.6 GW of total new installed capacity, 75-80% was from renewable sources; see Annex Figure 3-2: New installed capacity in 2010 by energy source (total 12.6 GW), 2010.

Annex Figure 3-2: New installed capacity in 2010 by energy source (total 12.6 GW), 2010



Source: (BMWi 2012)

Role of energy infrastructure. Since most renewable energy deployment will be at the network extremities (e.g. offshore or far from demand centers or congested areas (cities) of the existing grid), transmission and distribution infrastructure will be increasingly important to meeting policy objectives. Infrastructure will thus have to undergo significant investment to expand and upgrade the existing grid if energy targets are to be realized.

For the first time in 2010, more generation capacity was situated on the distribution network (82.9 GW), than on the transmission network (77.6 GW) (BNetzA 2011). This demands more effort from network operators to operate the system within security and efficiency limits, at the same time as they handle an increasing volume of unplanned flows and new dynamic flow patterns.

Sector findings

Total climate-specific investment

In total, climate-specific investment[4] in the energy generation and infrastructure sector[5] amounted to EUR 10.3 billion—which is full capital investment.[6] Other sectors also invested heavily in renewable energy: EUR 20 billion was invested in the buildings (EUR 14.5 billion including industry/tertiary) and agriculture (EUR 5.4 billion) sectors; see the appropriate annex for more details.

Annex Table 3-2 : Climate finance in the German energy generation and infrastructure sector in 2010, million EUR

SOURCE	CLIMATE-SPECIFIC INVESTMENT: ENERGY EFFICIENCY (TOTAL CAPITAL INVESTMENT)	CLIMATE-SPECIFIC INVESTMENT: RENEWABLE ENERGY (TOTAL CAPITAL INVESTMENT)	CLIMATE-SPECIFIC INVESTMENT: NON-ENERGY RELATED (NOT APPLICABLE)	CLIMATE RELATED[a] (NOT ESTIMATED)
Public	0	218	NA	NE
Private	500	9,630	NA	
Total	500	9,848	NA	

a Climate-related investments cover broader financial flows, which are not climate-specific but are either part of broader, multiple-purpose measures and/or are part of measures that deliver climate co-benefits in terms of reduction or avoidance of emissions technologies (see methodological Chapter 2 for details).

The public sector financed a small portion of the overall investment: grants from the EU budget amounted to around EUR 218 million, and the European Investment Bank (EIB) committed to loans of less than EUR 1 billion.[7] In conjunction with households, KfW provided concessionary loans of some EUR 9 billion; for more detailed information on this, see Annex Table 3-4. Most public funds were used to facilitate the deployment of renewable energy.

In 2010, the EU budget provided support for climate-specific measures in energy generation and infrastructure from several funds and frameworks:

- European Regional Development Fund (ERDF) under Cohesion Policy and the European Program for Economic Recovery (EEPR) provided some EUR 180 million.
- Regional Development Fund provided grants for renewable energy in the total amount of EUR 27 million, which was co-financed with national public sources of around EUR 10 million.
- Trans-European Networks-Energy contributed less than EUR 2 million for feasibility studies.
- Intangible investment: the 7th Framework Research Program (FP7) provided support for research and development, and the Intelligent Energy Europe Program (IEE) of Competitiveness and Innovation Framework Program (CIP) provided support for innovation in the field of climate mitigation in the energy generation and infrastructure sectors.

The private sector financed the vast majority (98%) of climate investment in the energy generation and infrastructure sector. Renewable energy accounted for EUR 6.6 billion of the total investments in the sector, carried out by private actors. Energy infrastructure climate-specific investment of EUR 3 billion was almost entirely financed by private regulated companies.

This situation largely results from two factors. 1) the legacy left by the privatization process of the energy supply side and the unbundling/regulation of the network infrastructure, and 2) other private actors such as households carry out substantial investments in renewable energy (see below).

Investment in renewable energy

Policy objectives target increasing volumes of renewable energy investment in the generation portfolio. Renewable energy is the main focus of investment in the generation sector, and is the main driver of investment in infrastructure. As mentioned earlier in the chapter, 10 GW of the 12.6 GW of new installed capacity was renewable energy.

While the energy sector attracted some EUR 6.7 billion of investment in renewable energy generation, the majority of renewable investment was carried out in other sectors. Another EUR 20 billion was invested in the buildings and industry (EUR 14.5 billion) and agriculture (EUR 5.4 billion) sectors.

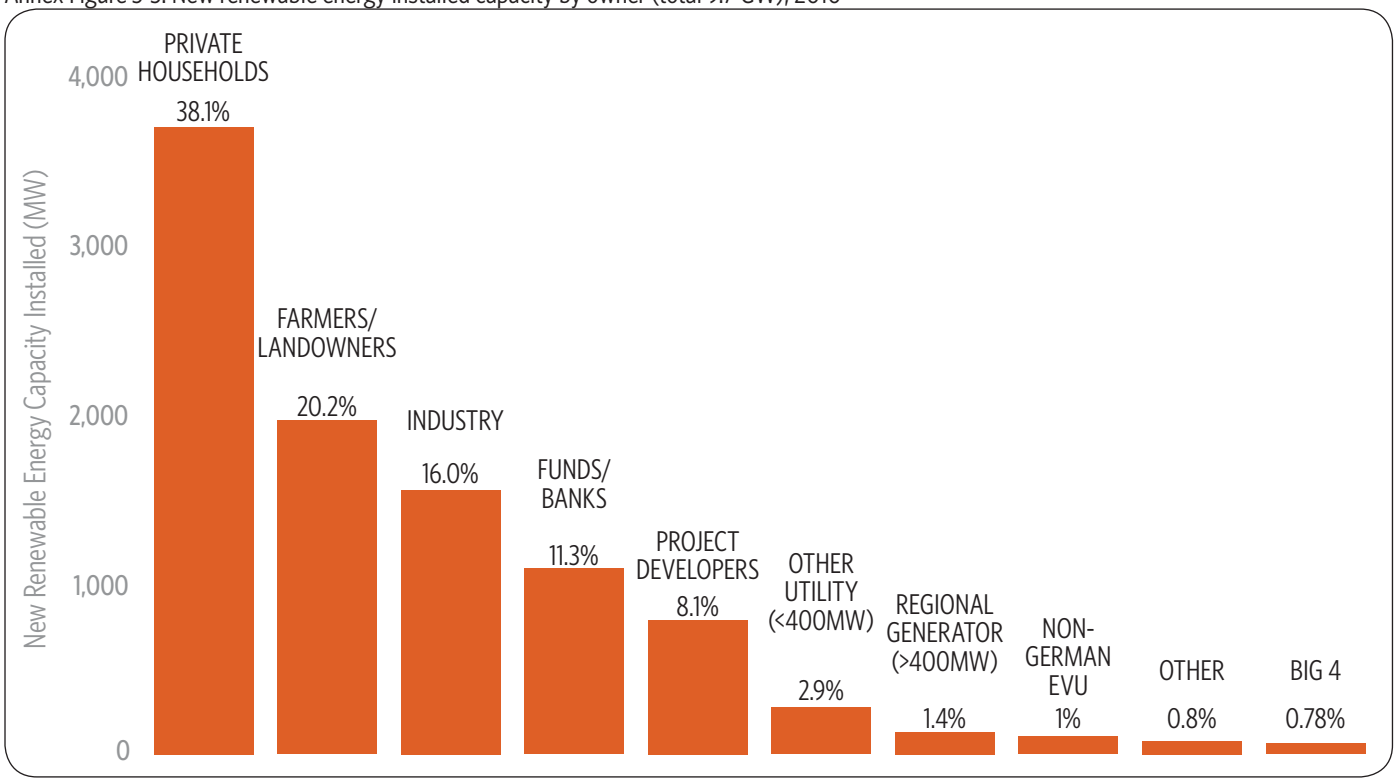
4 Climate-specific investment refers to capital flows that target investments resulting in climate change mitigation or avoidance of emissions (see methodological Chapter 2 for details).

5 Where necessary, we present findings from the German Energy Sector as 1) Renewable Energy, 2) Energy Infrastructure, and 3) Emission Reductions in Fossil Fuel Generation.

6 For the remainder of the Energy Generation and Infrastructure Annex, all costs will be assumed full capital investment, unless specifically mentioned.

7 EIB commitments are not depicted in the Landscape diagram due to non-availability of disbursement data.

Annex Figure 3-3: New renewable energy installed capacity by owner (total 9.7 GW), 2010



Sources: (BMU and AGEE-Stat 2012; trend:research 2011).
Notes: When the installer received public support, the ownership was fully allocated to such installer. Non-German EVU is non-German energy suppliers.

Investment in renewable energy remains the most important finance flow in terms of volume and climate change impact in the energy sector. The BMWi provided official data for total investments into renewables of EUR 26.6 billion (calculated by the ZSW,[8] and used in this report (BMWi 2012)). We were then able to use data from trend:research (2011) to provide a breakdown of 2010 renewable investments by actor (e.g. utilities, industry, households or agriculture; see graph below).

- Small-scale investment. Building on assumptions and data from Germany Trade and Invest (GTAI), Federal Network Agency, Bloomberg New Energy Finance, and trend:research (BNEF 2012; BNetzA 2011; GTAI 2011; trend:research 2011) on the breakdown of renewable investment by actor, we determined the share of small-scale investment. Almost all small-scale investment is assumed to be in other sectors (totalling EUR 20 billion). Concessionary loans played a key role in the financing of these renewables: see Annex Table 3-4 and Sector Chapters (3 - Industry, Annex 5 - Buildings, and Annex 7 - Agriculture) for details on how these loans were used.
- Large-scale investment. The remaining EUR 6.7 billion of renewable investment is assumed to come from large investors such as utilities (EUR 3.6 billion) or banks/funds (EUR 3 billion) investing directly into large-scale projects. Big utilities finance large-scale renewables projects such as onshore wind and solar PV parks, usually by equity on their balance sheet. According to trend:research (2011), approximately EUR 3 billion of investment (11.3%) was from commercial banks and funds.

The following provides a breakdown of renewable investors across all new capacity in 2010 as determined by trend. Of particular interest is the share of investors that would naturally choose small-scale investment into renewables: private households, farmers, and small–to-medium enterprises/industry, which represent a set of non-traditional renewable energy investors.

The Feed-in Tariff (FIT) has been a leading factor in encouraging private sector investment in renewables. While not a direct investment flow (see FIT Focus Section below), the FIT amounted to EUR 13.1 billion in 2010, by redirecting finance from households via their electricity bills. Project developers (as well as those households that have installed renewable energy devices) receive the funds through the system

8 Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW - Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg), see http://www.zsw-bw.de

Annex Table 3-4: Investment breakdown of 2010 infrastructure investment, EUR million

INFRASTRUCTURE		TOTAL INVESTMENT IN 2010 (MILLION EUR)	...OF WHICH EXCLUDING SERVICING MAINTENANCE (MILLION EUR)	TOTAL CLIMATE-SPECIFIC (80% ELEC, 10% GAS) (MILLION EUR)
Electricity	**Transmission (4 TSOs)**	807	620	496
	Distribution (869 DSOs)	6,401	3,189	2,551
Gas	**Transmission (17 TSOs)**	800	272	27
	Distribution (695 DSOs)	2,017	742	74
	Totals	10,025	4,823	3,149

Source: Own calculations, (BNetzA 2011)
Notes: TSOs - transmission system operators, DSOs - distribution system operators.

operators. This in turn drives investment in energy from renewable sources.

Investment in energy infrastructure (renewable energy-related)

Infrastructure is a critical element in Germany's energy system, and is vitally important to meet policy objectives. In 2010, renewable energy investment has significantly exceeded infrastructure investment. Policy plays an important role in facilitating an expansion of the network (through approval and permitting processes), which is needed to accommodate the expected increase in renewable energy generation.

For the first time in 2010, more generation capacity was connected to the distribution network than the transmission network. Transmission and distribution network owners invested a total of EUR 4.8 billion (excluding servicing and maintenance totalling EUR 5.2 billion) in both gas and electricity networks.

It is difficult to determine what share of this investment was specific to low-carbon technology because of the multi-purpose nature of infrastructure. However, discussions with electricity network owners suggest that some 80% of investment in electricity networks is driven by climate change factors, i.e. ensuring the incorporation of renewable energy. Conversely for gas networks, we assumed that the bulk of extensions and new builds were not climate-specific, with only about 10% of them climate-specific.[9]

Grid financing is carried out by regulated entities, which typically finance their investment on the company balance sheet, recouping their investment through regulated returns on assets. The regulatory scheme has a significant impact on the network owners' ability to invest (see Neuhoff et al. 2012).

Using assumptions on debt-equity leverage ratios (which are determined largely from the regulatory structure) we assume a 60-70% debt to 40-30% equity. The most common sources of funding for infrastructure on the debt side are through commercial banks, issuing of corporate bonds, or public funds. In 2010, German infrastructure projects received some EUR 100 million from EEPR grants. Thus, in total, we calculate that EUR 3.1 billion of infrastructure investment (excluding maintenance/servicing) was funded by approximately EUR 2 billion of debt.

Equity is typically from internal sources, meaning about EUR 1.1 billion was invested by infrastructure entities in direct equity. Equity is a limited factor for investments in infrastructure (Roland Berger 2011). The leverage ratios of companies are typically restricted, meaning that in order to invest, equity and debt need to be raised in equal measures, which is not normally possible. Investment in infrastructure can typically be financed as regulated assets or by private investors, both of which are options to meet future demands for network expansions, particularly in electricity infrastructure.

- Regulated returns. As a relatively safe and stable investment, grid operators can benefit from cheap debt. But with increases in investment needed soon, they may need to turn elsewhere if equity financing becomes harder.
- Merchant investment. The other option is merchant line or third-party investment, where the asset is unregulated, and cash flow is determined by the congestion revenue and ability to arbitrage between the two interconnected regions. While this is more related to international interconnectors than intra-German

9 It was not possible to reliably calculate what portion of gas infrastructure investment was climate-specific. As such 10% was used in order to have a lower estimate in overall infrastructure investment. It is possible that some investment is to mitigate so-called fugitive emissions, in which case it could be counted as climate-specific.

investment, it may also be possible to finance national lines financed on this basis.

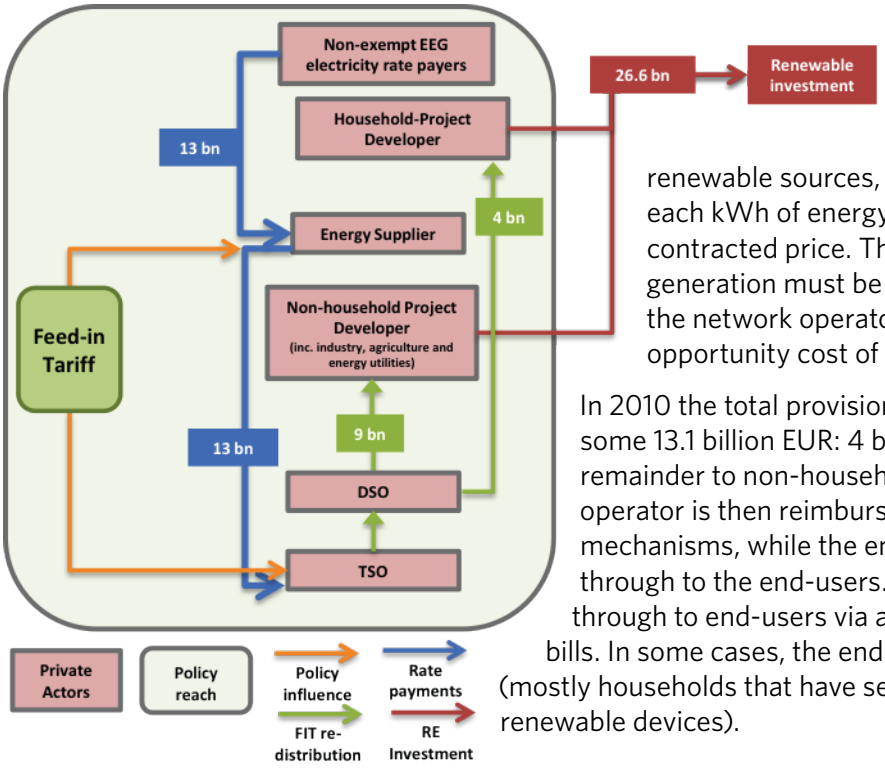
Increasing volumes of unplanned generation will ultimately make it more difficult and expensive for system operators to manage the system: the total cost of operating the German power system was almost EUR 1.2 billion in 2010 (BNetzA 2011).

Investment in energy efficiency (conventional generation)

Total non-climate-specific investment in (conventional) energy generation amounted to around EUR 3 billion. It was particularly challenging to determine what share of this overall investment was dedicated to reducing emissions, such as investments in switching from coal to gas, co-firing with biomass, or retrofitting/upgrading technology. Thus it was only possible to estimated that EUR 0.5 billion of the EUR 3 billion was full-capital climate-specific investment, and, like the rest of the

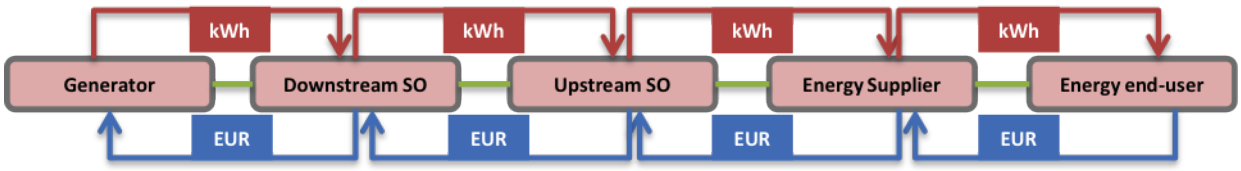
Focus section: feed-in tariff

The German Renewable Energy Act (Erneuerbare Energien Gesetz, EEG) is the single most important policy tool to encourage and facilitate investment in German renewable energy. While we do not class it as a primary financial flow in our overall climate finance landscape, it does oblige several actors to support renewable deployment and in turn influences investment decisions. The EEG has three overarching provisions: 1) priority access to the grid for energy from renewable sources; 2) a mechanism that allows for the priority purchase, grid transportation, and payment for energy from renewables, and 3) a nationwide system to equalize the costs fairly among the participants.



In this respect, it acts as a risk management instrument, by placing obligations on network operator(s) to accept generation from renewable sources, and pay the generators for each kWh of energy produced according to the contracted price. Therefore, all of this renewable generation must be accepted and purchased by the network operators, or they will have to pay the opportunity cost of the lost generation.

In 2010 the total provision of the FIT amounted to some 13.1 billion EUR: 4 billion to households and the remainder to non-households. The initial network operator is then reimbursed via several pass-through mechanisms, while the energy is similarly passed through to the end-users. The overall amount is charged through to end-users via a surcharge on their electricity bills. In some cases, the end-user may also be a generator (mostly households that have self-installed small-scale renewable devices).



sector was financed privately. Global renewable investment trends have been increasingly larger than those of conventional generation (UNEP-FS 2012).

Discussion of results

The energy sector represents a significant portion of Germany's emissions, and is in a state of transition, with investors increasingly attracted to low(er) carbon-intensive sources of energy. The energy sector has received large volumes of private investment since sector liberalization and unbundling in the early 1990s. Our study showed that 2010 was no exception: 98% of the overall climate-specific investment in the energy sector was carried out by private actors.

Interestingly, however, is that in 2010 the large majority of investments in renewable energy were not sourced from actors involved in the energy sector. Instead, 75% of the total renewable energy investment (EUR 20 billion of EUR 26.6 billion) was in small-scale technologies, crucially, in other sectors of the economy (buildings, industry, and agriculture). Solar photovoltaic technology in particular attracted large volumes of investment across all sectors, accounting for 60% of the total new generating capacity installed in 2010, equating to 77% of the total EUR 26.6 billion invested.

The energy infrastructure network plays a critical role in meeting the country's low-carbon ambitions. For the first time in 2010, more generation capacity was situated on the electricity distribution network, than on the electricity transmission network. This demands more from network operators to operate the system within security and efficiency limits while at the same time handling an increasing volume of unplanned flows and new dynamic flow patterns.

Overall, large-scale renewable energy investment in the energy sector (EUR 6.7 billion) significantly exceeded electricity transmission infrastructure investment, which had climate-specific investments of EUR 0.5 billion; see Annex Table 3-4 for a breakdown of infrastructure investments. We can make a simple supply-chain generation-to-infrastructure assumption that 1) large-scale renewable energy investment will be connected to the "large-scale"/electricity transmission network, and 2) that small-scale renewable energy investment will be connected to the "small-scale"/electricity distribution network. Similarly, we can thus compare small-scale climate-specific investments: EUR 20 billion for renewable energy and EUR 2.5 billion in distribution networks.

If this trend continues, it may cause an imbalance between renewable installations and the necessary energy (electricity) infrastructure to accommodate them. The Network Development Plan (*Netzentwicklungsplan*) (2012), for instance, is a coordinated effort among the four German transmission system operators (TSOs) to organize grid investments over the next 10 years, expected to be around EUR 20 billion in total, equating to approximately 12 GW of new transmission capacity. Interestingly, the next ten years may connect some 50 GW of new renewable energy capacity.

During the course of our analysis, we identified some areas to improve the tracking of climate investment in the energy sector.[10] In most cases private sources and their climate-specific investments were established using bottom-up (project- and technology-level) or top-down (aggregate reports) approaches, and in some cases expert judgement if no agreed-upon reporting process exists for private actors.

Institutions can play a greater role in improving climate finance tracking in the sector. For instance, the identity of all investors in renewable energy is unknown; energy regulator BNetzA (Federal Network Agency) tracks every investment in solar PV, but does not track investors or investments in other renewable energy technologies.

Sector methodology

In gathering the data and determining the methodology to identify climate-specific investment in the agriculture sector, the information was broken down into areas corresponding to the framework for the overall landscape. We identified sources and end-uses, intermediaries, and instruments. Further we detail evaluation of the each element of the Landscape. For a summary of assumptions made to analyze the data points, please refer to Annex Table 3-5.

Sector definition and boundaries

The energy generation and infrastructure sector is largely defined according to Federal Statistical Office classification WZ2008 scheme classes D "Electricity, gas, steam, and air conditioning supply," but focused primarily on D35.1 "Electric power generation, transmission, and distribution."

Investments to reduce emissions in generation are reflected either under fossil fuel or new-build renewable

10 See Chapter 4 in the main overview report for more general tracking recommendations.

energy. The former category includes 1) only emission reduction investments including switching existing fossil fuel capacity from more carbon intensive to less carbon intensive per unit of energy output, 2) retrofitting/ upgrading existing fossil fuel capacity from more carbon intensive to less carbon intensive, and 3) investments into co-firing fossil fuel capacity including biomass up to 100% share of energy supply. The latter category includes all-scale onshore wind, offshore wind, hydro-electric power, solar power plants, biomass energy supply, and energy supply from geothermal or marine technologies.

Energy infrastructure includes energy transmission and distribution infrastructure for the transport of gas and electricity. The investments tracked are only those that contribute climate-related measures such as accommodating for renewable energy by building energy infrastructure or expanding or upgrading existing energy infrastructure.

Sources and Uses

Overall investment in renewable energy. The BMU (Federal Ministry of Environment) provides annual investment volumes into renewable energy by technology in EUR. This data is gathered on their behalf by the research institute ZSW.[11] We accounted for this as full capital cost investment. It did not provide details on who the investors were. A study by trend:research (2011) determined the actor or investor into renewables by new 2010-installed capacity. This was used in combination with the ZSW data to determine who invested in renewables (energy sector, buildings, agriculture, or industry) and at what scale, which was in turn used to determine the finance flow.

Overall investment in infrastructure. BNetzA tracks overall private corporate investment by electricity and gas transmission and distribution system operators (TSOs and DSOs, respectively).

Overall investment in fossil fuel emission reductions. Climate-specific investment in reducing emissions from fossil fuel generation is not tracked, and data availability is very limited. It was thus only possible to estimate that EUR 0.5 billion full capital climate-specific investment occurred in 2010. This information was sourced using a press release from a private energy corporation.

Role of public investment. EU public funds were used for some investment in renewable energy and infrastructure. The amount is relatively small compared with private investments. See Section 3 of the report.

Intermediaries

Large-scale climate-specific investment in the energy sector (for renewable energy, infrastructure, and fossil fuel emission reduction) was assumed to be in line with typical investment strategies for the investors. Please see Table 3-5 for more details. For small-scale investment into renewable energy, please see the relevant sector Annexes.

Instruments

We made assumptions of what financial instruments were used by the actors investing in the energy sector. For project finance of large-scale investments we assumed a debt-to-equity split of 65/35, based on average ratios of renewable energy projects financed in 2010 in Germany. Debt and equity ratios of small-scale renewable energy projects by households are assumed to be 80/20, and based on the co-financing ratio of KfW programs. The remaining investments are treated as 100% equity (see Annex 2 for more details).

11 Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW - Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg), see http://www.zsw-bw.de

Annex Table 3-5: Assumptions used for evaluation of finance in the energy generation and infrastructure sector

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCES
Renewable energy				
1 TOTAL renewable investment volume	26,570	2010	Total as given in the reference.	(BMU and AGEE-Stat 2011).
2 Share of renewable investment small-scale (<1 MW installed capacity) (74.8%)	19,895	2010	The figure is calculated as: • Take share as given in Point 3 below (for those marked small-scale), • Multiply by overall investment given in Point 1, • Sum up those marked "small-scale" in the investor breakdown below.	(trend:research 2011).
Share of renewable investment large-scale (25.2%)	6,701	2010	As above, but for those marked "large-scale."	As above.
3 Renewable investment by installer[a] (% of overall installed capacity)	-	2010	The figures in point 3 are calculated as: 1. Investor share in overall new 2010 renewable capacity taken from (trend:research 2011) 2. Share is multiplied by overall 2010 investment figures in EUR from BMU (Point 1) 3. Result is proxy for investor share of overall EUR	(trend:research 2011).
Private Households (38%)	10,110	2010	The figure also appears in the buildings sector as indirect investment into it (see the Annex 5. The Buildings Sector 5). This category is fully assumed as small-scale.	As above.
Farmers/landowners (20%)	5,380	2010	The figure also appears in the Agriculture Sector as indirect investment into it (see Annex 7. The Agriculture Sector). This category is fully assumed as small-scale.	As above.
Industry + Commerce (16%)	4,227	2010	The figure includes investment into renewable energy installations by the industry and commercial sector actors. The figure was not split into sectors due to the lack of data and does not appear in End-Use Sector Annexes. This category is fully assumed as small-scale.	As above.
Funds/Banks (11%)	3,005	2010	Investment by funds/banks into renewable energy. This category is fully assumed as large-scale.	As above.
Project Developers (8%)	2,160	2010	Investment into renewable energy by large-scale project developers. This category is fully assumed as large-scale.	As above.
Other Utility (<400MW) (3%)	759	2010	Investment into renewable energy by large-scale utilities holding portfolio of <400 MW total. This category is fully assumed as large-scale.	As above.
Regional Generator (>400MW) (1%)	362	2010	Investment into renewable energy by large-scale utilities holding portfolios of >400 MW total. This category is fully assumed as large-scale.	As above.
Big 4 - RWE, EON, Vattenfall, EnBW (1%)	223	2010	Investment into renewable energy by large-scale utilities of Germany's so-called Big 4 utilities (RWE, EON, Vattenfall, and EnBW). This category is fully assumed as large-scale.	As above.
Non-German Utility (1%)	189	2010	Investment into renewable energy by large-scale non-German utilities. This category is fully assumed as large-scale.	As above.
Other (1%)	174	2010	Investment into renewable energy by others as defined in (trend:research 2011). This category is fully assumed as small-scale.	As above.

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCES
Contractor (0%)	2	2010	Investment into renewable energy by contractors as defined in trend:research (2011). This category is fully assumed as small-scale.	As above.
4 Large-scale total investment into renewable energy	6.701	2010	Large-scale investment in renewables from above.	As above.
Large-scale renewables investment through project financing (debt 65%)	1,954	2010	We assume that 25% total investment in renewable energy is large scale (of installed capacity more than 1 MW), 45% of which was financed through project finance with an average debt/equity split of 65/35, based on the Bloomberg New Energy Finance database. The remaining investment is accounted as balance sheet finance. We assume balance sheet finance to be 100% equity due to possibility of later capitalization of loans, i.e. recording loan value as assets of a company or its subsidiary.	(BNEF 2012; trend:research 2011).
Large-scale renewables investment through project financing (equity 35%)	1,052	2010		(BNEF 2012).
Large-scale renewables investment through balance sheet financing (equity - 100%)	3,582	2010		Own calculation.
Large-scale renewables investment through public funds	118	2010	EEPR grant for offshore wind projects located in Germany, considered a maximum of EUR 81 million; unknown share was disbursed in 2010. Regional Development Fund provided grants for renewable energy in the total amount of EUR 27 million, which was co-finance with the national public sources of around EUR 10 million.	(Deloitte 2012; European Commission 2011a).
Energy infrastructure				
5 Transmission electricity (4 TSOs) total investment, including maintenance costs.	807	2010	Provided in BNetzA Monitoring Report (2011).	(BNetzA 2011).
Transmission electricity investment excluding maintenance costs	620	2010	Provided in BNetzA Monitoring Report (2011).	(BNetzA 2011).
Transmission electricity climate-specific investment (80% of total excluding maintenance costs)	496	2010	The figure is based on expert interviews with network operators, who estimate that between 70 to 90% of investment is potentially specific to climate change.	Sector experts.
...Public funds	100	2010	Grant for electricity interconnections (Halle/Saale Schweinfurt), considered a maximum of 100 million EUR; unknown share was disbursed in 2010. See also EU Budget section of report and Annex Table 1-8.	(Deloitte 2012; European Commission 2011a).
6 Distribution electricity (869 DSOs) total investment, including maintenance costs	6,401	2010	Provided in BNetzA Monitoring Report (2011).	(BNetzA 2011).
Distribution electricity investment excluding maintenance costs	3,189	2010	Provided in BNetzA Monitoring Report (2011).	(BNetzA 2011).
Distribution electricity climate-specific investment (80% of total excluding maintenance costs)	2,551	2010	The figure is based on expert interviews with network operators, who estimate that between 70 to 90% of investment is potentially specific to climate change.	Sector experts.

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCES
7 Transmission gas (17 TSOs) total investment, including maintenance costs	800	2010	Provided in BNetzA Monitoring Report (2011).	(BNetzA 2011).
Transmission gas investment excluding maintenance costs	272	2010	Provided in BNetzA Monitoring Report (2011).	(BNetzA 2011).
Transmission gas climate-specific investment (ca.10% of total excluding maintenance costs)	27	2010	Expert judgment that between 0 and 20% is potentially specific to climate change reasons.	Own calculation.
8 Distribution gas (695 DSOs) total investment, including maintenance costs	2,017	2010	Provided in BNetzA Monitoring Report (2011).	(BNetzA 2011).
Distribution gas investment excluding maintenance costs	742	2010	Provided in BNetzA Monitoring Report (2011).	(BNetzA 2011).
Distribution gas climate-specific investment (ca. 10% of total excluding maintenance costs)	74	2010	The figure is an estimate based on the expert judgement; we decided between 0 and 20% is potentially specific to climate change.	Own calculation.
9 Corporate investment by TSOs/ DSOs	3,047	2010	Assumptions based on above.	(BNetzA 2011) and assumptions.
Corporate investment by TSOs/ DSOs debt (65%)	1,981	2010	The figure is derived from data in the annual reports on debt/equity capital structure, and Roland Berger study for EC (2011) that gives the typical structures for both gas and electricity network operators (60-70% debt).	Annual reports of typical network operators, see Roland Berger (2011).
Corporate investment by TSOs/ DSOs equity (35%)	1,066	2010	The figure is derived based on the data in the annual reports debt/equity capital structure, and Roland Berger study for EC (2011) that gives the typical structures for both gas and electricity network operators (60-70% debt).	Annual reports of typical network operators, see Roland Berger (2011).
Emission reduction from fossil fuels				
10 Climate-specific investment in emission reductions related to fossil fuel energy efficiency	500	2010	Assumed that 500 million of project cost was financed on balance sheet (100% equity) and was financed totally in 2010.	(RWE Power 2009).

Notes: [a] When the installer received public support, the ownership was fully allocated to such installer.

Annex 4. The Industry Sector

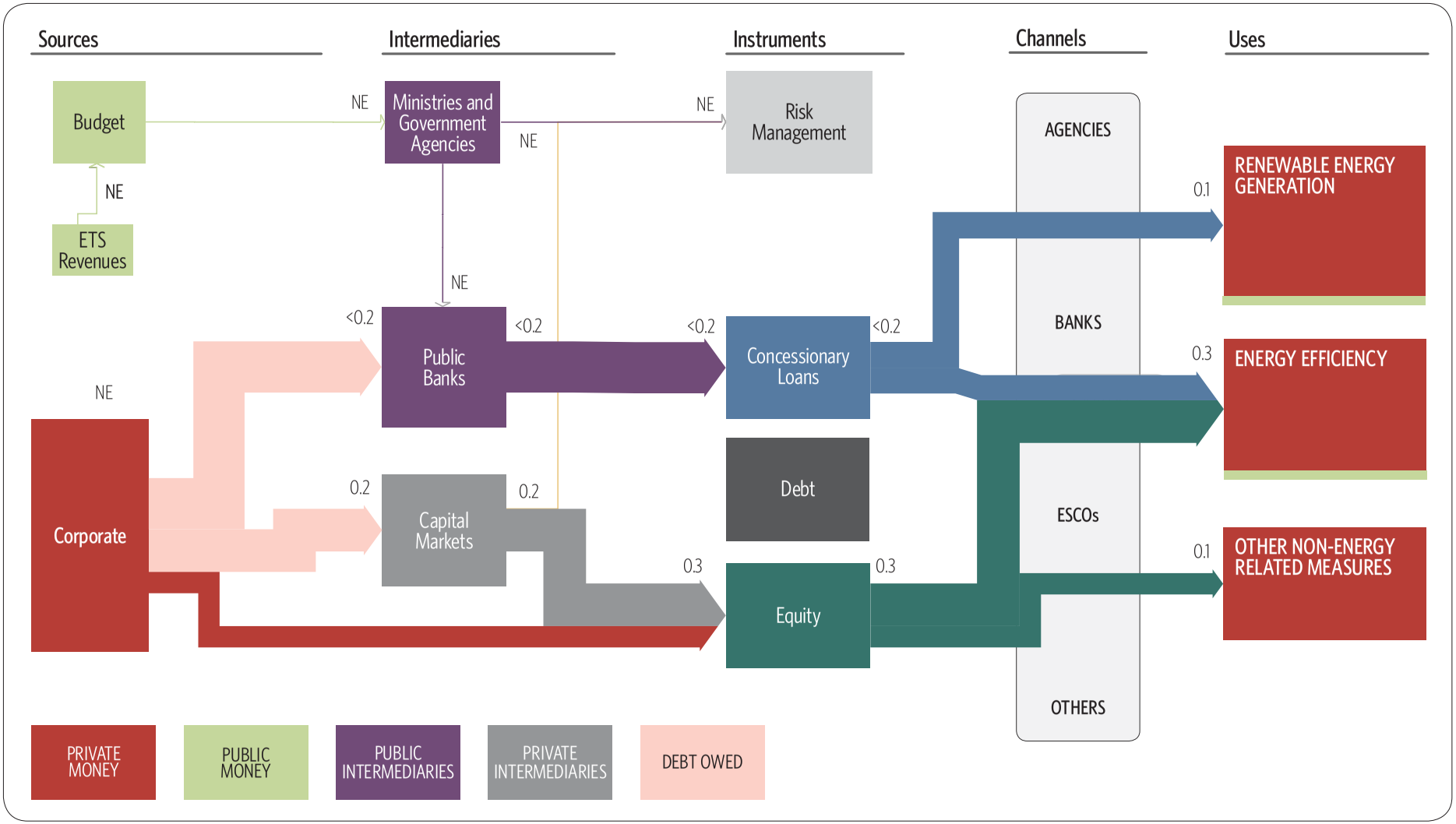
Key findings

1. **In 2009, 579 million EUR was invested into climate-specific measures[12] in the German industry sector.** Although this investment volume represents solely the incremental share of climate-specific investment in the industry sector,[13] it seems rather small compared to the overall potential for climate-specific investment in Germany, especially when considering industry's 33% share of emissions.
2. **Most industrial climate-specific investment (59%) went to energy efficiency measures.** 22% went to renewable energy and 19% to non-energy related GHG emission reduction measures.
3. **Official statistics do not distinguish public finance from private investment**, which makes it impossible to determine the share of either private or public actors in industrial climate-specific finance. In particular, private actors do not track the share of their investments attributable to energy efficiency. For them, such investments are largely indistinguishable from "normal" expenditures in the re-investment cycle, such as acquisition of new equipment.
4. **Policies such as the EU ETS or the Environmental Tax Reform are likely to influence private investments towards climate-specific measures.** A comprehensive assessment of climate-specific investments in the industry sector would need to consider the effects of such instruments.

12 For industry actors climate-specific investments are largely indistinguishable from "normal" investments as part of the re-investment cycle, in terms of new machinery for example.

13 In other words, the cost difference between the more carbon-intensive standard measure and a climate-friendly measure, see Chapter 2 for details.

Annex Figure 4-1: Industry sector climate finance diagram 2010, billion EUR



Notes: In the Landscape, figures for industry represent incremental climate-specific investment. Sources: 1) Corporate capital investment flows are simplified. In fact, they cover both private and public spending. 2) Debt owed does not represent the actual flows of climate finance, but is shown to highlight the original investors and asset owners, who make use of capital markets and public banks. We note that actual lending volumes of loans and equity provided by public banks or capital markets as financial intermediaries are much higher than the depicted flows, since their investment support reaches beyond the illustrated sole cost increment between a standard technology and a climate-friendly technology. Intermediaries: Capital markets include finance provided by commercial banks and institutional investors.

Annex Table 4-1: Climate finance in the German industry sector in 2009, million EUR

SOURCE	CLIMATE-SPECIFIC INVESTMENT			CLIMATE RELATED
	ENERGY EFFICIENCY (INCREMENTAL COST)	RENEWABLE ENERGY (INCREMENTAL COST)	NON-ENERGY RELATED (INCREMENTAL COST)	
Public	NE	NE	NE	NE
Private	NE	NE	NE	NE
Total	**>341.8**	**>124.8**	**>111.3**	**1,018.70**
mining/quarrying	*2.6*	*NE*	*NE*	*66.3*
manufacturing	*339.1*	*124.8*	*113.3*	*1,042.40*
small and medium enterprises	*118.7*	*96.5*	*10.9*	*155.9*
large companies	*220.4*	*28.2*	*100.4*	*886.5*

Sector background: why care about investment?

The significant contribution of industry to national energy use and emissions means it plays a key role in Germany's low-carbon trajectory. Some 33% of the country's total GHG emissions in 2010 were generated by manufacturing and mining/quarrying companies (UBA 2011b).

- Energy - direct emissions: Industry produces 12% of German emissions from direct use of fossil fuels for auto-generation of heat and electricity.
- Energy - indirect emissions: Industry uses about 40% of electricity generated in Germany, accounting for 13% of Germany's emissions.
- Other process - direct emissions: Industry generates 8% of Germany's emissions from non-energy-use industrial processes.

Because of the variety and scale of companies and processes in the industry sector, many opportunities exist to reduce emissions largely by increasing overall energy efficiency, for instance, by substituting technologies, optimizing production processes, or switching to energy from renewable sources.

Although the Energy Concept of 2010 (BMWi and BMU 2010) does not set explicit targets to reduce industrial emissions, it does highlight the key role of industrial energy efficiency in Germany's low-carbon future. The EU Emission Trading Scheme targets the reduction of emissions from all large industrial installations to 21% below 2005 by 2020. In Germany, about 1,600 installations (industry and energy generation) are subject to emissions trading. Together, they account for about half of the country's emissions (UBA 2011b). For the remaining players and sectors not covered by ETS the target allocated to Germany is a 14% emission reduction from the 2005 level.

Sector findings

Total climate-specific investment

In 2009, EUR 579 million were invested into climate-specific measures[14] in the German industry sector. This investment volume represents solely the incremental share of climate-specific investment in the industry sector.[15] The bulk of industrial climate-specific investment, 59%, went into energy efficiency measures, and the remainder into the renewable energy (22%) and into direct GHG emission reduction measures (19%). In addition to climate-specific investments, investments by industry in other climate-related measures[16] such as air pollution prevention or water pollution control amounted to EUR 1,019 million in 2009. Total investments of companies added up to EUR 46.7 billion in 2009 (Destatis 2011a).

Investment in renewable energy

About 22% of climate-specific investment in the industry sector was spent on renewable energy (EUR 125 million) (Destatis 2011a). This volume of investment in renewable energy describes incremental climate-specific investments and covers private spending and

14 Climate-specific investment refers to capital flows that target investments resulting in climate change mitigation or avoidance of emissions (see methodological Chapter 2 for details).

15 Incremental climate-specific investments are defined as the difference in required investment volumes for the more carbon-intensive standard (or baseline) measure and a less carbon-intensive measure.

16 Climate-related investments cover broader financial flows, which are not climate-specific but are either part of broader, multiple-purpose measures and/or are part of measures that deliver climate co-benefits in terms of reduction or avoidance of emissions technologies (see methodological Chapter 2 for details).

public support. In addition to these official statistics, KfW reports the channeling of around EUR 3.7 billion[17] through concessionary loans provided by its Programs on Renewable Energy Standard and Renewable Energy Premium to actors from the industry and tertiary sectors (CPI estimates). Comprising public and private money, total investments in renewable energy from industry actors and the tertiary sector together are estimated at EUR 4.2 billion by other studies (trend:research 2011). These numbers cannot, however, be split between these sectors and therefore were excluded from our calculations.

Investment in energy efficiency

The majority of public and private climate-specific investment in the industry sector was spent on energy efficiency (EUR 342 million) (Destatis 2011a). We did not find other reference sources underpinning these incremental costs for energy efficiency measures for two reasons. First, industry actors do not track the share of their investments attributable to energy efficiency. For them such investments are largely indistinguishable from "normal" expenditures in the re-investment cycle, such as acquisition of new equipment.

Second, implementers of public programs rarely publish numbers on the share of public finance dedicated specifically to the incremental cost of climate-specific measures in the industry sector. An example of such public programs to promote industrial energy efficiency is the Environmental Protection and Energy Efficiency Program (ERP) Part B[18] by the Federal Ministry of Economic Development and Technology.

Other investment

Climate-specific investment also directed EUR 111 million into non-energy-related climate-specific measures (Destatis 2011a). Beyond renewable energies and energy efficiency, other measures facilitate the avoidance and reduction of GHG emissions in the industry sector. Examples in this category are the capture and use of sewage gas, replacement of conventional air conditioning and refrigeration systems by systems with halogen-free refrigerants, and the change of products and production processes. As with renewable energy and energy efficiency investments, we cannot distinguish between the private and public shares of these funds.

In addition to *tangible* climate-specific investments, public and private actors also undertook a number of *intangible* investments that are worth highlighting.[19] Public money was spent on intangibles such as information programs, schemes incentivizing behavioral changes, or support for research and development.[20] Investments in intangibles were difficult to account for. An example of such programs is the KfW Special Fund for Energy Efficiency in Small and Medium Enterprises. It plays a key role in channeling financial flows, with public financial support to advise SMEs on energy efficiency and renewable energy use. This fund is also financed by the *ERP* mentioned before.

Further, the EU Regional Development Fund provided Germany EUR 15.5 million for "assistance to small and medium enterprises for the promotion of environmentally-friendly products and production processes" (category code 6 of the Structural Fund categorization). This finance is designated for introduction of effective environment managing systems, adoption and use of pollution prevention technologies, and integration of clean technologies into firm production. This measure was co-financed with EUR 14.9 million from the public domestic budget and private actors.[21]

There are significant industry investments in so-called clean technologies or green products that do not directly lower emissions in the industry sector, but will indirectly reduce emissions in other sectors. These include, for example, insulation in buildings and hybrid-electric vehicles for transport. Primary finance flows connected to the manufacture of green products, such as the construction of production facilities, are beyond the scope of this study. However, to illustrate the extent of these flows we did track secondary investments into green products, for example, investments by households into energy-efficient appliances in the buildings sector (see Annex 5. The Buildings Sector).

17 CPI estimate, based on the share of each sector in the total investment into renewable energy in Germany by technology type, and eligibility criteria of KfW Renewable Energy Standard and Premium [KfW Eneuerbare Energien Standard and Premium] programs. The total lending volume of two programs in Germany was EUR 8.2 billion and EUR 0.3 billion accordingly.

18 CPI did not allocate the lending volume of this programme dedicated specifically to the industry sector.

19 Although important, they were excluded for the purposes of this study.

20 We considered the following programs as public support for intangibles: Energy Efficiency Contracting especially in the fields of lighting, compressed air, CHP, heating, ventilation and air conditioning; Energy Efficiency Initiative., implemented by DENA; Compressed Air Campaign, implemented by the BMWi; promotion of Energy Management System and the European ECO Management and Audit Scheme (EMAS), implemented by DENA.

21 See Annex 1 for details of the EU finance.

Companies from the industry sector might also invest directly into climate-specific projects in other sectors, e.g., take an equity share in large-scale wind farm. Such investments are difficult to track and were not considered for this report.

Discussion of results

Compared to other sectors, climate-specific investments in the industry sector seem quite low, since they cover incremental cost only and therefore show only the cost difference between, for example, a standard technology and a low-carbon technology.

There is no official number on the share of either public or private finance of the total EUR 579 million climate-specific investment in the German industry sector. Official statistics only comprise aggregate figures for climate-specific investments in industry.

The national public budget supports the investment into climate-specific tangibles in the industry sector via various public programs coupling public and private investment. We learned from our analysis of the public budget that such funding mainly takes place through low-interest loans and repayment subsidies. Due to the volatility of market interest rates, there are no official numbers on the total amount of interest rate buy-downs for the industry sector in 2010, but only on the total lending volume of low-interest loans. The total lending volumes channeled through such public programs say little about incremental cost borne by private and public actors for a climate-friendly measure as compared to a standard measure. We did not assess numbers on total repayment subsidies.

In general, policy incentives for emission reduction in the industry sector are offered via price instruments such as environmental taxation. Several important EU and German policies are likely to influence the transition to low-carbon industrial activity in Germany:

- Environmental Tax Reform: This tax reform, which introduced taxes on fossil fuel and electricity use, was designed to raise energy prices and in turn incentivize increased energy efficiency, thus encouraging the deployment of renewable energies (Rosenberg et al. 2011). To ensure the competitiveness of German industry, energy-intensive companies benefit from tax exemptions, which added up to EUR 4.4 billion in 2010 (GoG 2010c). The exemption scheme for the Environmental Tax Provision is currently being revised. The German government envisions coupling future tax exemptions worth EUR 2.3 billion for the entire industry sector (GoG 2010c) to the mandatory implementation of energy management systems and the achievement of additional energy efficiency improvements.
- EU Emission Trading Scheme (ETS): The EU ETS targets the reduction of emissions from all large industrial installations. In Germany, approximately 1,600 installations (industry and energy generation), which account for about half of the country's emissions, are subject to emissions trading (UBA 2011b).
- The Renewable Energy Act (EEG) and the Combined Heat and Power Act (KWK) both support investments in renewable energy. In addition, they influence energy prices, which directly incentivize energy efficiency measures.

Although evaluation studies of public programs attempt to estimate the share of private investments triggered by certain programs, we could not derive a robust number for climate-specific private investment from such studies.

We are not in a position to compare actual climate-specific investments with those required to meet German industrial energy and climate targets.

Sector methodology

In gathering the data and determining the methodology to identify climate-specific investment in industry, the information was broken down into areas corresponding to the framework for the overall landscape. We identified sources and end uses, and intermediaries and instruments. Where possible, we used official figures and statistics from ministries and government agencies responsible for tracking the sector. Further, we detail evaluation of the each element of the Landscape. For a summary of assumptions made to analyze the data points, please refer to Annex Table 4-2.

Sector definition and boundaries

The industry sector is defined according to the classification scheme of economic activities WZ2008 (Destatis 2007) of the German Federal Statistical Office as WZ2008-B (mining and quarrying) and WZ2008-C (manufacturing industry). Activities that reduce emissions from industrial processes, the use of solvents and other products such as pesticides, lubricants, waxes, and paraffins are included here.

Sources and Uses

The 2010 annual survey of the German Federal Statistical Office on industry environment- and climate-specific investment provided the main source of information (Destatis 2011a; 2011b). It covers, among other sectors, German mining/quarrying and manufacturing companies (WZ2008 class B, C). The survey differentiates between investments in renewables and energy efficiency and climate-specific measures that do not fit into these two categories (direct GHG emission reduction measures). The statistical office's questionnaire defines the different uses for climate investment as follows:

- Energy Efficiency: Examples for increasing energy efficiency/energy saving measures are heat exchangers (heat recovery), heat pumps, combined heat and power, thermal insulation of buildings and production facilities, modernization of heating and hot water systems (for example, switching to a modern condensing boiler). Only the portion of the investment that directly increases energy efficiency is considered here.
- Renewables: Installation/switch to renewables (as defined in the Energy Generation and Infrastructure Annex 3).
- Other climate protection: Measures helping the "avoidance and reduction of emissions of greenhouse gases (post-Kyoto Protocol)." Examples for this category are: capture and use of sewage, landfill, and mine gases (methane); replacement of conventional air conditioning and refrigeration systems by systems with halogen-free refrigerants; conversion to halogen-free blowing agents, e.g. in the preparation of sprays or foams, and general renunciation of the use of GHG in production processes.

The survey defines investments such as activated gross additions in fiscal year (without the tax-deductible VAT) of acquired and self-constructed property and equipment (or parts thereof); leasing goods that have been activated by lessee, and equipment under construction (if applicable).

Excluded from the figures are investments in subsidiaries abroad; additions through the purchase of entire companies or establishments; cost of financing; acquisition of shares, securities, etc. (financial assets); acquisition of licenses, patents, and other intangible assets; acquisition of rental equipment formerly used in the company.

Public support is explicitly included in the reported investments.

The overall quality assessment of this survey indicates that its results are accurate. A degree of uncertainty results from errors not related to the sampling itself, such as conscious or unconscious misreporting and features that are conceptually difficult to differentiate, such as investments in integrated environmental protection.

Experts suggested a comparison of the rather low results from the described official approach with data based on other references, e.g. combining average annual energy efficiency improvements in the industry sector with various cost estimates for improvements. However, because of the lack of homogeneity in the industry sector and the extensive data mining effort this suggested approach would require, we did not attempt it in this version of the Landscape.

Intermediaries

In addition to the described incremental cost for climate-specific measures (Destatis 2011a) for both private and public sources, we analyzed the support of public intermediaries as revealed in evaluation studies or annual reports (see Annex Table 4-2). This support refers to overall project finance volume and can therefore not be compared to the spending reported for sources.

Instruments

We faced difficulties in identifying the split of investment into different instruments. For a first assessment of privately used instruments, we assumed that climate-relevant measures were purely balance-sheet-financed and as such 100% equity-based.

Annex Table 4-2 : Assumptions used for evaluation of finance in the Industry Sector

PROGRAM/MEASURE	VALUE (MILLION EUR)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
Climate-specific measures	579	2009	The data is directly taken from the source as it reports climate-specific incremental costs.	(Destatis 2011a).

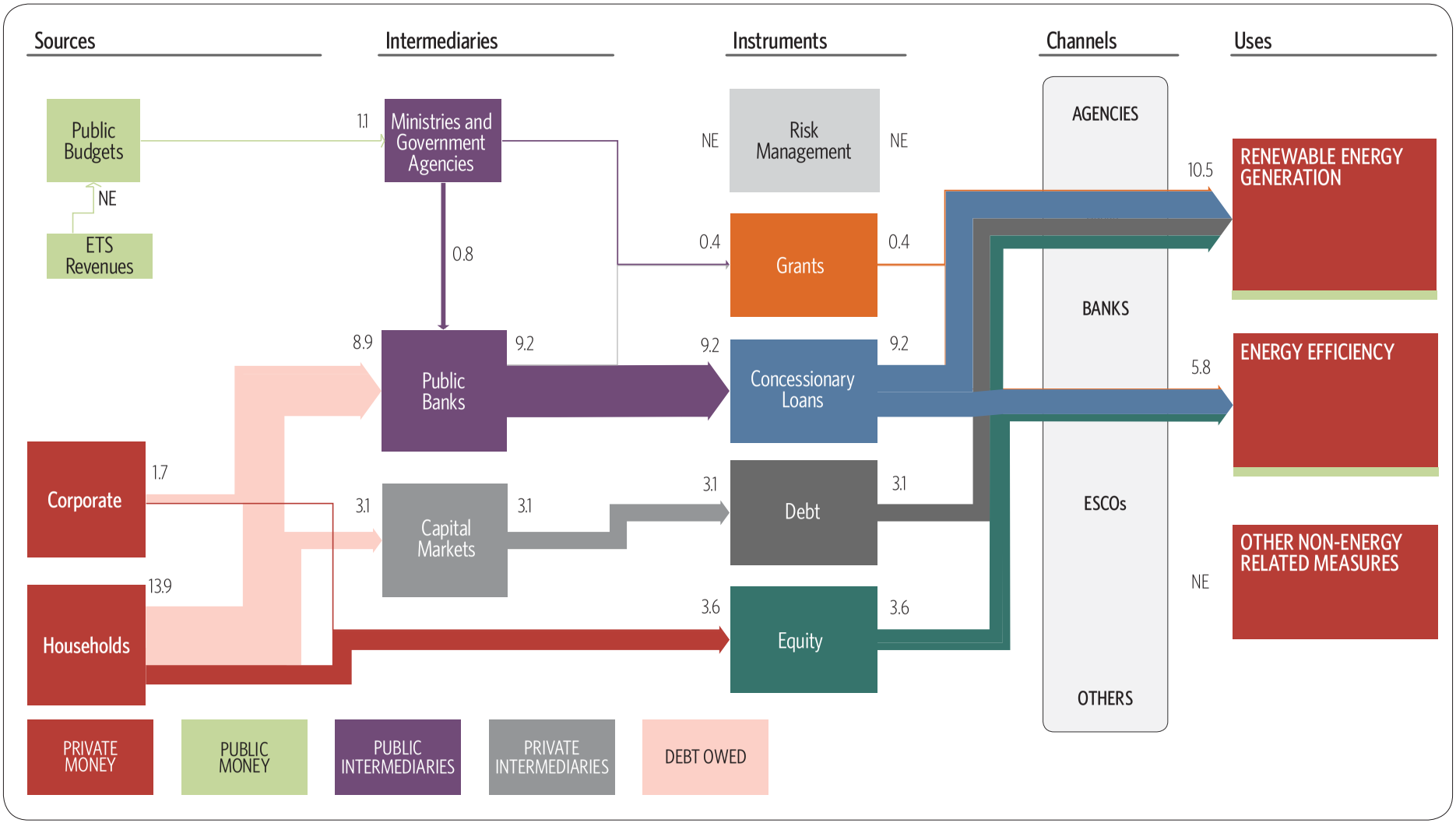
Annex 5. The Buildings Sector

Key findings

1. **In 2010, climate-specific investment in the German buildings sector was at least EUR 16.3 billion:** EUR 15.6 billion was private and EUR 0.7 billion was public money.[22]
   - Households were the main source of finance investing EUR 13.8 billion.
   - Corporations invested at least EUR 1.7 billion.
   - Public investment into public estates was 0.1 billion EUR and public grants and repayment bonuses for non-public buildings were EUR 0.6 billion.
2. Of these, **EUR 10.5 billion were channelled to building-integrated renewable energy and EUR 5.8 billion to energy efficiency**. These numbers are structurally different, as the former represents total capital investment while the latter represents incremental costs.
3. **KfW is the most important financing institution,** channelling at least EUR 9.0 billion through concessionary loans and EUR 0.4 billion through grants and repayment bonuses.
   - Support for energy efficiency was EUR 4.5 billion.
   - Support for renewable energy was EUR 4.8 billion.
   - Total KfW lending volume for all programs was EUR 13.2 EUR billion. The difference is due to KfW supporting total capital investments for energy efficiency, while we only accounted for incremental costs.Actual investment in the buildings sector is higher.
   - Our estimates predominantly cover investment in residential buildings.
   - Investments in non-residential buildings are not covered due to data gaps.
4. **Energy consumption trends and retrofitting rates (among others) suggest that the current investment level is not sufficient to meet the Energy Concept targets;** the actual investment gap however is unknown.
   - Due to the uncertainty about the total investment required for achieving the building sector's targets, the progress towards compliance with the objectives of the Energy Concept can only be evaluated indirectly through sector indicators such as the retrofit rate and energy consumption trends.
   - Such analysis suggests that investment in new residential buildings and in buildings-integrated electrical renewable energy is largely on track. Investments in existing residential buildings and electrical equipment and appliance are likely below the required levels for achieving the Concept's targets. Conclusions on investments in other sector segments were not possible because of data limitations.

22 In 2010, the government also supported private actors that made investments prior to 2010. Total disbursements from the government "at the source side" (EUR 1.2 billion) therefore differs, among other reasons, from public spending "at the use side" (above mentioned EUR 0.8 billion). See Box 1 in main report for further information why such numbers differ, i.e. why we chose to use different numbers in the diagram than in our total climate-specific investment estimate.

Annex Figure 5-1: Buildings sector climate finance diagram 2010, billion EUR



Notes:
1) The diagram landscapes the estimated climate-specific investments; these were largely investment into residential buildings retrofit, residential construction, and household electrical appliances. The diagram does not illustrate investment into the commercial and public sector except for a small share. 2) Figures for renewable energy represent total investment. Figures for energy efficiency represent incremental costs. 3) All figures are for 2010 except for investments into efficiency of household appliances, which were estimated based on spot data on sales and prices of individual appliances from 2007 to 2012.

Sector background: why care about investment?

In 2010, the buildings sector contributed 31% to total GHG emissions in Germany (UBA 2011b). In addition, 2009 figures show that 30% of total electricity and district heat production in Germany was used by households, and 27% by the tertiary sector (including agriculture) (AG Energiebilanzen e.V 2011). While emissions associated with electricity and district heat generation are accounted for in the balance of the energy sector, they originate in the buildings sector and are therefore this sector's indirect emissions.

Considerable potential to reduce GHG emissions exists mainly in space heating and electricity demand. Space heating is responsible for more than half of primary energy consumption in the buildings sector, and there is a significant potential to reduce emissions associated with it through thermal retrofitting of existing buildings, high-performance new construction, and the use of renewable heat (Neuhoff et al. 2011; Schlomann et al. 2012). Electricity use contributes about one third to the primary energy consumption of the sector emissions and its share continues to grow. Associated mitigation measures include improving the electrical efficiency of appliances, electronics, ICT equipment and electrical process-related equipment, promoting electricity conservation, and complementing conventional electricity supply with buildings-integrated renewable electricity production (Schlomann et al. 2012).

The German Energy Concept contains several sector-specific targets. It requires a 20% reduction of sector heat demand by 2020 and an 80% reduction of primary energy demand by 2050[23] (BMWi and BMU 2010). To reach these targets, the Concept requires climate-neutral new construction from 2020 onwards. Further, it requires existing buildings to be close to climate-neutral by 2050; for this the Concept demands an increase of the thermal retrofit rate to 2% per year, roughly double the current rate.[24] The Concept does not explicitly set targets for emission reductions associated with electrical efficiency improvement in the buildings sector. It does, however, set a target for the reduction of German electricity use of 10% in 2020 versus 2008 (and 25% in 2050). Targets for electrical renewable energy (see Annex 3 "The Energy Generation and Infrastructure") have implications for the sector as small-scale renewable energy is mostly installed on buildings.

At EU level, the EU–Effort Sharing Decision (European Commission 2009b) as a part of the Energy and Climate Package (European Commission 2008) sets a target for GHG emission reduction of energy-using sectors except for those falling under the scope of the Emission Trading Directive (European Commission 2009a). For non-ETS emissions, the Package sets country-by-country targets in 2020 relative to 2005 emissions in a bracket from -20 to +20%, taking into account the GDP per capita, which calls for a 14% reduction in German emissions. The buildings sector is also in the focus of the EU Energy End-Use Efficiency and Energy Services Directive (European Commission 2006b). The Directive requires each EU member to reduce energy sales to end-users by 9% in 2016 vs. 2001-2005. The newly adopted EU Energy Efficiency Directive (European Commission 2012a) replaced the Energy Services Directive, but the article setting the target remains active. The Energy Efficiency Directive further requires member states to set individual energy-efficiency country targets in 2020. It also requires member states to set utility obligations schemes or alternative policy measures in order to reduce energy sales to end-users by 1.5% per year during 2014-2020 versus the volume averaged over the most recent three-year period before the Directive takes effect.

Sector findings

Total investment

This section discusses our findings regarding climate-specific tangible[25] investments[26] in the buildings sector in 2010. In line with the study's overall methodology, we calculated the incremental costs[27] for energy efficiency and the total investment for renewable energy.

Annex Table 5-1 summarizes the estimated volume of climate-specific finance by measure type and by investing actor in 2010. The table shows that total

23 No reference years are provided in the Energy Concept.

24 The 2010 retrofit rate itself is not known, however the retrofit rate of building insulation between 2005 and 2008 was 0.8% per year (Diefenbach et al. 2010).

25 This was investment in physical assets like machinery, equipment, or buildings. We excluded investment into intangible (soft) measures such as research and development, information, training, or capacity building (see methodological Chapter 2 for details).

26 Climate-specific investment refers to capital flows that target investments resulting in climate change mitigation or avoidance of emissions (see methodological Chapter 2 for details).

27 Incremental costs refer to investments necessary to cover the difference, or "increment," between the more carbon-intensive baseline option and less carbon-intensive option technologies (see methodological Chapter 2 for details).

Annex Table 5-1 : Climate finance in the German building sector in 2010, million EUR

SOURCE	CLIMATE-SPECIFIC INVESTMENT			CLIMATE RELATED[a] (NOT ESTIMATED)
	ENERGY EFFICIENCY (INCREMENTAL COST)	RENEWABLE ENERGY (TOTAL CAPITAL INVESTMENT)	NON-ENERGY RELATED (NOT APPLICABLE)	
Public	426	293	NA	
Private	5,373	10,181	NA	
private: households	3,944	9,862	NA	NE
private: corporations	1,429	319	NA	
Total	**5,799**	**10,474**	**NA**	

Notes:

1. Climate-specific investment in the buildings sector includes investment in energy efficiency and renewable energy. For energy efficiency it includes the incremental share of investment and for renewable energy it includes total capital investment. Only tangible investment (in physical assets) is included.
2. Household investment includes climate-specific investment in residential building retrofits, residential construction, and household electrical appliances. We were only able to include energy efficiency investment in retrofit and construction of buildings related to KfW support.[b] Renewable energy investment is also available independent of KfW support. Investment in electrical appliances was only calculated for five key appliance categories.
3. Corporate investment includes investment related to KfW support in energy efficiency and renewable energy of existing residential buildings and residential construction. It does not include climate-specific investment in retrofits and construction of commercial buildings or in efficient appliances, electronics, ICT, and process-related electrical equipment.
4. Public investment includes investment related to KfW support for energy efficiency and renewable energy of existing residential buildings and residential construction owned by public actors. It also includes grants and repayment bonuses provided by the government to private actors. Public investment does not include climate-specific investment into non-residential buildings construction, retrofit of non-residential buildings, and public procurement of efficient electrical appliances and equipment.
5. The incremental share of the energy efficiency in the total costs of the retrofitting project, estimated as the investment leveraged with the KfW loans, was estimated to be 1/3. The energy efficiency investment into construction, calculated as the investment leveraged with KfW loans, was estimated to be fully incremental. The public spending for grants and repayment bonuses of concessionary loans was considered to cover incremental costs. See Annex Table 5-2 for details.
6. All figures are for 2010 except for investment in efficient household appliances, where estimates are based on spot data on sales and prices of individual appliances in 2007-2012.

a Climate-related investments cover broader financial flows, which are not climate-specific but are either part of broader, multiple-purpose measures and/or are part of measures that deliver climate co-benefits in terms of reduction or avoidance of emissions technologies (see methodological Chapter 2 for details).

b The reason is that there is no comprehensive statistic on climate-specific investments in buildings. There are well researched studies on total investments in buildings (including non-energy related investments), namely by Gornig et al. (2011) and by Heinze GmbH (Hotze et al. 2011). The latter also researches specifically "energy-related retrofits". Yet Heinze's definition is too broad to distill climate-specific finance from their figures. It labels all investments in components as "energy related retrofits" which can in principle reduce the energy demand of a building (e.g. windows, doors, heating system and outer walls). However, Heinze's figures on energy related retrofits also includes mere replacements of these components, e.g. a replacement of a standard two glazed window with a standard two glazed window. Therefore, their figures are not sufficiently comparable to other investment figures we are citing in this report and could therefore not be included.

climate-specific investment in the German buildings sector was at least EUR 16.3 billion. Of this amount, EUR 15.6 billion was private and EUR 0.7 billion was public. The total volume mostly refers to investments in efficiency and renewable energy for existing residential buildings, new residential construction, and household electrical appliances. Our figures largely do not cover investment in commercial and public buildings. Therefore, the actual total climate-specific investment was likely higher, but its total volume is not estimated due to data limitations (listed briefly in the notes under Annex Table 5-2 below as well as explained in detail in the methodological section).

In the category of private investors, households were the main financer in the building sector, followed by corporations. Our estimated investment of households is EUR 13.8 billion and that of corporations is EUR 1.7 billion. Total investment figures by Hotze et al. (2011) and by (2011) suggest that this rank (not the magnitude) holds true despite data limitations.

Public finance from national budgets may support renewable energy and energy efficiency measures in the buildings sector in two ways: 1) by direct investment in public assets (public procurement), or 2) by providing support for investment in non-public buildings. Public investment in residential buildings owned by public actors was 0.1 billion EUR. Public support to residential buildings in the form of grants and repayment bonuses was EUR 0.6 billion.[28]

28 In 2010, the government also supported private actors that made investments prior to 2010. Total disbursements from the government "at the source side" (EUR 1.2 billion) therefore differs, among other reasons, from public spending "at the use side" (above mentioned EUR 0.7 billion). See Box 1 in main report for further information why such numbers differ, i.e. why we chose to use different numbers in the diagram than in our total climate-specific investment estimate.

KfW played a significant role in supporting climate finance. In 2010, we estimate that KfW provided EUR 9.0 billion in the form of loans and EUR 0.4 billion through grants and repayment bonuses. Of these, actors invested EUR 4.5 billion in energy efficiency and EUR 4.8 billion in renewable energy. These figures are lower than the total KfW disbursement volumes for these programs, because KfW provided support for total investment and not incremental climate-specific investment as defined here. As described in our methodology in Annex Table 5-2, we took a share of these total investments to calculate incremental costs for the energy efficiency part of KfW finance.

Investment in renewable energy

We estimated that investment in renewable energy installations, integrated into buildings, was EUR 10.5 billion in 2010. This investment covered almost exclusively residential buildings; households invested EUR 9.9 billion. The remaining EUR 0.6 billion was invested by corporations and public investors into residential buildings. A significant part of the investment was supported by KfW. Through its programs, KfW supported EUR 4.8 billion in concessionary loans. Further, the Ministry of Environment (BMWi) provided EUR 235 million as grants as part of the Market Introduction Program for Renewable Thermal Energy (already included in the above-mentioned EUR 0.6 billion).

These figures above do not yet include investments in non-residential buildings, due to lack of available data. We were, however, able to retrieve a figure for the tertiary sector (commercial and public) and the industry sector combined. Together these sectors invested EUR 4.4 billion (of this EUR 0.6 billion in renewable energy in residential buildings; see above). According to CPI estimates, KfW provided EUR 3.8 billion of loans for renewable energy through its two programs Renewable Energy Standard and Renewable Energy Premium in these two sectors, i.e. the dominant part of the renewable investment volume. We did not include these numbers in our Sector Finance Diagram (Annex Figure 5-1: Buildings sector climate finance diagram 2010, billion EUR) because we were not able to allocate them with sufficient precision to the industry and commercial sectors.

Investment in energy efficiency

We estimated that the total incremental costs in efficiency was EUR 5.8 billion. Of this, households invested EUR 1.5 billion in the energy efficiency of existing residential buildings, EUR 1.9 billion EUR in the energy efficiency of new residential buildings, and EUR 0.6 billion in the efficiency of electrical appliances. Corporations invested EUR 0.8 billion in the energy efficiency of new residential buildings and EUR 0.6 billion in existing residential buildings. Public investment in the energy efficiency of residential buildings owned by public actors was 0.1 billion EUR, and public support in the form of grants and repayment bonuses was EUR 0.3 billion. As mentioned in Footnote 28, this represents investments in the use sector of 2010, but not disbursed public finance.

Other investment

A diverse policy framework encompassing information instruments, market-based instruments, and command and control instruments is in place to support climate-specific investments in the building sector. However, we have included only such policies in our landscape diagram and our discussions above that have the form of actual climate-specific investments in tangible assets, e.g. grants or repayment bonuses of loans for efficient buildings.

This definition does not refer to many instruments that set incentives for climate-specific investment rather than represent an actual climate-specific investment in tangible end-uses. Our exclusion of these policies does not, by any means, assign a lower impact to them. These can be:

- Command and control instruments, such as building codes, which demand a minimum performance from (especially new) buildings and their components.
- Market-based instruments, which improve the economics of climate-specific investments, for example, through changing energy prices.
- Information Instruments that raise awareness and help actors to decide on optimal climate-specific investments.

Another investment category not represented in our sector Finance Diagram is spending for Research and Development (R&D). This is because it was classified as intangible investment (see Chapter 2 for the definition). Within this category, the EU funds supported energy efficiency and renewable energy R&D through the 7th Framework Research Program (FP7), the Intelligent Energy Europe program (IEE), and the Information and Communications Technologies Policy Support (ICT). The national public budget for R&D in energy efficiency in the buildings sector was EUR 19.1 billion (OECD/

IEA 2012). Further, the public budget spent EUR 187.5 billion as R&D investment into a range of renewable energy technologies and practices, including those used in the buildings sector (OECD/IEA 2012). For more details, see Box 4: EU budget support of Research and Development in Germany and Box 5: National Finance of Research and Development in Chapter 3.

Discussion of results

The results above clearly show that KfW plays a crucial role in the buildings sector, as a financer of both energy efficiency (EUR 4.5 billion) and renewable energy (EUR 4.8 billion).

The actual total climate-specific investment in the buildings sector was likely higher than the reported EUR 16.3 billion, but its total volume was not estimated due to limited data. Data gaps are most prominent for non-residential public and commercial buildings. Therefore, in the interpretation of our results, we can draw the conclusion that tracking for these segments is urgently needed.

Is climate finance sufficient in the building sector? We can discuss this indirectly based on sector specific physical indicators. But our results on investments in the building sector themselves do not indicate whether investments are sufficient to meet the Energy Concept's targets because we were able to estimate only a share of the actual climate-specific investment in the sector due to the data availability and limitations; and because total required investment for the building sector for compliance with the targets set by the Energy Concept are uncertain. An evaluation of the sector segments based on physical indicators suggests the following:

- Climate-specific investments in new residential buildings are likely on track towards the respective strategy target. Investing actors obtained KfW loans for about 50% of 2010 residential construction (CPI estimate based on KfW Group (2011b) and Gornig et al.(2011)).[29] Buildings, which are in this category, achieved a 30%-higher performance on average than required by the acting building code (CPI estimate based on KfW-Group (2011b)).
- Investments in existing residential buildings were likely insufficient, as the current retrofit rate was approximately half of the 2% retrofit target rate established by the Energy Concept (BMWi and BMU 2010).[30]
- The estimated investment in efficient household appliances was EUR 0.6 billion. This is low, given a Concept target of 10% national electricity use reduction by 2020 vs. the 2008 level and a 46% share of the primary energy consumption of the buildings sector for electrical services in 2008 (CPI estimate).
- The level of investment into renewable energy installations producing electricity is likely in line with the Energy Concept target. Solar photovoltaic (PV) deployment by households amounted to 3.0 GW of installed capacity or 40% of total new PV (trend:research 2011). This volume alone equals the annual target of PV installations for Germany as set by the government.
- Our estimates illustrate that investment into renewable electricity dominated over investment into electrical efficiency. This contrasts with the fact that the GHG mitigation potential of electrical efficiency is associated with lower costs than the GHG mitigation potential of renewable electricity installations (Levine et al. 2007; Sims et al. 2007).

29 Measured in terms of constructed floor space

30 The 2010 retrofit rate itself is not known, however the retrofit rate for building insulation between 2005 and 2008 was 0.8% (Diefenbach et al. 2010).

Sector methodology

In gathering the data and determining the methodology to identify climate-specific investment in the buildings sector, the information was broken down into areas corresponding to the framework for the overall landscape. The methodologies applied in evaluating energy efficiency and renewable energy investment in buildings varied for building types. We have obtained the results mostly through bottom-up analysis, aiming only to make transparent assumptions that are based on evidence or at least external expert consultation. All of these assumptions are listed in the methodology Annex Table 5-2 below. This rigorous approach also implies that we have to rely on existing hard data that is collected by various actors, although we find that such data does not exist for many segments of the sector (also see Footnote b to Annex Table 5-1).

Sector definition and boundaries

The buildings sector includes households and the tertiary sector (defined according to the methodology used by (AG Energiebilanzen e.V 2011), excluding agriculture). The tertiary sector largely corresponds to classes WZ2008-F to WZ2008-U (Destatis 2007) and thus covers manufacturing firms with fewer than 20 employees, which are not included under manufacturing industry, construction industry, commercial properties and enterprise premises, commercial enterprises, private and public service companies and organizations (including banks, insurance companies, laundries, hospitals, public authorities. and the German postal service). The transport sector (WZ2008-H) is studied separately.

Sources and Uses

The sources of climate-specific finance include public and private investors. The uses of such finance are measures that reduce GHG emissions associated with thermal energy use, and measures that reduce GHG emissions associated with electricity consumption. The finance flows from the listed sources to uses are different for residential, commercial, and public buildings and therefore these categories are discussed separately below.

Private investors include households and commerce. As discussed above, public finance from the national budget may support climate-specific measures in the buildings sector in two ways: by direct investment in public buildings, or by providing support for improvements to non-public buildings.

Direct public investment in public buildings includes:

- Public investments in efficient new and thermal-efficiency retrofit of existing buildings, which are on the balance of federal, regional, and municipal budgets. Data limitations prevented tracking of this flow, apart from investment in residential buildings coupled with KfW support.
- Procurement of efficient electrical appliances, office equipment, and ICT technologies at federal, regional, and municipal levels. We also could not track this flow due to similar problems with data limitations.

Public support for non-public buildings:

- Different ministries provide public support for renewable energy measures and for energy efficiency in the buildings sector (e.g. for the KfW CO_2 rehabilitation program). Annex Table 1-1 provides a breakdown of all public disbursements for these programs at the "source side." As explained by Box 1 in the main report, public finance differs at the "source side" from public finance at "the use side." The latter is explained in the methodology table below.

Intermediaries

Ministries and subordinated agencies act as intermediaries disbursing finance from the public budget to other intermediaries. A part of this finance goes through the public bank KfW which provides this public finance as well as its own (non-public) finance to recipients in the form of concessionary loans or grants to conduct energy efficiency and renewable energy measures in new and existing buildings. Also non-public, private banks act as intermediaries in the building sector.

Instruments

Climate finance in the buildings sector is delivered through a range of instruments. KfW provides concessionary loans with and without repayment bonus components to households, corporate, and public actors. Further federal support is provided in the form of grants, for example by the Ministry of Environment (BMU) as part of MAP (*Marktanreizprogramm Erneuerbare Energien*). Households, corporate, and public actors invest into climate measures from obtained grants and concessionary loans as well as with market loans and equity.

Annex Table 5-2: Assumptions used for evaluation of finance in the Buildings Sector

PROGRAM/ MEASURE	VALUE (MILLION EUR)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCES
Electrical uses				
Residential electrical appliances, electronics, and equipment	Investments by households and small and medium enterprises 569	2010 based on 2007, 2008, 2009 2010, 2011 data	• 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 average by the difference in price between that class and the price of the average energy efficiency class. • Only the major domestic appliances are covered: refrigerators, freezers, dishwashers, washing machines, and clothes dryers. The estimate represents a lower bound as it does not include appliances and equipment other than those listed. • 2010 German appliance stock is forecast using 2007 German stock and the EU average growth rate for major appliance stock. • Refrigerators, freezers, washing machines: Sales structure and price by energy efficiency classes are for Western Europe in 2010. • Tumble dryers: Sales structure is for Switzerland in 2009; incremental efficiency cost is derived from prices by energy efficiency classes for Germany in 2008. • Dishwashers: Sales structure is for Germany in 2011; incremental efficiency cost is derived from prices by energy efficiency classes for Germany in 2006 and 2008. • Refrigerators, freezers, washing machines: The total stock is extrapolated from the estimate of dominating types.	(Attali et al. 2009; Beglinger et al. 2009; GfK 2011; Grond 2012; Herzog 2010; Presutto 2010; Rüdenauer 2006).
Commercial electrical office IT equipment, electronics, and process-related equipment	Public support 10	2010	• Calculated as the public finance provided by the Stimulus Program for Commercial Refrigeration Facilities under the National Climate Initiative (NKI). The program provides public finance in the form of grants; the value was taken from BMU (2012a) and is evaluated as being fully linked to the incremental costs. The corporate co-financing could not be tracked as climate-specific because we could not extract the incremental share following our methodology (Chapter 2). • The estimate represents a lower bound, as it does not include end-uses and equipment other than the types supported by this program. It is possible to estimate the total investments based on corporate procurements reports, but this data is fragmented and difficult to evaluate without dedicated research.	(BMU 2012a).
Public electrical appliances, ICT, and electronics	Not estimated	2010	• Information on which share of public procurement is conditional to energy efficiency does not exist (personal communications with experts) and this number is difficult to estimate without dedicated research. McKinsey (2008) estimated the energy-relevant public procurement on federal, regional, and municipal levels in 2006 to be ca. EUR 2.1 billion. The greatest share of investment comes not from the federal budget but from municipal and regional budgets. Thus, the share of energy-efficient procurement is unclear. The available fragmented data on the total spending related to climate mitigation is not sufficient to calculate the incremental efficiency share.	Personal communications.

PROGRAM/ MEASURE	VALUE (MILLION EUR)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCES
Construction, energy efficiency				
Residential buildings by all actors	By households 1,900 By corporations 787 By public investors 27 Public support 34	2010	Step 1: The total of energy efficiency and renewable energy investment was calculated as follows: • The total investment equals the amount of concessionary loans from the KfW (see Annex Table 1-2) received by various actors. Based on interviews with experts, KfW supported about 50% of new residential floor area in 2010. There is a considerable number of new buildings that were constructed without the KfW support (Diefenbach et al. 2010), but the data available were not sufficient to estimate the investment volume in such buildings. • On average, it was assumed that KfW support represented only the incremental energy efficiency share of total investment in construction. Indeed, according to interviews with experts, KfW-supported buildings were better than the acting building code (referred as Energieeinsparverordnung or EnEv 2009) by about 30% (supported buildings were "KfW 40-55", KfW's term for 40-55% of building standard for new buildings). The maximum KfW support per household in 2010 was EUR 50,000. In absolute values, the difference in construction cost between buildings rated as KfW 40-55 and buildings corresponding to the building code (EnEv 2009) varies in the range of EUR 24,000-99,000 per household, depending on building type and building performance. It is likely that the amount of KfW support was on average less than the additional costs of construction for KfW 40-55 as compared to the EnEv 2009 standard. Step 2: The share of investment in renewable energy was subtracted. • First, the total number of residential units supported by the KfW Energy Efficient Construction Program (see IWU and Bremer Energie Institut 2011 for the data) was recalculated to the total number of buildings by using information about the total German buildings stock from the TABULA building typology project (TABULA 2012). • Second, the breakdown of space and water systems according to fuel as reported by KfW (IWU and Bremer Energie Institut 2011) was applied. • Third, the number of buildings with renewable heating systems were multiplied by their respective costs using the data of BBSR (2012) and Bettgenhäuser and Boermans (2011). • Finally, the renewable investment was subtracted from the total investment to calculate the energy efficiency investment. Step 3: The obtained amount was split into the public support and the investment leveraged by it. • The repayment bonus of the concessionary loans was calculated (see Annex I) and then split into the renewable and energy-efficiency parts as above. The public support for energy efficiency is then subtracted from the total energy efficiency estimated. Step 4: The latter was split by investing actor. • The result of Step 3 is then split into investment made by the household, corporate, and public investors based on GoG (2012a).	(Diefenbach et al. 2010; GoG 2012a; IWU and Bremer Energie Institut 2011; KfW-Group 2011a; 2011b; Neuhoff et al. 2011; TABULA 2012; Walberg et al. 2011), Expert interviews, Annex Table 1-2.
Commercial non-residential buildings	Not estimated	2010	• According to our knowledge, which was corroborated in interviews with experts, an estimate of climate-specific investments into commercial construction does not exist. Dedicated research is required in order to calculate this number, and therefore it was not estimated in this report.	Expert interviews.

PROGRAM/ MEASURE	VALUE (MILLION EUR)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCES
Public non-residential buildings	Not estimated	2010	• The same as in the line "Public electrical appliances, ICT, and electronics" above.	Expert interviews.
Retrofit of existing buildings, energy efficiency				
Residential buildings by all actors	By households 1,475 By corporations 642 By public investors 57 Public support 298	2010	Step 1: The total of energy efficiency and renewable energy investment was calculated. • The total investments equal the investment leveraged with concessionary loans and grants disbursed by KfW programs (see Annex Table 1-2). Volumes of loans and grants are taken directly from the KfW statistics (KfW-Group 2011b). Co-financing of grants was back-calculated from the level of support in absolute and relative numbers. Existing residential buildings that did not receive KfW support are not included. Step 2: The share of investment in renewable energy was subtracted. • The renewable share of the investment was calculated differently for different elements of the KfW programs, i.e. such as supporting single measures and such as supporting sets of measures. • For support of single measures, the share of renewable energy investment was taken directly from KfW statistics (KfW-Group 2011b). • For support of sets of measures, we made the following calculations: Using information about the total German building stock and number of renovated units from the TABULA buildings typology project (TABULA 2012), and assuming that the ratio was the same as for KfW, we extrapolated the total number of renovated KfW buildings . The breakdown of space and water systems according to fuel use was then applied, as reported by KfW (IWU and Bremer Energie Institut 2011). Finally, the number of buildings with renewable heating systems was multiplied by their respective costs, using data from BBSR (2012) and Bettgenhäuser and Boermans (2011). • The sum of above renewable figures was subtracted from the total investment. Step 3: The obtained amount was split into the public support and the investment leveraged by it. • For the public support, we tracked the grant portion of the KfW Energy Efficient Retrofits program and the repayment bonus of the concessionary loans provided with the KfW's Energy Efficient Retrofit program and the energy efficient part of the KfW Housing Modernization programs. • The repayment bonus was subtracted from the total volume of concessionary loans in order to determine the investment leveraged by the public support. Step 4: The incremental share of the energy efficiency investment was calculated. • The investment leveraged by the public support does not represent climate-specific incremental costs, because KfW supports the full costs of retrofit projects (including scaffolding, etc.). As several studies found (Novikova et al. 2011; Stieß et al. 2010), the majority of households in Germany conduct buildings retrofit, which includes a thermal efficiency component, for reasons that are not linked to energy savings (e.g. appearance). Based on several studies we found that the thermal-related incremental cost of a retrofit is approximately one-third of the full cost (on median 37.5%) (Neuhoff et al. 2011). Therefore we multiplied the total investment by one third. • Grants and repayments bonuses were tracked as covering only the incremental energy efficiency costs. Step 5: The latter was split by investing actor. • The obtained incremental costs leveraged by the public support is then split into investment made by the household, corporate, and public investors based on GoG (2012a).	(BBSR 2012; Bettgenhäuser and Boermans 2011; GoG 2012a; IWU and Bremer Energie Institut 2011; KfW-Group 2011b; Neuhoff et al. 2011; TABULA 2012), Annex Table 1-2.

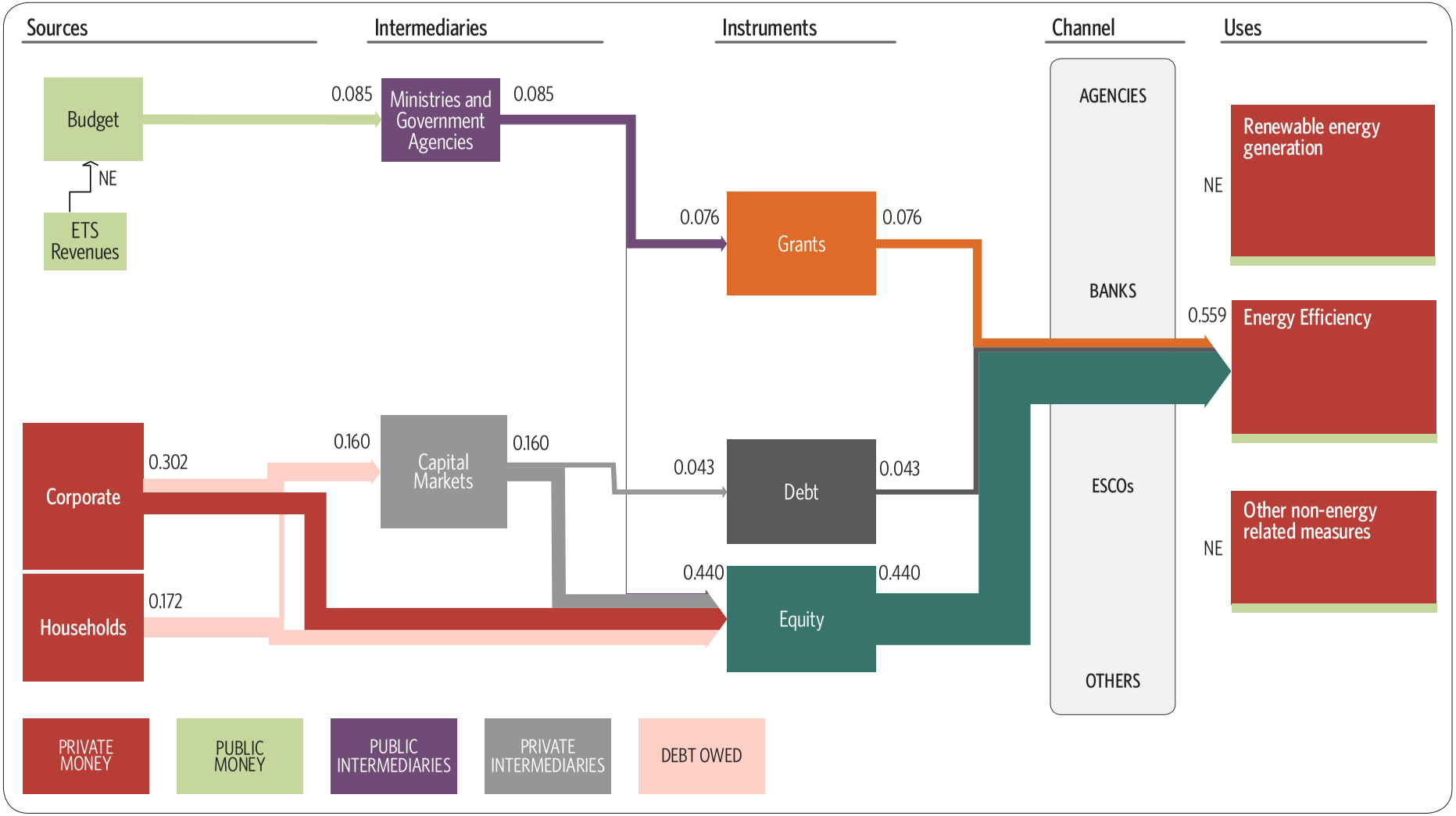
PROGRAM/ MEASURE	VALUE (MILLION EUR)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCES
Commercial non-residential buildings by all actors	Not estimated	2010	• No data is available on investment into energy efficiency retrofit of the commercial buildings.	Expert interviews.
In public non-residential buildings by all actors	Not estimated	2010	• The same as in the line "Public electrical appliances, ICT, and electronics" above.	Expert interviews.
Thermal and electrical renewable energy, construction, and existing buildings				
Residential buildings by all actors and investors	By households: 9,862 By corporations 319 By public investors 23 Public support 271	2010	• The main share of the estimate is discussed in the Annex 3. • On top of this estimate we added the above-mentioned subtraction of renewable investment from the KfW Energy Efficient Retrofit and Construction programs. The renewable part of investment from these two programs was split into the public support and the investment leveraged by it. The leveraged investment was split by investor type (household, commercial, and public actors) using the data of GoG (2012a). • The share of public finance in the total was calculated as a sum of the grant part of the MAP program operated by BAFA (see Annex Table 1-1,) and the renewable share of the repayment bonus of the KfW programs Energy Efficient Retrofits and Energy Efficient Construction (see Annex Table 1-2 for details). The share of renewable energy in the repayment bonus was calculated using the methodology described in the construction and retrofit lines of this table. The co-finance of the MAP program operated by BAFA was determined by taking the average grant share from Langniß et al. (2011) and calculating the respective co-finance.	Annex Table 1-1, Annex Table 1-2, Annex 3, (Langniß et al. 2011; ZSW 2011).
Commercial non-residential buildings by all actors	Not estimated	2010	• The total commercial and industrial investments were estimated together as EUR 4.2 billion; see calculations and references in Annex Table 3-4. However, the sectoral split could not be made and we have therefore left the flow unestimated.	
Public non-residential investors by all actors	Not estimated	2010	• The same as in the line "Public electrical appliances, ICT, and electronics" above.	

Annex 6. The Transport Sector

Key findings

1. **In 2010, EUR 268-851 million, or on average EUR 559 million, was invested into climate-specific measures in the German transport sector.**
   - Corporations were the main source of finance with at least EUR 302 million.
   - Households invested at least EUR 172 million.
   - Public investment was EUR 85 million, mainly through grants.
2. **The main climate-specific investment was the purchase of energy-efficient passenger cars by households and corporations.**
3. **Our estimate of climate-specific investment in the transport sector is conservative** as the incremental climate-specific share of climate-related infrastructure projects such as railways or bicycles poses difficulties and has been excluded from our calculation.
   - Climate-related investments were EUR 3.1 billion, covering the total capital costs of investments in railway, water, and bicycle infrastructure as well as investments in modal shift and combined transport.
4. **All of the climate-specific transport investments went into reducing energy demand** through energy efficiency assets such as efficient cars, and electric and hydrogen loading stations. No investment in renewable energy could be identified.
5. **Public finance was mostly for electric mobility and hydrogen demonstration projects, and energy-efficient street lighting.**
   - These were channelled predominantly through grants and matched by equivalent shares from corporations or co-financing rates of 80% by municipalities respectively.

Annex Figure 6-1: Transport sector climate finance diagram 2010, billion EUR



Notes:

Investments in efficient cars is in the range of EUR 109-401 million, depending on the assumed range of cost per reduced g CO_2/km between EUR 15 to 95 (see Annex Table 6-2). Exact numbers for private sector investments were not always available. The investment by the private sector was then derived from the grant conditions, such as those for electric mobility and hydrogen projects.

Annex Table 6-1: Overview of climate-specific and climate-related investments in the German transport sector in 2010, million EUR

SOURCE	CLIMATE-SPECIFIC INVESTMENT (MILLION EUR)			CLIMATE RELATED[a] MULTI-PURPOSE MEASURES (TOTAL CAPITAL INVESTMENT)
	ENERGY EFFICIENCY (INCREMENTAL COST)	RENEWABLE ENERGY[b]	NON-ENERGY RELATED (NOT ESTIMATED)	
Public	84.6	NE	NE	3,080
Private[c]	184-767[d]	NE	NE	>5
Total	**268-851**	**NE**	**NE**	**3,085**

Notes:
a For climate-related investments, the share of private investments does not include the matching investments from grants and loans and is thus likely to be understimated.
b Finance channeled to renewable energy and non-energy-related measures were not estimate due to the lack of data.
c Exact numbers for private sector climate-specific investments were not always available. The investment by the private sector was then derived from the grant conditions of, for example, the electric mobility and hydrogen projects.
d Investment in efficient cars is in the range of EUR 109-693 million, depending on the assumed range of cost of 15 to 95 Euro per reduced g CO_2 / km (see Annex Table 6-2).

Sector background: why care about investment?

The transport sector accounted for 17% of German total GHG emissions in 2010 (UBA 2011b).[31] In 2010, the sector used about 28% of final energy consumption; most of it (80%) can be allocated to road transport (AG Energiebilanzen e.V 2011).[32] Heavy duty (freight) transport by road makes up 72% of total transport activity in terms of ton-kilometers, with rail covering 18% and inland waterways 10% (Ifeu 2011). Passenger car activity makes up 90% of total passenger transport activity in terms of person-kilometers, compared with 67% in 1960. Individual light-duty vehicles cover 97% of total road transport activity, with the remainder covered by motor-bikes and buses in 2010 (Ifeu 2011).

There are numerous existing technologies and practices that can reduce GHG emissions in the transport sector (Kahn Ribeiro et al. 2007). These include more fuel-efficient and hybrid vehicles, modal shifts from road towards rail and public transport, and behavioral changes such as increased cycling and walking, and land-use planning. Second generation biofuels, higher efficiency aircraft, and high efficiency electric and hybrid vehicles as well as the underlying battery technologies have substantial abatement potential that can still be commercialized (Kahn Ribeiro et al. 2007).

The Germany Energy Concept, and its preceding programme, the Integrated Energy and Climate Programme (IEKP), foresee a significant number of emission reduction and energy efficiency objectives (BMWi and BMU 2010; GoG 2007).[33] These focus in particular on road transport emissions: Germany aims to decrease final transport-sector energy consumption by 10% by 2020 relative to the 2005 level, and to decrease it by 40% of this level by the year 2050 (BMWi and BMU 2010). It also aims to deploy one million electric cars by the year 2020, and six million of these cars by 2030 (BMWi and BMU 2010).[34] Further Germany-specific goals are not quantified in the Energy Concept, e.g., increased deployment of natural gas vehicles, shift of freight transfer to rail, and increased investments in rail infrastructure to build freight corridors have no quantitative target to compare with actual implementation.

In addition, Germany has committed to EU-wide goals such as the reduction of average CO_2 emissions for light duty vehicles (i.e. passenger cars) to 130g CO_2/km by the year 2015 and 95g CO_2/km by 2020, and the increase in the renewable energy share in the transport sector to 5.75% by 2010 and 10% by 2020 (European Commission 2009c; 2009d).[35] Aviation emissions are covered under the EU emissions trading scheme and are thus subject to the reduction targets set at the EU level in consultation with EU member states (European Commission 2009a).

31 Almost exclusively CO_2.
32 Motor gasoline and diesel oil cover the major share. Six per cent of road transport CO_2 emissions come from the combustion of biofuels (UBA 2012).
33 The Energy Transition (Energiewende) has not added any additional targets for the transport sector.
34 The goal of 1 million cars has been confirmed by the October 2012 Electromobility Summit (GoG 2012d).
35 This includes the following interim milestones: by the year 2012 an average of 65% of new car registrations by each manufacturer must comply with this threshold, by 2013, 75% and in 2014 80%; The performance targets for light-duty vehicles are enforced through excess premium payments for manufacturers who do not fulfill the EU CO_2 emission targets for cars (European Commission 2009d).

Sector findings

Total climate-specific investment

Total national climate-specific investment in the transport sector, was EUR 559 million, calculated as the midpoint in the range of EUR 268-851 million in 2010.[36] This figure represents incremental costs in climate-specific assets.[37] The wide range in the volume of the climate-specific investment is mainly due to assumptions regarding the efficiency cost for car purchases.[38] In addition, investment in climate-related assets in 2010 was EUR 3.1 billion.[39] However, it is important to note that the figures on climate-related asset investments are based on total capital investments rather than incremental costs.

Annex Table 6-1 illustrates investment in climate-specific and climate-related assets by public and private actors. Private actors, private households, and corporations represent the largest share, 85%, of total climate-specific investment. This is mainly due to the purchase of more energy-efficient cars, which alone make up 72% of the total climate-specific investment. The EU budget played no role in climate-specific investments in 2010. The EU budget, however, contributed to the share of climate-related investments, all of which are listed in Annex Table 6-3 and in Annex Table 1-4.

The main climate-specific investments in 2010 comprised private energy-efficient car purchases and demonstration projects for electric mobility and hydrogen. A marginal share is covered by energy-efficient street lighting.[40] Car purchases were financed mainly through savings, with loans covering a quarter (25%) of the investment. Demonstration projects were co-financed in equal amounts by public grants and corporations. Energy-efficient street lighting was financed through the National Climate Initiative with grants of 20%, with the remainder financed through public municipal budgets. In total, the grant and debt share for climate-specific investments was 14% and 8% respectively, for the total of private and public investments.[41] This means that the bulk of investment occurred on the basis of equity and savings investment, while these results are highly influenced by the large investment in cars' energy efficiency.

Investment in renewable energy

No renewable energy investments could be quantified. Investment data, for instance, on biofuel and hydrogen gas stations for vehicles is not transparently and publicly available.[42]

Investment in energy efficiency

Climate-specific investment in energy efficiency by private actors amounted to 475 million in 2010.[43] These investments were largely the purchases of more energy-efficient cars by households and corporations. Corporations invested EUR 74 million in demonstration projects for electric cars, hydrogen and fuel cell technologies in cars, and loading stations. Both of these programs were co-financed through the public budget in 2010.

Climate-specific investment in energy efficiency by the public sector amounted to 85 million in 2010. For electric mobility and hydrogen projects, the public sector

36 The section on the transport sector changed since the CPI consultation draft October 2012 addressing several comments received from experts. The main changes comprise the addition of incremental costs in efficiency of cars and the list of all climate-related investments (railways, water, road, bicycle, modal shift and multi-modal transport) in Annex Table 6-3.

37 Climate-specific investment refers to capital flows that target investments resulting in climate change mitigation or avoidance of emissions, for instance investing in renewable energy technologies (see Chapter 2 for details).

38 As illustrated in Annex Table 6-2 the assumed cost range for the improvement of 1 g CO_2/km is between EUR 15 and EUR 95. The figure depicted in the German Climate Finance Diagram is the midpoint of this range. All percentages within this report are also based on the midpoint.

39 Climate-related investments cover broader financial flows, which are not climate-specific but are either part of broader, multiple-purpose measures and/or are part of measures that deliver climate co-benefits in terms of reduction or avoidance of emissions technologies (see Chapter 2 for details). A full list of measures included under climate-related investments is in Annex Table 6-3).

40 Investments from the National Climate Initiative (NKI) in general and in transport and buildings sector in particular were influenced by the budget expenditure freeze in 2010 (expert interviews).

41 It is not transparent how the public budget is financed for specific projects, whether through taxes revenue or through government bonds. We have consistently assumed that direct investments by the public budget have been financed through equity investment.

42 Investments in electric mobility have been accounted for as energy efficiency investments. During the commenting period for the consultation draft version of this study, experts have mentioned the investment by large car manufacturers in renewable energy to power their electric vehicles. However, in car manufacturer's annual reports no information on renewables investments for the year 2010 could be identified.

43 Exact numbers for private sector investments was not always available. The investment by the private sector was then derived from the grant conditions for instance for the electric mobility and hydrogen projects, respectively. While corporations have invested EUR 23 million in hydrogen and fuel cell R&D it is not clear whether these investments are included in the EUR 10 billion estimate by Deutsche Bank (Deutsche Bank 2011; NOW 2011). However, their share of the total is negligible at 2% so that our findings would not change in either case.

spent EUR 74 million. All of these investments were channelled through grants. In addition, the National Climate Initiative financed energy-efficient street lighting with 2.1 million, with the remaining EUR 8.6 million being financed by municipalities.[44]

Other investment

Investment in intangible assets[45] made up a considerable share of financial flows in the German transport sector, a total of EUR 10.1 billion in 2010. The private sector accounts for 99% of these R&D investments, followed by the public and EU budget with 0.5% and 0.4%, respectively. For instance, car manufacturers' R&D for more efficient cars and motors accounts for EUR 10 billion (Deutsche Bank 2011). The public budget financed R&D of hydrogen and fuel cell cars for EUR 23 million, and made additional investments of EUR 6.7 million in energy efficiency measures in 2010 (NOW 2011). The EU budget financed a total of EUR 39 million of R&D in the transport sector in Germany in 2010 through the 7th Framework Research Program (see Annex 1 for more details on the EU finance to Germany).

A minor share, less than 0.01%, of all intangible transport investments went into soft tools such as capacity-building and information measures. In our data we were able to capture climate and bicycle concepts for cities and communes. However, this data potentially underestimates the expenditure in these programs. It includes key efforts such as:

1. The Zero Emission Mobility campaign targeted at providing information and support for the image of bicycle transport received about EUR 1.3 million per year for three years.
2. The DENA energy management action program that funded soft measures through grants for the years 2008-2010 with about EUR 1.3 million per year.
3. The Consumer Advice Center (Verbraucherzentrale) received about EUR 6 million per year for three years, but it is not clear how much of this funding was allocated to providing transport-relevant information.

For climate-related investments, the total of almost EUR 3.1 billion was mainly channelled into rail infrastructure (71%), followed by investments in water-specific infrastructure (16%), and heavy-duty vehicles (6.5%). Bicycle infrastructure (3.8%) and multi-modal (0.1%), modal shift (0.4%), and combined transport (1.8%) made up minor shares. The lion's share of 98% of these investments was financed through the public budget, with an additional 2% financed through the EU budget.

Discussion of results

GHG emissions from transport in Germany decreased by 6% between 1990 and 2010 (UBA 2011b). The major emission source remains road transport, and thus the highest GHG reduction potentials are in reducing road transport activity in favor of lower-emission options. However, the GHG impacts of investment in the transport sector have often not been systematically assessed.

Without additional analysis there is no way to assess whether the climate-specific investment of EUR 268-851 million in 2010 is sufficient to meet goals for decarbonization in the transport sector, as it cannot be compared to a total investment requirements for reaching the sector's targets. It is unclear, for instance, if the investment in electric mobility demonstration projects and private actors' purchases of cars will enable Germany to achieve its proposed deployment of one million electric cars by 2020. While R&D investments in more efficient motors are substantial, it is unclear what their actual effect is on reducing GHG emissions.

While Germany mentions in the Energy Concept the aim to increase the volume shifted to rail, it does not commit and implement any quantifiable targets such as kilometers of new railways in freight-relevant routes. Still, investments in railways make up the bulk of climate-related investments with EUR 2.2 billion CPI calculations based on (GoG 2011). For these investments to have substantial impact on the climate, they need to shift freight transported on heavily frequented roads to rail. However, the potential impact of rail infrastructure investments and of shifting freight from road to rail on GHG emissions has not been quantified systematically.

While freight and passenger transport activity has increased between 1990 and 2010, owing to an increase in household income, GHG emissions have decreased in Germany in the same period. This can be explained by an improvement in the efficiency of cars and partly by "refueling tourism", where private cars and freight trucks refuel in bordering countries to save fuel on costs (UBA 2012).

The European Commission is currently revising the 95 g CO_2/km target for cars (European Commission 2009c).

44 For references and assumptions please turn to Annex Table 6-2. Street lighting has been allocated in this study to the transport sector. The NKI by which the program is financed allocates street lighting to "Communes" (BMU 2012b).

45 Investment into intangible (soft) measures include such as research and development, information, training, or capacity building (see methodological Chapter 2 of the main report for details).

Germany's fleet average for 2010 was 151 g CO_2/km compared to Italy's and France's 132 g CO_2/km and 130 g CO_2/km, respectively (EEA 2011). Discussion of revising the target provides an opportunity to review its effectiveness in terms of the benefits and challenges of the current weight-based differentiation of emission intensity targets among car manufacturers and the alternative, a size-based differentiation. An analysis of patterns of EU-wide climate-specific investments in energy-efficient cars by both size and weight can support these policy discussions as well as update the assessment of needed low-emission transport infrastructure for hydrogen and electric vehicles. Early results from such an analysis can feed into target-setting for emissions for the year 2020 and beyond, which currently extends only to 2014.

A transparent and relevant monitoring and reporting system for car manufacturers' emission intensities needs to be developed to ensure compliance. To achieve the CO_2 emission targets, manufacturer's production and the registration of vehicles have to be monitored. The German Federal Motor Transport Authority has started to publish monthly updates on the CO_2 efficiency of newly registered cars, and it reports emissions to the EU Commission annually (EEA 2011; 2012; Kba 2011). A harmonized European monitoring and reporting approach can provide relevant data and thus help to analyze the effectiveness of the emission intensity policy for cars as well as uncover consumption patterns of car buyers to improve and update transport climate and energy policy. Investments in infrastructure can be guided by this data and should take it into account.

The GHG reduction in the German transport has to be seen in light of substantial refueling tourism. By failing to take this practice into account, the German GHG data on transport may overestimate emission reductions achieved in 2010, as GHG inventories are calculated using national fuel consumption. In addition, refueling abroad reduces energy tax revenues available for investments in low-emission infrastructure while increasing these revenues for bordering countries. This issue emphasizes the challenge of harmonization of fuel costs and underlying energy taxes as well as the potential gains from channelling tax revenues from border regions towards EU or bilateral low-emission infrastructure projects.

To summarize: the transport sector saw climate-specific investment of up to half a billion Euros and climate-related investment of EUR 3.1 billion in 2010, based on a conservative estimate. The effectiveness of this spending in relation to GHG impacts has often not been systematically assessed.

Sector methodology

In gathering the data and determining the methodology to identify climate-specific investment in the transport sector, the information was broken down into areas corresponding to the framework for the overall landscape. We identified sources and end-uses, intermediaries and instruments. Further we detail evaluation of the each element of the Landscape. For a summary of assumptions made to analyze the data points, please refer to Annex Table 6-2. For a complete list of climate-related investments that we tracked but did not include in the German Climate Finance Diagram, please refer to Annex Table 6-3.

Sector definition and boundaries

The transport sector is defined according to the scheme WZ2008 class H "Transportation and storage" as well as Code 42.1 "Construction of roads and railways" and Code 42.21 "Construction of utility projects for fluids" as defined by WZ2008 (Destatis 2007). Investments in infrastructure and support for low-emission modes of transport are included here. Investments by automobile manufacturers are only included in this sector, where investments can be clearly isolated as energy-efficiency investments such as for low-emission motors.

Sources and Uses

We utilized six main data sources to identify climate-specific and climate-relevant investments in the transport sector:

1. German federal public budget for 2010 (see Annex Table 1-1)
2. Länder reports on EU funding (see Annex Table 1-3 and Annex Table 1-4)
3. National Platform Electric Mobility reports
4. National Organization Hydrogen and Fuel Cell Technology reports
5. National Climate Initiative reports
6. Federal Motor Transport vehicle registry

A key challenge in all publications is that investments are not disaggregated into climate-specific investment categories, i.e., renewable energy and energy-efficiency investments. Investments that had a clear climate-specific purpose were selected from the above data publications and were accounted as incremental costs

if their main impact was on climate change mitigation. We selected titles from the public budget using a full text keyword search. From the EU budget we used the classification of the EU cohesion policy, however, we finally included all investments such as bicycle and rail infrastructure as climate-related because of the climate co-benefits of these investments (European Commission 2010). Where it was not possible to quantify the climate impact, or it was negligible, we accounted for investments as climate-related. Where other data were not available we calculated contributions by the private sector assuming maximum grant rates, usually 50%, offered by the public sector for climate-specific measures. We discussed our approach and findings with sector experts.

Intermediaries

Often ministries or the capital market acted as intermediaries by providing grants and loans. Information on intermediaries was based on the public budget and additional information from the statistical office and banking reports on households and corporate consumption behavior.[46] Where an intermediary was not transparently available, e.g. for private actors, we assumed that the financial flow goes directly through an instrument (e.g. debt, equity, grants) or that it goes through the capital market. The latter was the case for corporations that, for example, contributed to the electric mobility model regions.

Instruments

Where available in the public budget, we used grant and loan conditions to identify which instrument was used. In the public budget we identified both climate-specific and climate-related measures, while measures funded by the EU budget were exclusively climate-related. We assumed that private investments were based on equity unless we found information to the contrary. Such information was, for example, available from the Association of German Banks (*Bankenverband deutscher Banken*) on credit-financed car purchases.

46 While EU funding did not qualify as climate-specific within the definition of this study, it is included as climate-related investments (see Annex Table 6-3).

Annex Table 6-2: Assumptions used for evaluation of climate-specific finance in the transport sector

PROGRAM/ MEASURE	VALUE (MILLION EUR)	YEAR	METHOD/ASSUMPTIONS/LIMITATIONS	REFERENCE
Energy efficient car purchases				
Purchases of energy efficient cars	401 (109-693)	2010	We calculated the energy efficiency investment of households and corporations as the multiplication of: • the annual improvement in efficiency • all new cars registered in 2010 in Germany • the cost of reducing 1 g CO_2/km All data for these variables is available from the Federal Motor Transport Authority. The cost of reducing 1 g CO_2/km is based on a range of the lowest (15 Euro) and the highest penalties (95 EURO) per g CO_2/km from EU Regulation Nr 443/2009 for emission performance standards for new passenger light-duty vehicles. We assume here that the efficiency performance standards reported by car manufacturers to the German Federal Motor Transport Authority are accurate. A recent study by ICCT (2012) has shown that performance certification processes result in efficiencies lower than reported. We take the midpoint of the range between these two results.	(European Commission 2009d; ICCT 2012; Kba 2010; 2011).
Electric mobility				
Public - Model regions electric mobility	48	2010	• First, we identified the climate-specific and climate-relevant budget lines in 2010 project report by National Organization Hydrogen and Fuel Cell Technology (NOW 2011). These figures represented actual investments in 2010, rather than disbursements in 2010. • Second, we calculated private contributions to the program from the data on public spending and grant conditions. • We assumed that all investments in electric mobility loading stations and cars are climate-specific and belong to energy efficiency. It was further assumed that there is no overlap with private expenditures on energy-efficient cars and that 50% of total program costs were covered by public sector, with the remainder by private actors according to grant conditions. • With the current electricity mix, some electric cars have potentially higher emissions than conventional (gasoline or diesel) cars, although this problem is likely to diminish with a higher share of renewable electric power and increased battery storage capacity.	(NOW 2011; Schallaböck et al. 2012).
Private - Model regions electric mobility	48	2010		

PROGRAM/ MEASURE	VALUE (MILLION EUR)	YEAR	METHOD/ASSUMPTIONS/LIMITATIONS	REFERENCE
Hydrogen and Fuel Cell technology				
Public - Modell and demonstration projects for hydrogen and fuel cell technology	26	2010	• We identified reported figures in national budget (GoG 2012c): Code 891 61-622 - Plan 12 BMVBS, page 30. We assumed that reported figures represent actual investments in 2010, rather than disbursements in 2010. • We further assumed that all investments in hydrogen and fuel cell loading stations and cars are climate-specific, with no overlap with private expenditures on energy-efficient cars, and that 50% of total program costs were covered by public sector, and the remainder by private actors according to grant conditions. • The split of investments between investments in loading stations and cars is not available.	(GoG 2012c).
Private contributions - Modell and demonstration projects for hydrogen and fuel cell technology	26	2010		
Energy-efficient street lighting				
National Climate Initiative - Change to energy-efficient lighting for streets - Funds by Municipalities	9	2010	• We identified transport climate-specific investments in tangibles supported through the National Climate Initiative (Nationale Klimaschutz Initiative [NKI]), excluding intangibles such as climate change concept planning. • We assumed that the actual grant rate is 20% of total investment. • The numbers provided in the NKI are commitments. Disbursement numbers are available only after a program is ended.	(BMU 2012b).
National Climate Initiative - Change to energy-efficient lighting for streets - Approved NKI funding to Communes and Länder	2	2010		

Annex Table 6-3: Assumptions used for evaluation of climate-related finance in the transport sector

PROGRAM/MEASURE	VALUE (MILLION EUR)	YEAR	METHOD/ASSUMPTIONS/LIMITATIONS*	REFERENCE
Total all climate-related	**3,085**			
Total railways	**2,211**			
BMVBS - Grant investment program for rail tracks by German government	1,032	2010	Code 891 51-832.	(GoG 2012c).
BMVBS - Innovation and investment program for railways	370	2010	Code 89191-832.	(GoG 2012c).
Financial support for Länder for rail infrastructure for public transport	245	2010	Code 882 02-741.	(GoG 2012c).
Investments in railways	168	2010	Code 891 21-832.	(GoG 2012c).
Grants for investments in public transport by the Deutsche Bahn and by publicly-held companies	86	2010	Code 891 01-741.	(GoG 2012c).
Grants by European Union for investments in Trans-European railway infrastructure	77	2010	Code 891 03-832.	(GoG 2012c).
Grants for investments in Trans-European railway infrastructure	70	2010	Code 891 01-832.	(GoG 2012c).
Support for measures related to rail crossings (public easement: Municipalities)	57	2010	Code 883 01-725.	(GoG 2012c).
Grants by the EU Regional Development Fund (ERDF) for railway infrastructure	48**	2010	Code 891 04-832.	(GoG 2012c).
Support for measures related to rail crossings (public easement: Länder)	18	2010	Code 882 01-723.	(GoG 2012c).
ERDF grants for railways	18	2010	The sum of expenditures under the category codes from 16 to 19 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
Grants to private companies for construction, extension, and reactivation of railroad sidings	6	2010	Code 892 42-839.	(GoG 2012c).
Support for measures related to road-rail crossings (roads)	5	2010	Code 745 21-722.	(GoG 2012c).
National federal, regional, and municipal co-funding of ERDF measure support for railways*	5	2010	The sum of expenditures under the category codes from 16 to 19 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
Support for measures related to rail crossings (public easement: federal state)	4	2010	Code 745 01-722.	(GoG 2012c)
National private co-funding of ERDF measure support for railways	2	2010	The sum of expenditures under the category codes from 16 to 19 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***

PROGRAM/MEASURE	VALUE (MILLION EUR)	YEAR	METHOD/ASSUMPTIONS/LIMITATIONS*	REFERENCE
Total water	490			
Innovation and investment program federal waterways	179.67	2010	Code 780 91-731.	(GoG 2012c).
Redevelopment, expansion, new build of federal waterways	116.35	2010	Code 780 12-731.	(GoG 2012c).
Investments in federal waterways	105.96	2010	Code 780 21-731.	(GoG 2012c).
Assignments to Länder for investments in seaports	38.35	2010	Code 882 01-910.	(GoG 2012c).
Program for sea port hinterland to reduce congestion in freight transport	30	2010	Code 891 09-832.	(GoG 2012c).
Grants by European Union for investments in trans-European federal waterway infrastructure	8.37	2010	Code 752 11-731.	(GoG 2012c).
ERDF grants for ports	3.53	2010	The sum of expenditures under the category code 30 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
ERDF grants for inland waterways	2.03	2010	The sum of expenditures under the category codes 31 and 32 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
Support for environmentally friendly ship motors for the modernization of the German barge fleet	1.68	2010	Code 683 05-732.	(GoG 2012c).
National private co-funding of ERDF measures for ports	1.56	2010	The sum of expenditures under the category code 30 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
Redevelopment and expansion of internal company routes at federal waterways	0.95	2010	Code 780 14-731.	(GoG 2012c).
National federal, regional, and municipal co-funding of ERDF measure support for ports	0.88	2010	The sum of expenditures under the category code 30 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
National federal, regional, and municipal co-funding of ERDF measure support for inland waterways	0.25	2010	The sum of expenditures under the category codes 31 and 32 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
National private co-funding of ERDF measure support for inland waterways	0.14	2010	The sum of expenditures under the category codes 31 and 32 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***

PROGRAM/MEASURE	VALUE (MILLION EUR)	YEAR	METHOD/ASSUMPTIONS/LIMITATIONS*	REFERENCE
Total road	**197-203**			
Grant for the support of environment and safety in freight transport companies subject to highway tolls	118.88	2010	Code 684 52-790.	(GoG 2012c).
Grants for particle filter purchases	47.69	2010	Code 681 01-332.	(GoG 2012c).
Support for the purchase of commercial vehicles	21	2010	Grants to support environmentally friendly commercial vehicles.[1]	(KfW-Group 2011b).
Grant for the purchase of low-emission commercial vehicles	14.83	2010	Code 684 51-790.	(GoG 2012c).
Interest subsidy for the purchase of low-emission commercial vehicles	0.24	2010	Code 662 51-790.	(GoG 2012c).
Total bicycle	**119.19**			
Construction of bicycle paths, including maintenance (federal roads)	94.11	2010	Code 746 22-722.	(GoG 2012c).
ERDF grants for bicycle paths	17.58	2010	The sum of expenditures under the category code 24 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
National federal, regional, and municipal co-funding of ERDF-measure support for bicycle paths	4.71	2010	The sum of expenditures under the category code 24 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
Implementation of national bicycle road plan - Grants to private companies	1.79	2010	Code 686 01-692.	(GoG 2012c).
National private co-funding of ERDF measure support for bicycle paths	0.69	2010	The sum of expenditures under the category code 24 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
Implementation of national bicycle road plan - Grants to Länder	0.32	2010	Code 632 01-692.	(GoG 2012c).
Total combined transport	55.67			
Grants to private companies for investments in combined transport	46.8	2010	Code 892 41-839.	(GoG 2012c).
Grants to private companies for new combined transport	4.26	2010	Code 683 41-839.	(GoG 2012c).
Investments in combined transport	3.61	2010	Code 892 21-839.	(GoG 2012c).
Grants to private companies for trans-shipment investments in combined transport	1	2010	Code 862 41-839.	(GoG 2012c).
Total modal shift	**13**			
Marco Polo grant for modal shift in transport*	6.5	2010	Identify measures with relation to German companies.	(European Commission 2011a).
Marco Polo co-financing from private companies for modal shift in transport*	6.5	2010	Derived from grant conditions in the 2010 Financial Report of the European Commission (European Commission 2011a).	(European Commission 2011a).

PROGRAM/MEASURE	VALUE (MILLION EUR)	YEAR	METHOD/ASSUMPTIONS/LIMITATIONS*	REFERENCE
Total multi -modal	4.53			
ERDF grants for multi-modal transport	3.43	2010	The sum of expenditures under the category codes 26 and 27 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
National federal, regional, and municipal co-funding of ERDF measure support for multi-modal transport*	0.85	2010	The sum of expenditures under the category codes 26 and 27 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
National private co-funding of ERDF measure support for multi-modal transport*	0.25	2010	The sum of expenditures under the category codes 26 and 27 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
Total clean urban transport	2.07			
ERDF grants for clean urban transport	1.48	2010	The sum of expenditures under the category code 52 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
National federal, regional, and municipal co-funding of ERDF measure support for clean urban transport	0.49	2010	The sum of expenditures under the category code 52 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***
National private co-funding of ERDF measure support for clean urban transport*	0.09	2010	The sum of expenditures under the category code 52 in 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).	(European Commission 2010), 2009/2010 Länder reports on program implementation from the European Regional Development Fund (ERDF).***

Notes to the table:

* Budget codes are from GoG (2012c) and European Commission (2010).

** It was not clear if this national co-funding is included in the EUR 5 million "National federal, regional, and municipal co-funding of ERDF measures support for railways." Thus there is a potential double-counting of EUR 5 million.

*** 2009/2010 Länder Implementation Reports of ERDF (Baden-Württemberg Ministerium für Ländlichen Raum und Verbraucherschutz 2010; 2011; Bayerisches Staatsministerium für Wirtschaft 2010; 2011; Berlin Senatsverwaltung für Wirtschaft 2010; 2011; Brandenburg Ministerium für Wirtschaft und Europaangelegenheiten 2010; 2011; Hamburg Behörde für Wirtschaft 2010; 2011; Hessisches Ministerium für Wirtschaft 2010; 2011; Mecklenburg-Vorpommern Gemeinsame Verwaltungsbehörde - Verwaltungsbehörden für den EFRE ESF und ELER 2010; 2011; Niedersächsisches Ministerium für Wirtschaft 2011a; 2011b; Nordrhein-Westfalen Ministerium für Wirtschaft 2010; 2011; Rheinland-Pfalz Ministerium für Wirtschaft 2010; 2011; Saarland Ministerium für Wirtschaft und Wissenschaft 2010; 2011; Sachsen-Anhalt Ministerium der Finanzen 2010; 2011; Sachsen Staatsministerium für Wirtschaft 2010; 2011; Schleswig-Holstein Ministerium für Wissenschaft 2010; 2011; Senator für Wirtschaft und Häfen der Freien Hansestadt Bremen 2010; 2011; Thüringen Ministerium für Wirtschaft 2010; 2011).

Other notes:

1) The EU budget funding is also reported in Annex 1.
2) Two KfW programs, KfW Investment credit Municipalities (Investitionskredit Kommunen) and KfW communal investing (Kommunal Investieren) have been excluded from this table as the climate-related transport share from these programs could not be quantified.

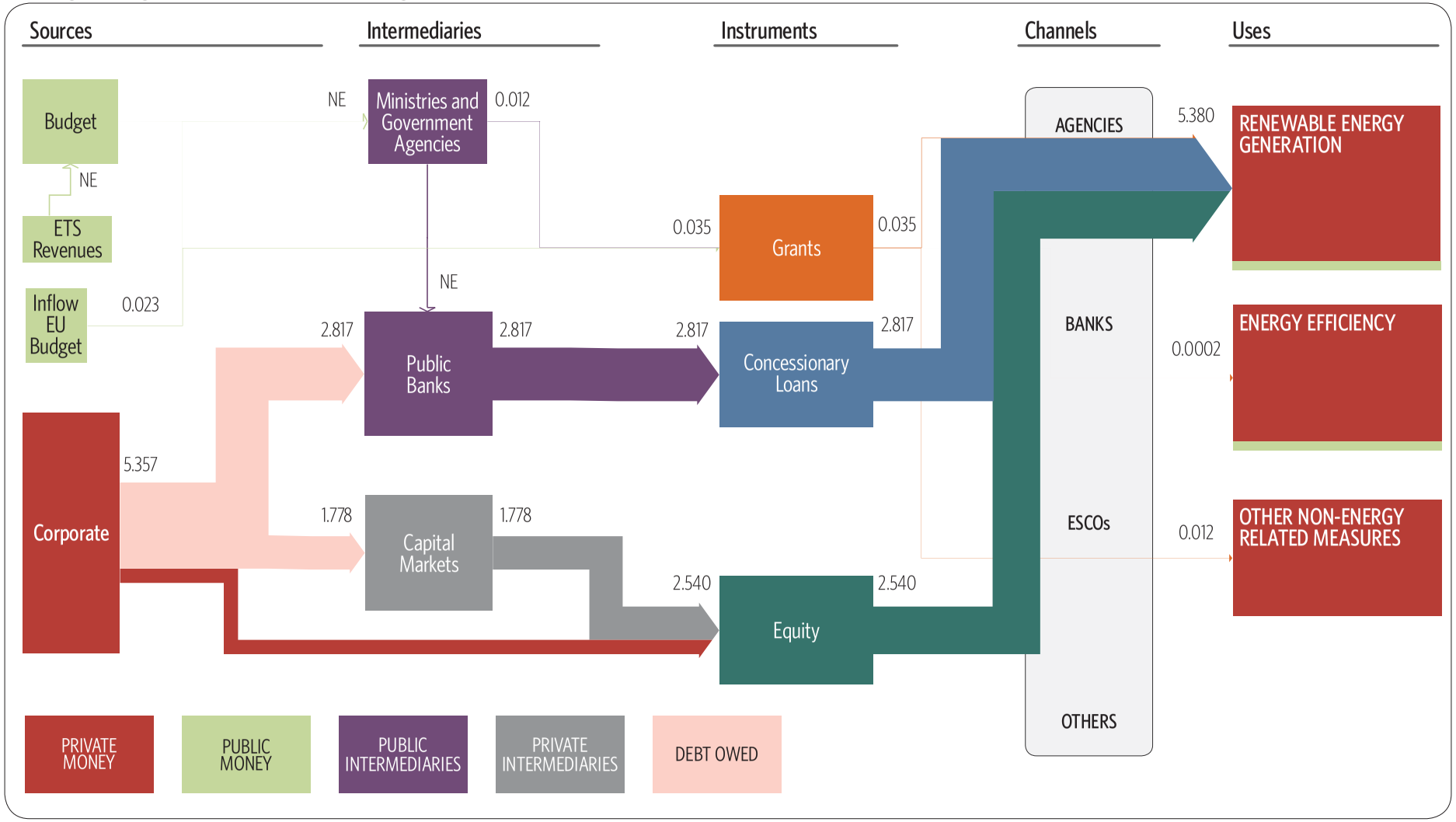
Annex 7. The Agriculture Sector

Key findings

1. **In 2010, total climate-specific investments in the German agriculture sector were around EUR 5.4 billion.**
   - While for renewable energy our estimates are based on full capital cost, other measures are represented by incremental cost.
   - EUR 5.3 billion was from private investors and less than EUR 0.035 billion was from public sources.
2. **Total capital investment in renewable energy accounted for the largest share of climate-specific investment (billion 5.4 EUR),** representing about 20% of total renewable energy investment in Germany. The only other climate-specific measure identified was afforestation of formerly non-forested land, which was supported by the EU and German public budget with EUR 0.01 billion of incremental support.
   - About 98% of renewable investments was private. Farmers were significantly supported by concessionary loans of EUR 2.3 billion from the Agricultural Rentenbank.[47]
   - Investments toward tangible energy-efficiency-related measures, while eligible for support under various broader budget lines, are not separately reported.
3. **Non-climate-specific agri-environmental land-use measures with climate change mitigation potential, received EUR 0.18 billion.**
   - Such measures are not focused on climate change mitigation, but they are very likely to reduce emissions from land-use (particularly N_2O) or to increase the sequestration of carbon in soils.
4. **Broadly defined budget lines make agricultural climate finance tracking challenging.** Besides figures for biomass and bioenergy,[48] neither the EU nor the German government (at all levels), nor the private sector report climate-specific investments in agriculture.
   - The ongoing discussions of the future 2014-2020 EU CAP[49] present an excellent opportunity for improving the monitoring and reporting of climate-specific finance in the agricultural sector.
   - Private renewable energy investment data was available from alternative sources.
5. **While the agriculture sector represents 7% of GHG emissions, neither the German energy concept nor relevant EU climate legislation foresee any target for GHG emission reduction.**

47 Additionally, EUR 0.5 billion was provided through KfW programs and other state banks.
48 Support for non-food energy and non-energy related uses of renewable resources.
49 EU CAP: The EU's Common Agricultural Policy represents the common policy framework for all EU member states (including Germany). The CAP governs the bulk of EU funds directed toward the agricultural sector.

Annex Figure 7-1: Agriculture sector climate finance diagram 2010, billion EUR



Notes:
GAK (the Joint Scheme "Improving agricultural structures and coastal protection") is the key domestic policy framework supporting agriculture and forestry, jointly administered and financed by national and state-level governments and municipalities. EU CAP: The EU's Common Agricultural Policy represents the common policy framework for all EU member states (including Germany). The CAP governs the bulk of EU funds directed toward the agricultural sector of the EU member states through the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Rural Development Fund (EARDF). For more information please see (European Commission 2012b). The broken lines indicate that emission reductions from investments in bioenergy from agriculture are accounted for in other sectors (defined as indirect measures, see Chapter 2).

Annex Table 7-1 : Climate finance in the German agriculture sector in 2010, million EUR

SOURCE	CLIMATE-SPECIFIC INVESTMENT (MILLION EUR)			CLIMATE-RELATED INVESTMENT MULTI-PURPOSE MEASURES (TOTAL CAPITAL COST)
	ENERGY EFFICIENCY (INCREMENTAL COST)	RENEWABLE ENERGY (TOTAL CAPITAL COSTS)	NON-ENERGY RELATED (INCREMENTAL COST)	
Total	**NE**	**5,380.0**	**11.7**	**>173.6**
Public	NE	22.6	11.7	173.6
EU	UNKNOWN	20.9	1.9	103.2
GAK	UNKNOWN	1.7	9.8	70.4
Private	NE	5,357	NE	NE

Note: Other non-energy related measures represent afforestation of formerly non-forested land.

Sector background: why care about investment?

The agriculture sector emitted 69.6 million tons CO_2-equivalent or 7% of the country's total GHG emissions in 2010 (UBA 2011b). Opportunities to reduce these emissions often involve changes in agricultural practices rather than investments in physical assets.

Substantial abatement potential exists particularly through land management, energy efficiency, and sustainable use of biomass for bioenergy and industrial feedstock. The Federal Environment Agency (UBA 2011a) also considers organic farming to have a significant energy savings potential over conventional farming.[50]

German agricultural policy and financing are dominated by the EU CAP and the GAK[51] policies. The German Energy Concept does not set explicit targets for agriculture but points to the potential opportunities for a more sustainable use of energy and for more efficient agriculture and forest management practices (BMWi and BMU 2010). Annex Table 7-1 shows a breakdown of climate finance.

Sector findings

Total climate-specific investment

In 2010, climate-specific investment[52] in agriculture amounted to EUR 5.4 billion, almost all of which went to renewable energy (calculated based on full capital cost), apart from EUR 0.01 billion of incremental support to afforestation of formerly non-forested land. EUR 0.18 billion went to non-climate-specific agri-environmental land-use measures with a potential for climate protection that could not be determined. Annex Table 7-1 provides the breakdown of "uses" into public EU, public German, and private sources.

Public financing of rural development is primarily based on the European Agricultural Fund for Rural Development (EAFRD), the joint federal and Länder task for agriculture and coastal protection,[53] and additional finance at the Länder and municipality level (BMELV 2012c). In addition there are direct payments from the European Agricultural Guarantee Fund (EAGF) (again requiring national co-funding), representing 14.1% of farm revenues in the year 2009/10 (Rentenbank 2011).

The process takes EU Funds to the Länder level, which is then disbursed via grants, co-financed by the Länder and the Federal Government, to the private sector. EU support for climate-specific measures in agriculture, and the co-financing of these measures from the federal, Länder, and municipal budgets, predominantly takes the form of grants, with varying private co-financing depending on the measure.

50 However, accounting for leakage effects on the energy balance of organic farming proves to be challenging (von Thünen Institut, vTI, personal communication).

51 GAK (the Joint Scheme 'Improving agricultural structures and coastal protection') is the key domestic policy framework supporting agriculture and forestry, jointly administered and financed by national and Länder governments and municipalities. See also BMELV 2012c.

52 Climate-specific investment refers to capital flows that target investments resulting in climate change mitigation or avoidance of emissions (see methodological Chapter 2 for details).

53 GAK: Joint Tasks „Improvement of the Agricultural Structures and Coastal Protection" [Gemeinschaftsaufgabe „Verbesserung der Agrarstruktur und des Küstenschutzes"].

Private investments into other climate change mitigation activities in the agricultural sector are not available. This is largely due to a lack of reporting requirements or incentives for investments in these types of activities, and the fact that some of the important climate change mitigation measures involve changes in agricultural practices and management rather than investments in physical assets[54].

Investment in renewable energy

Besides afforestation, renewable energy and resources represent the only climate-specific measures clearly reported in the national and EU budgets, in terms of investments into biomass and bioenergy (EUR 2.4 million from the EAFRD for renewables/biomass production, EUR 18.5 million from the EAGF for energy crops, and EUR 1.7 million from German public budgets. An additional EUR 50 million was spent by the BMELV on intangible investments (Research and Development, information and advisory programs, market introduction, etc.).

As mentioned above, investments in renewable energy amounted to EUR 5.4 billion (trend:research 2011). No robust quantitative information on private finance was available. The Rentenbank, which has been supporting agricultural investments in renewable energy and resources since 2005, provided concessionary loans of EUR 2.3 billion in 2010 (Rentenbank 2011), and the L-Bank (on behalf of the state of Baden-Württemberg) provided EUR 82.6 million worth of concessionary loans for renewable energy investments in the same year (L-Bank 2011).

The German Central Bank's statistics show a significant overall increase in lending to the agricultural sector, starting from early 2009 and peaking at a record EUR 40.3 billion in the last quarter of 2010. This can largely be explained by investments in renewable energy (Rentenbank 2011).

Investment in energy efficiency

Energy-efficiency-related activities are in principle eligible for public financing under different budget lines, including investments in greenhouses, pig stables, efficient tractors, etc., but neither public nor private climate-specific investment is separately reported.[55] One example of this non-climate-specific type of investment is the agricultural investment program (EUR 0.268 billion from EU and German public budgets in 2010), which largely consists of investments in farm buildings (including stables and greenhouses) and machinery (BMELV 2012a, Table 3.1).

Other investment

Afforestation of previously unforested land[56] received a small share of <15% of total public climate-specific finance, equivalent to EUR 11.7 million (of which 16% EU and 84% German funds). No private investment data was available.

Direct emission reductions in the sector are dominated by non-climate-specific land-use related measures (as part[57] of the agri-environmental measures[58]) with likely co-benefits in terms of emission reductions. However, the exact effect on GHG emissions and carbon sequestration cannot be determined. The most relevant measures received EUR 173.6 million of public funding in 2010 (60% EU, 40% German funds), of which EUR 103.2 million (including EUR 74.5 million for organic farming) is from the European Agricultural Fund for Rural Development (EAFRD), and EUR 70.4 million (of which EUR 60 million is for organic farming) from the GAK (BMELV 2012a, Table 1-1).

Intangible climate-specific measures under the GAK include a EUR 0.45 million energy advisory program (BMELV 2012a, Table 4). BLE, vTI and FNR are federal agencies for agriculture and food (BLE); for agricultural research (vTI) and for renewable resources (FNR). They are generally involved in the provision or execution of intangible programs (such as research activities, including activities related to climate change), but do not disburse finance for investments in tangible climate-specific assets. As the focus of this study is on tangible investments, the intangible programs have not been comprehensively assessed, as they are not being centrally tracked or reported.

54 While for measures driven by investments in physical assets investments costs represent a significant share of total costs, for the measures driven by changes in management practice, opportunity costs from potential reductions in yields and foregone revenues represent a more adequate measure of cost. These potential opportunity costs (plus the value of potential environmental services including carbon sequestration or emission reductions) are implicitly reflected in the agri-environmental subsidies.

55 Besides a EUR 0.45 million Energy advisory program (BMELV 2012a, table 4), see also "intangible measures" below.

56 "First afforestation" [Erstaufforstung] represents afforestation measures on (mostly agricultural) land not formerly forested. Other forestry measures were not included in this report.

57 See list of agri-environmental measures included in Annex Table 7-2 below.

58 In total, agri-environmental measures were supported with a total of EUR 577 million from EU and German public sources (BMELV 2012a). They commonly fulfill biodiversity, water and climate change related objectives (Tietz 2010).

Discussion of results

In summary, the lack of detailed reporting and the very broadly defined budget lines (such as direct payments under the GAK and EAGF or agricultural investment (GAK and EAFRD), as well as the climate relevance of multiple-purpose measures (such as those supported with agri-environmental payments) and non-investment type land-use management measures make the tracking of climate-specific finance in agriculture very challenging.

The dominance of the private sector (in our results) is explained solely by the high private investment in renewable energy.

The dominance of renewable energy in our results for climate-specific investments coincides with availability of information about renewable energy from different sources. Moreover, renewable energy is different from most other relevant types of mitigation measures in this sector in that it can be clearly identified as climate-specific and as an investment-driven rather than a change-of-management-practice-driven mitigation measure. The same, however, holds for energy efficiency, which underlines the scope for improved reporting in this area.

The ongoing discussions at EU level about the future of the CAP present an excellent opportunity for addressing the lack of transparency and for improved reporting of climate-specific investments and subsidies.

While no representative survey data or other types of evidence are available to confirm this point, it is probably fair to say that the absence of any concrete targets at EU or national level for direct and indirect emission reductions from agriculture plays a role in explaining the absence of any comprehensive, systematic reporting of climate-specific investments in this sector. Whether it will be the reporting that will drive climate change mitigation policy objectives for the agricultural sector or whether it will be ambitious general European and German climate policy objectives that will translate into sector specific targets and more transparent reporting of public and private investments, remains to be seen.

Sector methodology

We tried to gather and identify data and information in relation to sources and end-uses, intermediaries, and instruments of climate specific investments in intangible assets. For each number included in the German Climate Finance Landscape, we summarize the relevant assumptions and data sources in Annex Table 7-2.

Sector definition and boundaries

The agriculture sector is defined according to the WZ2008 scheme class A (Agriculture, forestry and fishing), including all of agriculture, but excluding fisheries and forestry except afforestation of previously non-forested land.

Sources and Uses

Sources for information and methodologies included: EU and the German agriculture ministry (BMELV) websites for overall background and identifying general budget lines, reports and studies on relevant climate change measures in agriculture,[59] discussions with national and EU sector experts, and assumptions on relevant climate-related measures under broader categories, such as agri-environmental payments or land-use related categories. BMELV provides aggregate budget tables for GAK disbursement for 2010 on its website. EU support from the EAGF is reported by the European Commission (European Commission 2011b). Data on agricultural renewable energy investments were derived from trend:research (2011), see Annex Table 3-4 for details.

Intermediaries

Data from the public budget allowed identifying the respective ministries that acted as intermediaries. Where an intermediary could not be determined, for instance for private investment, we mapped the financial flow directly to the corresponding instruments (e.g. concessionary loans, debt, equity, grants). Debt-based finance was associated with the capital market.

Instruments

Information on the use of concessionary loans for renewable energy was available from the annual report of the agricultural Rentenbank and L-Bank or estimated as specified in Annex Table 1-2 on KfW programs. The remaining investments are treated as 100% equity (see 1 for more details).

59 The reports include references to their corresponding EU budget line, defined by so called "measures codes". The federal agricultural research institute (VTI) provided a number of background studies. Two studies were also available from the BMELV and UBA websites.

Annex Table 7-2: Assumptions used for evaluation of finance in the agriculture sector

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
Finance from federal budget and public banks				
Concessionary loans from the agricultural Rentenbank for renewable energy investments in the agriculture sector	2,322	2010	• This number (among other numbers) is used for calculating the use of concessionary loans for renewable energy in general and for agricultural investors in particular. The total renewable energy investment figure is taken from other sources and does not build on this number.	(Rentenbank 2011).
BMU NKI - Energy Efficiency in Agriculture (BMELV)	0.2	2010	• See Annex Table 1-1, the line Energy efficiency in agriculture and farming.	Annex Table 1-1.
KfW Renewable Energy Standard and Premium Programs [*Eneuerbare Energien Standard und Premium*]	412.8	2010	• Please see Annex Table 1-2.	Annex Table 1-2.
Rural Energy Program [*Energie vom Land*]	82.6	2010	• Calculated from total agricultural lending (see p.30, L-Bank 2011) This number (among other numbers) is used for calculating the use of concessionary loans for renewable energy in general and for agricultural investors in particular. The total renewable energy investment figure is taken from other sources and does not build on this number.	(L-Bank 2011, Budget Line "*Energie vom Land*").
GAK NRR 4.2.2.1 and NRR 4.2.2.3: "First afforestation" of agricultural and other areas" (i.e. of previously unforested land) [*Erstaufforstung landwirtschaftlicher und sonstiger Flächen*] (corresponds to national co-financing of EAFRD measures 221 and 223)	9.8	2010	• 2010 table was provided directly by BMELV and is available online now (27 November 2012).	(BMELV 2012a, Table 12).
GAK NRR 4.3.1.1.1: „Renewable energy" under "Support to investments into diversification" [*Einzelbetriebliche Förderung landwirtschaftlicher Unternehmen. Förderung von Investitionen zur Diversifizierung*] (corresponds to national co-financing of EAFRD measure 311)	1.3	2010	• 2010 table was provided directly by BMELV, and is available online now (27 November 2012).	(BMELV 2012a, Table 3.2).
GAK NRR 4.3.2.1.1.2: „Biogas and local heat distribution" [*Biogas und Nahwärmeleitungen*] under "Integrated Rural development" [*Integrierte ländliche Entwicklung*]	0.37	2010	• 2010 table provided by BMELV and is available online now (27 November 2012). EU support for this measure in 2010 was zero, hence no separate row for the EU share.	(BMELV 2012a, Table 1n *Biogas und Nahwärmeleitungen*).

Notes:
NRR: Codes according to the national framework of Germany for rural development (Nationale Rahmenregelung der Bundesrepublik Deutschland für die Entwicklung ländlicher Räume)

PROGRAM/MEASURE	VALUE (EUR MILLION)	YEAR	METHODS/ASSUMPTIONS/LIMITATIONS	REFERENCE
GAK NRR 4.2.1.4: Measures A1, A2, A3, A4, B2, C, and D under "Agri-environmental measures" (corresponds to national co-financing of EAFRD 214)	70.4	2010	2010 table was provided directly by BMELV, and is available online now (27 November 2012). Agri-environmental measures are included under land-use-related measures [Markt- und standortangepasste Landbewirtschaftung (MSL)]. Measures included under the numbers in this chapter as climate-related: • A.1: Fruchtartendiversifizierung im Ackerbau, • A.2: Anbau von Zwischenfrüchten oder Untersaaten im Ackerbau oder Begrünung von Dauerkulturen, • A.3: Anwendung von Mulch- oder Direktsaat oder Mulchpflanzverfahren im Ackerbau, • A.4 Ausbringung flüssiger Wirtschaftsdünger mit besonders umweltfreundlichen Ausbringungsverfahren, • B.2: Förderung extensiver Grünlandnutzung, Umwandlung von Ackerflächen in extensiv zu nutzendes Grünland, • C: Förderung ökologischer Anbauverfahren, • D: Förderung der mehrjährigen Flächenstilllegung Outside GAK there are further agri-environmental measures that are not covered by the GAK-statistics and are hence not covered in this study.	(BMELV 2012a, Table 11).
Finance from the EU budget				
EAGF: Energy crop production	18.5	2010	• The aid for energy crop production (code 05030201) as reported by the EAGF financial report 2010 was the only budget line of the EAGF included as climate finance (see also Annex 1 for more information). • The format of the financial report did not allow extracting other climate-specific or -related expenditures of the EAGF.	(European Commission 2011b).
EAFRD 311: "Renewable energy," under "Diversification into non-agricultural activities" (corresponding with NRR 4.3.1.1.1)	2.4	2010	• 2010 table was provided directly by BMELV and is available online now (27 November 2012). Correspondence of ELER and GAK budget lines is based on the handbook for ELER/GAK reporting 2007-2013 (p. 20 in Bund-Länder-Unterarbeitsgruppe Monitoring/Indikatoren 2011).	(BMELV 2012a, Table 3.2).
EAFRD 221 and 223: "First afforestation of agricultural land and of non-agricultural land" (i.e. of previously unforested land), (corresponding with NRR 4.2.2.1 and 4.2.2.3)	1.9	2010	• See EAFRD 311 (above).	(BMELV 2012a, Table 12).
EAFRD 214: "Agri-environmental measures" (corresponding with GAK NRR 4.2.1.4)	103.2	2010	• See GAK NRR 4.2.1.4 (above).	(BMELV 2012a, Table 11).
Private investors				
Corporate investment into renewable energy	2,540	2010	• The investment was estimated as a difference between the total sector investment into renewable energy (calculated based on (trend:research 2011), see Annex Table 3-4 for details) and the sum of concessionary lending (provided above).	(trend:research 2011), Annex 3.

Annex 8. References to All Annexes

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