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Official Data on Investments in Environmental Protection

Data Documentation (2005 - 2016)

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1 Introduction

The *Research Data Centers of the Statistical Offices of the Federation and the Federal States* (RDCs) make a large variety of micro-level data sets on German firms, the *Amtliche Firmendaten in Deutschland* (AFiD) available. The *official data on investments in environmental protection* (IEP data) is one of those *AFiD* modules and records the annual investments in environmental and climate protection in Germany.[1] It is a primary survey conducted by *the Statistical Offices of the Federal States* and aims to provide a profound data basis for future environmental policy decisions (RDCs 2020a). The data set is an official statistic to which most firms and plants in the manufacturing sector are legally obliged to report their sustainable investments. It surveys the different types of environmental investments and reports the investment volume annually. The data is subject to several plausibility checks, which ensure high data quality (RDCs 2020a). This comprehensive data set is a valuable data source since it provides a broad picture of the investment in environmental and climate protection in Germany. It allows the user to track the development of different types of sustainable investments over time and reports information on the investing firm. The IEP data is a complete survey with cut-off limits which only exclude small firms. Hence, empirical studies based on the IEP data can benefit from a high external validity.

This data documentation describes the content of the *official data on investments in environmental protection*. As the data set is not publicly available, it is important to give some insights into the IEP data to researchers and other data users without access. Besides providing a definition of all variables contained and some further descriptive analysis, the documentation draws attention to particularities in the structure of the data set and some variables. It joins a series of other data documentations on other *AFiD* modules.[2] Also, the complete source codes on which the IEP data documentation is based are freely accessible for future data users as open-source code.[3]

The data documentation is structured as follows: After this introduction, Section 2 explains the structure of the IEP data set in greater detail. It explains the difference between the firm- and plant-level in the data set, provides information on their main economic activity, and describes sample sizes. Section 3 explains the different data access options. Section 4 reports the content of the IEP data in detail. In separate subsections, each group of variables is introduced, the number of cases per variable is presented, and some descriptive analyses are shown. Section 5 closes with an overview of different merge possibilities with other *AFiD* modules.

[1] From here on, the term sustainable investments summarizes the investments in environmental and climate protection.

[2] There are data documentations on the *AFiD* module on energy supply companies (Stiel 2015), water companies (Zschille 2016), and on the statistics of annual accounts of public funds, institutions, and enterprises (Wägner 2017).

[3] All codes are available on GitLab under https://gitlab.com/modern-state-owned-firms/data/data-documentation-environmental-protection.

2 Structure of the Data Set

2.1 Observation Period

The *official data on investments in environmental protection* is based on the questionnaire *Erhebung der Umweltschutzinvestitionen (EVAS 32511)*, which is an annual survey covering the years 2003 to 2017. This data documentation covers the years 2005 to 2016.[4] Data users can extend their data set to the whole time period available. When including the years before 2006, it is important to know that the questionnaire has been changed in 2006. Until 2005 the investment data was collected in greater detail; since 2006 only the total investments in different fields are included.[5] Also, the year 2017 is now available and can be merged to the existing data set without further adaption.

2.2 Reporting Entities

The data is collected on both firm- and plant-level in separate data sets.[6] Firms and plants get the same questionnaire so that each variable is available on both levels. Each plant has a unique plant and a firm identifier (ID) that points to the firm the plant belongs to. Using the firm ID and the year as identifiers, both data sets can be merged. A firm can have no, one, or several plants, and each plant is uniquely assigned to a firm. If a plant appears twice in a particular year and is assigned to two firms, the plant is sold from one firm to another. Users should check for this possibility to avoid the emergence of duplicates during the merging process.
The IEP data set contains information on all the entities in the manufacturing sector investing in environmental and climate protection. The manufacturing sector includes all entities which are active in one of the following economic fields:

- B: mining and extraction of stones and earths
- C: manufacturing industry
- D: energy supply industry
- E: water supply industry, including sewage and waste management, and environmental pollution elimination

The assignment of the units[7] to the manufacturing sector is based on the classification system of economic activities, the *WZ 2008* categories. It follows the systematics of the classification system of the European Union, NACE Rev. 2 (Statistisches Bundesamt 2008a).[8] The units are categorized to the *WZ 2008* categories according to their main economic activity (RDCs 2020a).
According to the RDCs (2020b), the IEP data covers the universe of firms and plants above specific cut-off values. Including all units that are not affected by the cut-off limit, the IEP data is a representative database for Germany. Depending on the assigned economic sector, different cut-off values rule which firms are included in the survey. For categories B and C, all firms with more than 20 employees enter the survey. All firms of category D are included, and firms of category E are part of the survey when their annual water discharge or sewage disposal exceeds 200,000 m^3. Firms in the waste management sector are only included if their annual sales exceed EUR 1 M (RDCs 2020a). All associated plants of a firm are included when the firm itself is required to report to this survey.

[4] The remaining years were not purchased as part of our project and hence were not accessible when the analysis for data documentation was conducted.

[5] For more information compare the lists of variables for the years 2003 - 2005 (RDCs 2005) and for the years 2006 - 2017 (RDCs 2020b).

[6] While a firm is the smallest unit obliged to keep accounts, a plant is a locally limited unit of production of a firm (RDCs 2020b).

[7] A unit can either be a plant or a firm, depending on whether the firm or plant data set is used.

[8] For more information and a complete listing of all *WZ 2008* categories see Statistisches Bundesamt (2008a). If users want to include 2003 to 2004, the data set may contain the *WZ 2003* classification. For the crosswalk files from *WZ 2003* to *WZ 2008* see Statistisches Bundesamt (2008c).

2.3 Size of the Data Set

Table 1 shows the annual number of firms and plants participating in the survey. Firms and plants are only covered in the database if they invest in environmental protection in a given year. Table 2 reports the year in which a unit enters the data set for the first time, and Table 3 shows how many years a unit remains in the data set. About 53 % of the plants and firms only appear once in the IEP data, and less than 1 % of the units report investments in environmental and climate protection every year. Moreover, data users should be aware that units do not necessarily stay continuously in the sample. About 31 % of all firms and 32 % of all plants are not continuously included in the data set. In summary, IEP data is an unbalanced panel data set and can be analyzed as a cross-sectional data set or panel data set (RDCs 2020b).

Table 1: Number of observations

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	31374	5258	4807	6397	6060	6997	7887	7647	9018	9698	10042	10204
No. plants	37957	6314	5608	7426	7127	8216	9328	9122	10525	11303	11839	11995

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Table 2: Year of entrance

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	31374	1265	801	2293	1003	1156	1161	941	1352	1447	1250	1099
No. plants	37957	1364	802	2597	1192	1329	1280	1094	1414	1595	1386	1282

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Table 3: Duration in the sample

No. years	1	2	3	4	5	6	7	8	9	10	11	12
No. firms	24111	7168	3908	2500	1732	1305	1141	900	1230	444	405	298
No. plants	28347	8406	4656	2924	2099	1625	1388	1106	1420	515	474	332

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

3 Data Access

The *official data on investments in environmental protection* is, as the other *AFiD* modules, subject to specific data protection regulation. Since all companies in the manufacturing sector investing in environmental protection are obliged to participate in this survey, the German legislator ensures in return that no conclusion can be drawn about the individual unit (RDCs 2020b).[9] To comply with the legal requirements, the IEP data is only accessible via the RDCs of the *Statistical Offices of the Federation and the Federal States*. Data users can access the data set for on-site use and conduct their analyses using the RDCs' visiting scientist workplace (GWAP) or use the controlled data remote processing (KDFV).

When working at **GWAP**, the researcher has access to a formally anonymized data set. Here, the unit's identifier is replaced with a system-free numeric ID to secure the company's anonymity (RDCs 2020b). Hence, the variable name of the unit's ID can differ from those in the original data set.[10] Data users should check for this possibility and adapt their codes depending on whether they want to execute them at GWAP or KDVF. Moreover, the data available at GWAP does not contain any information on units located in Bavaria. Apart from these constraints, researchers can run their analysis independently at GWAP. After completion of the analysis, the results are subject to an

[9] This is set out by law in § 16 German Federal Statistics Act (*Bundesstatistikgesetz*).

[10] See Section 4.1 for the different variable names at GWAP and KDFV for the IEP data.

audit by the RDC to ensure that data protection requirements are respected.[11]
When using the **KDFV**, the complete data set, including the Barvarian observations, is available. However, data users cannot conduct their analysis themself. They send their prepared programming code to the contact person of the RDC, which executes it. Only the computed results of their research can be viewed by the researchers as long as they fulfill the data protection requirements.[12] The data set itself is not visible to the researcher when working with controlled data remote processing.

4 Content of the Data Set

The variables of the IEP data set can be grouped into six categories introduced in the following subsections. Because the questionnaire is identical for firms and plants, the introduced structure applies to both data sets.

4.1 Unit Identifier

The first category of variables contains the unit ID, either a firm or a plant ID, and the year of observation. Table 4 summarizes the variables of this category. The ID variable contains an anonymized identification number, allowing identification of the same unit during the observation period. Neither the firm nor the plant data contain a unit without an ID. In the plant data set, the variable EF 35 points to the ID of the associated firm (EF 1) in the firm data set.[13] Hence, this variable can be used to merge the plant with the firm data. The unit ID (EF 1) can also be used to merge the IEP data to further *AFiD* modules. Section 5 provides more information on the merging procedure and the case numbers of successful merges.

Table 4: Overview: unit identifier

Variable		Description
KDFV	GWAP	
EF 1	EF 1_pseudo	Anonymized unit ID (firm or plant ID depending on the data set level)
EF 27	EF 27	Year of observation
EF 35	EF 35_pseudo	ID of associated firm

Note: The table is based on the questionnaire in RDCs (2020b).

4.2 Variables on Environmental Protection Investments

4.2.1 Variable Description

The IEP data holds comprehensive information on the unit's investments in environmental protection. These include all investments that exclusively or primarily aim to reduce the unit's environmental impact or increase the efficient use of resources (RDCs 2020a). The data distinguishes between different cases of investment spending. The RDCs (2020a) describe the fields of investments in environmental protection as follows:

- Investments in the area of **waste avoidance** include investments that intend to reduce, reuse and recycle waste according to the recycling and waste management act (Kreislaufwirtschafts- und Abfallgesetz (KrW-/AbfG))[14].
- The field of **sewage avoidance** includes all investments that reduce or avoid wastewater volume and load.
- All investments in **noise protection** either reduce noises or protect against vibrations.
- Investments in **clean air protection** aim to reduce local air pollutants like particulate matter, aerosols, vapors, or odorous substances.

[11] For detailed information on the data protection requirements, see RDCs (2022).
[12] For detailed information on the data protection requirements, see RDCs (2022).
[13] In the firm data set the variables EF 1 and EF 35 are identical.
[14] The Kreislaufwirtschafts- und Abfallgesetz was replaced by the Kreislaufwirtschaftsgesetz (KrWG) in June 2012

- Investments that maintain, restore, or redesign the natural appearance of soil and vegetation belong to the field of **species and landscape protection**.
- Investments in measures that prevent the infiltration of pollutants in groundwater and surface waters, as well as their cleaning from such, are part of the investment in **soil protection, groundwater and surface waters protection**. Investments to protect the soil from pollution, salinization, erosion, and further physical degradation also belong to this field.

For each intended use case, the total investments are split in investments in additive measures and integrative measures. **Additive measures** are added downstream assets that are separated from the remaining production process and explicitly protect the environment. Examples of additive measures for clean air protection are air filters. **Integrative measures** directly reduce the emissions in the production process (RDCs 2020a). Sometimes a changeover in the entire production process leads to a reduced environmental impact, but this improvement cannot be assigned to a specific component. When the costs of the measures responsible for enhancement cannot be accurately specified, only qualified estimates are reported (RDCs 2020b). This may lead to inaccuracy.
Table 5 describes all variables on environmental protection investments. It reports different variable names for the observation period 2003 to 2005 and the observation period 2006 to 2016.[15] The data set for 2003 to 2005 does not contain a variable for the total investments in a specific field. However, it can be calculated as the sum of investments in additive and integrative measures. All variables recording investments in environmental protection are measured in EUR.

Table 5: Overview: variables on environmental protection investments

Variable 2003 - 2005	Variable 2006 - 2016	Description
	Waste avoidance	
-/-	EF 2	Total investments [EUR]
EF 117	EF 3	Investments in additive measures [EUR]
EF 252	EF 4	Investments in integrative measures [EUR]
	Sewage avoidance	
-/-	EF 5	Total investments [EUR]
EF 150	EF 6	Investments in additive measures [EUR]
EF 254	EF 7	Investments in integrative measures [EUR]
	Noise protection	
-/-	EF 8	Total investments [EUR]
EF 168	EF 9	Investments in additive measures [EUR]
EF 256	EF 10	Investments in integrative measures [EUR]
	Air pollution control	
-/-	EF 11	Total investments [EUR]
EF 200	EF 12	Investments in additive measures [EUR]
EF 258	EF 13	Investments in integrative measures [EUR]
	Species and landscape protection	
-/-	EF 14	Total investments [EUR]
EF 228	EF 15	Investments in additive measures [EUR]
EF 260	EF 16	Investments in integrative measures [EUR]
	Soil protection, groundwater and surface waters protection	
-/-	EF 17	Total investments [EUR]
EF 246	EF 18	Investments in additive measures [EUR]
EF 262	EF 19	Investments in integrative measures [EUR]

Note: The table is based on the questionnaire in RDCs (2020b).

[15] All variables start with the prefix *EF* in the published list of variable characteristics. In the provided data set at the RDCs, all variables start with the prefix *uiu_* when belonging to the firm-level data set and with the prefix *uib_* when belonging to the plant-level data set.

4.2.2 Number of Cases

All variables recording the investments in environmental protection contain missing values. The following section describes the number of cases per year per variable. Some units report zero investments in a particular field, which means these units do not invest in this field. That is equivalent to a unit reporting a missing value in the same variable. Because these zero entries do not contain any other information, they are replaced by a missing value before this analysis. This applies to the investments in environmental protection and all other investment variables presented in the following sections of this data documentation. Table 6 shows the number of cases for the firm-level data, and Table 7 shows the same for the plant-level data set.

Table 6: Number of cases: firm-level investments in environmental protection

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	31374	5258	4807	6397	6060	6997	7887	7647	9018	9698	10042	10204
Waste avoidance												
EF 2	809	1470	1407	1866	1721	2059	2263	2275	2711	3167	3134	3315
EF 3	672	1131	1098	1529	1381	1679	1831	1862	2208	2451	2259	2483
EF 4	203	471	431	481	457	518	592	595	702	1006	1195	1172
Sewage avoidance												
EF 5	1321	2005	1878	2773	2638	2919	3206	3080	3451	3472	3502	3349
EF 6	1150	1518	1462	2316	2266	2496	2717	2586	2872	2763	2683	2574
EF 7	322	740	633	701	572	672	741	720	822	1052	1222	1111
Noise protection												
EF 8	553	951	888	870	666	739	828	803	951	939	961	929
EF 9	443	622	553	594	455	497	568	581	663	659	618	593
EF 10	156	400	395	341	254	295	318	283	355	347	410	399
Air pollution control												
EF 11	1383	2002	1873	1894	1544	1728	2015	1880	2275	2286	2372	2473
EF 12	1094	1331	1321	1339	1121	1267	1463	1362	1655	1683	1612	1667
EF 13	437	874	755	764	571	659	731	702	804	796	961	1027
Species and landscape protection												
EF 14	122	340	326	340	343	379	461	425	561	582	564	386
EF 15	92	269	258	261	264	307	378	340	443	473	430	296
EF 16	35	81	84	95	94	95	102	105	142	146	163	114
Soil protection, groundwater and surface waters protection												
EF 17	79	257	243	226	225	236	311	305	355	384	348	929
EF 18	60	201	181	186	190	184	236	236	278	310	254	713
EF 19	24	66	71	44	39	63	88	80	83	94	107	280

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Both tables show similar patterns. The number of firms and plants investing in environmental protection increases over time, independently of the field of usage. While the number of units investing in *waste avoidance*, *sewage avoidance*, *noise protection*, and *air pollution control* is reasonably high, the number of units investing in *species and landscape protection*, or *soil protection, groundwater and surface waters protection* is relatively low. In 2008, the number of units investing in *waste* and *sewage avoidance* increased significantly. This is due to the change in the classification system of economic activities, which changed from the *WZ 2003* to the *WZ 2008* categories. As a consequence, the number of units belonging to the manufacturing sector increased.
Moreover, more units invest in additive measures than in integrative measures. This can be explained by the fact that an additive measure can be implemented more quickly in a running production process because it is an end-of-pipe modification. Therefore, it is realized more often. In contrast, the implementation of an integrative measure needs to be included in the production process.

Table 7: Number of cases: plant-level investments in environmental protection

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. plants	37957	6314	5608	7426	7127	8216	9328	9122	10525	11303	11839	11995
Waste avoidance												
EF 2	930	1642	1589	2119	1960	2387	2652	2699	3197	3750	3739	3875
EF 3	768	1268	1233	1750	1568	1950	2139	2189	2527	2790	2635	2859
EF 4	226	496	486	523	510	595	681	701	878	1256	1425	1366
Sewage avoidance												
EF 5	1604	2299	2218	3285	3133	3497	3854	3706	4111	4092	4196	3979
EF 6	1372	1727	1707	2735	2666	2942	3229	3086	3361	3240	3198	3048
EF 7	390	832	752	803	679	843	911	872	1014	1203	1406	1279
Noise protection												
EF 8	605	1009	968	947	727	824	950	899	1054	1047	1069	1008
EF 9	475	645	597	631	488	536	646	630	720	702	683	623
EF 10	174	426	437	375	276	342	373	331	401	410	454	452
Air pollution control												
EF 11	1668	2325	2195	2215	1821	2074	2349	2230	2554	2555	2687	2769
EF 12	1308	1536	1533	1547	1301	1499	1693	1609	1850	1848	1825	1825
EF 13	513	978	856	881	664	795	858	815	920	912	1071	1161
Species and landscape protection												
EF 14	153	373	370	371	361	426	492	481	612	633	631	423
EF 15	107	293	285	273	274	336	393	375	454	498	464	303
EF 16	48	93	99	111	100	126	118	121	178	166	197	144
Soil protection, groundwater and surface waters protection												
EF 17	84	267	243	243	235	264	331	333	356	382	367	997
EF 18	63	204	179	202	196	189	249	254	271	305	270	771
EF 19	24	72	72	44	41	82	94	87	85	94	110	285

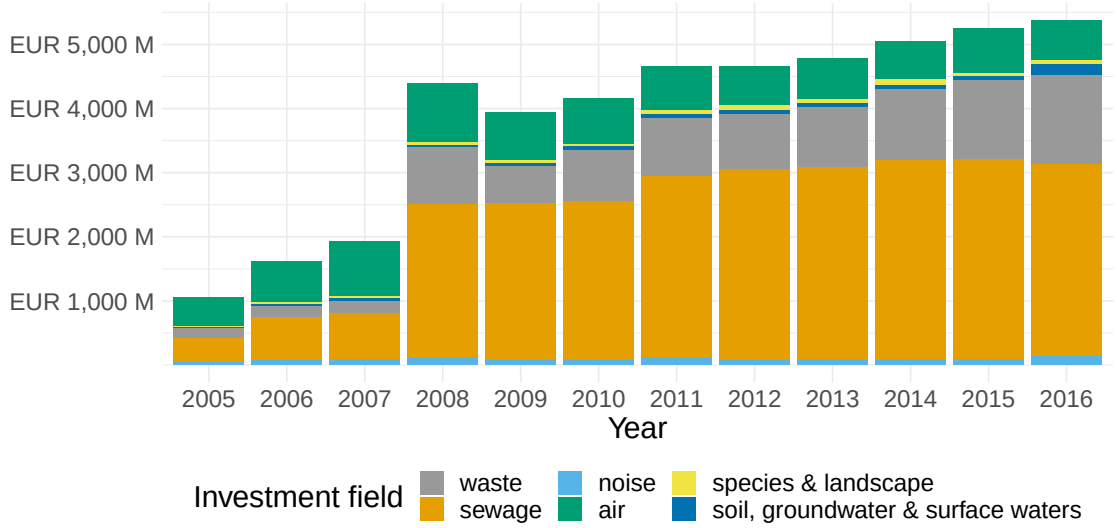
Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

4.2.3 Descriptive Analysis

Figure 1 shows the sum of firms' annual investments in environmental protection. The annual investments are split according to their intended field of usage. To ensure comparability across years, all investment variables are deflated by the producer price index (PPI).[16] The total annual investments in environmental protection increase steadily during the observation period.[17]
The largest share of annual investments is used to avoid sewage. While the share varies between 35 % and 41 % in 2005 to 2007, it significantly increases afterwards and remains stable at a high level. In 2012, it adds up to 64 % of the total investments in environmental protection. The abrupt rise of investments in *sewage avoidance* in 2008 is due to the change in the classification system of economic activities. From 2008 on, units that are active in the waste and wastewater management sector belong to the manufacturing sector (RDCs 2020b) and hence, are included in the IEP data. All taken investments of the waste and wastewater management industry are declared as investments in environmental protection (RDCs 2020a).[18] Investments in *waste avoidance* and *clean air protection* are the second and third largest investment fields. Investments in *noise protection*, *species and landscape protection*, and *soil, groundwater and surface waters protection* play a minor role. They contribute to the total environmental investments only by 4 % to 7 %.

[16] The PPI is provided by Statistisches Bundesamt (2008b). The base year is 2010.
[17] Figure A.1 depicts plants' annual investments in environmental protection in the appendix. Figure 1 and Figure A.1 show the same investment trend.
[18] Only investments in the unit's administration are excluded (RDCs 2020a).

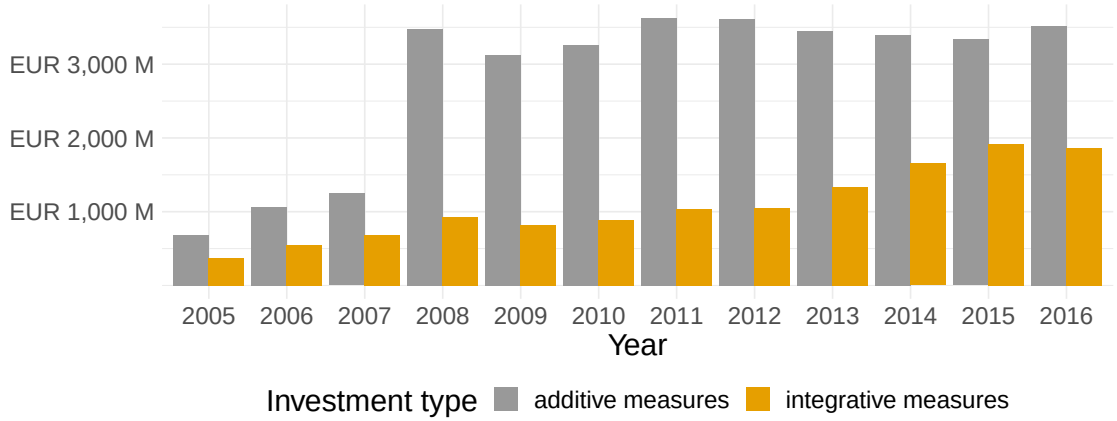
Figure 1: Firms' annual investments in environmental protection - field of investments



The figure depicts the annual investments in environmental protection of all firms. The investment division is done according to the variables EF 2, EF 5, EF 8, EF 11, EF 14, and EF 17. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Figure 2 depicts the firms' annual investments in additive and integrative measures.[19] The amount invested in additive measures exceeds the investments in integrative measures at any time. Investments in additive measures increase steadily from 2005 to 2007 and rise sharply in 2008. This coincides with the adaption of the classification system of economic activities and the inclusion of new units in the survey. After 2008, it seems that the investments in additive measures remain stable at a high level. When looking at the investments in integrative measures, the positive trend remains throughout the whole observation period.

Figure 2: Firms' annual investments in environmental protection - type of investments



The figure depicts the annual investments in environmental protection of all firms included in the IEP data set. It distinguishes between investments in additive and integrative measures. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

[19] Table A.2 reports the same results for the plant data set in the appendix.

4.3 Variables on Climate Protection Investments

4.3.1 Variable Description

The IEP data distinguishes between investments in environmental protection and climate protection. Further, the RDCs (2020b) divides the investments in climate protection into three categories:

- **Investments to reduce greenhouse gas emissions** summarize all investments aiming at lowering greenhouse gas (GHG) emissions, including carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorinated hydrocarbons, and sulfur hexafluoride.
- **Investments in renewable energies** are investments in hydroelectric power, wind power, solar power, geothermal energy, and energy from biomass.
- **Investments to increase energy efficiency and to save energy** include, e.g., investments in heat pumps, insulation, and efficient grids. When investing in new assets, only the part of an investment that is responsible for the increase in energy efficiency is considered. Therefore, the improved efficiency rate of a new asset is compared to the efficiency rate of a comparable average asset. This improvement is valued monetarily. Data users should note that the value reported here is only an estimate.

Table 8 summarizes the variables on climate investments. They are available in the IEP data since 2006. In contrast to the variables on environmental protection, the total investments in climate protection are not divided into investments in additive and integrative measures because both types' delimitation is too challenging (RDCs 2020b).

Table 8: Overview: variables on climate protection investments

Variable	Description
EF 20	Investments to reduce greenhouse gas emissions [EUR]
EF 21	Investments to use renewable energies [EUR]
EF 22	Investments to increase energy efficiency and to save energy [EUR]

Note: The table is based on the questionnaire in RDCs (2020b).

4.3.2 Number of Cases

Table 9 and 10 show the number of units reporting investments in climate protection at the firm- and plant-level. Similarly to the investments in environmental protection, both tables show increasing numbers of units.
Most units report investments in measures to increase energy efficiency, and the number of units increases over time. The number of units investing in reducing GHG emissions is lower than those investing in energy efficiency, but it follows the same positive trend. Also, the number of units investing in renewable energy sources increase until 2011. Afterwards, the number stagnates and even slightly decreases from 2014 onwards.

Table 9: Number of cases: firm-level investments in climate protection

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	5258	4807	6397	6060	6997	7887	7647	9018	9698	10042	10204
EF 20	434	318	336	363	442	494	467	564	646	653	680
EF 21	304	372	594	662	922	1120	953	1013	928	758	799
EF 22	992	1308	1491	1493	1713	2104	2248	2892	3454	3779	3723

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Table 10: Number of cases: plant-level investments in climate protection

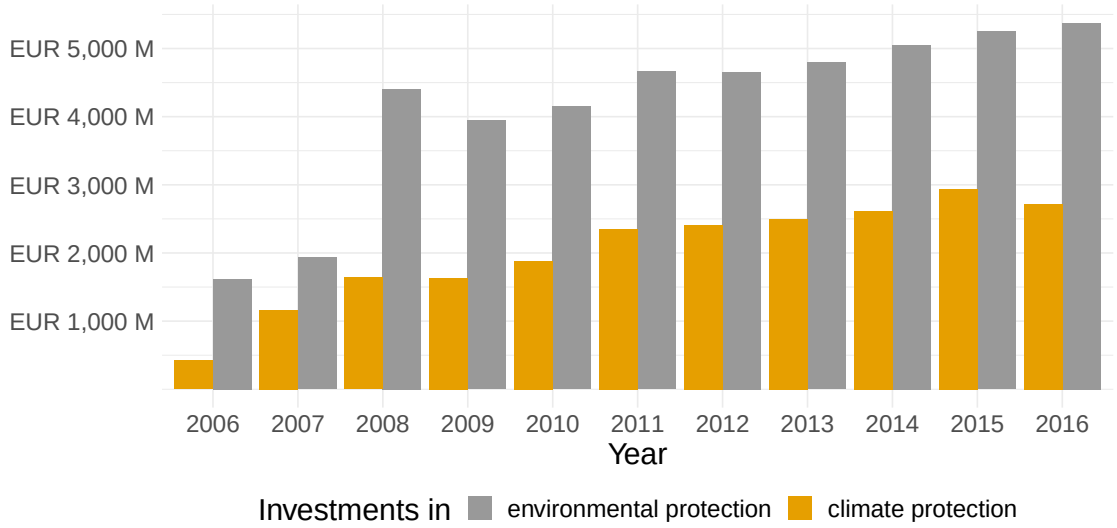
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. plants	6314	5608	7426	7127	8216	9328	9122	10525	11303	11839	11995
EF 20	442	357	367	413	531	550	509	593	668	708	733
EF 21	312	380	597	674	956	1162	997	1056	954	802	844
EF 22	1037	1420	1635	1683	1919	2367	2523	3158	3748	4196	4100

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

4.3.3 Descriptive Analysis

Figure 3 compares the annual investments in environmental and climate protection on firm-level.[20] Both follow an increasing trend over the observation period. Moreover, the investments in environmental protection exceed the investments in climate protection every year. The difference becomes evident from 2008 onwards when the investments in environmental protection rise sharply. Again, this happens simultaneously with the change in the classification system of economic activities and is caused by an increase in firms in the manufacturing sector being obliged to report their investments.

Figure 3: Comparison: annual firms' investments in climate and environmental protection



The figure depicts the annual investments in climate and environmental protection on firm-level. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Figure 4 shows annual total climate investments broken down into the three categories.[21] The investments in renewable energies have the largest share of the climate investments from 2011 on. The investments in energy efficiency rise in the first years but remain on a similar level from 2008 on. The investment volume in GHG emissions reduction is regressive over time and accounts only for a small share.

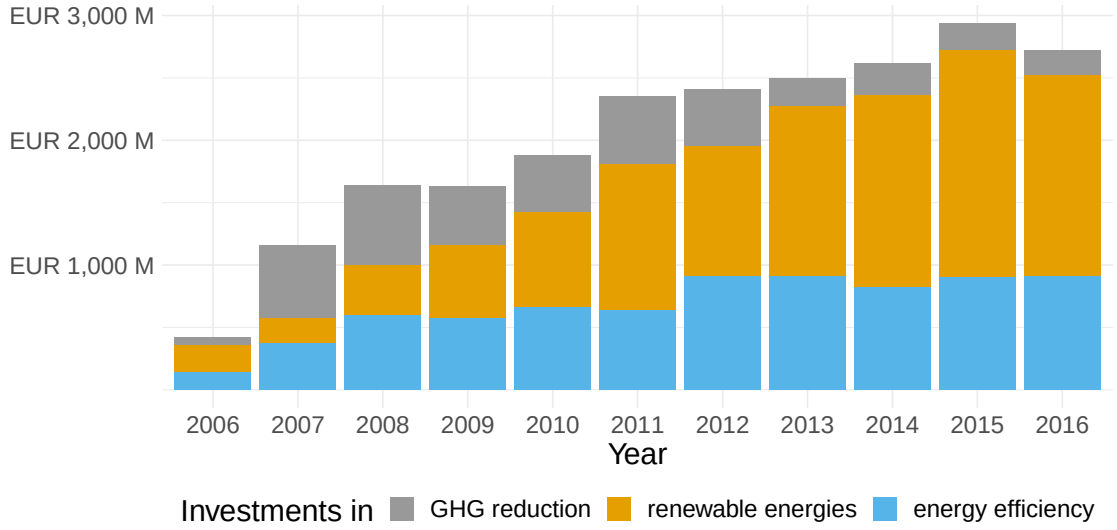
4.4 Variables on Rented Tangible Assets for Environmental Protection

4.4.1 Variable Description

Besides information on units' sustainable investments, the IEP data also holds information on rented or leased tangible assets reducing the units' environmental burden. Thus, data users get a broader

[20] Figure B.1 shows plants' annual investments in environmental and climate protection in the appendix.
[21] Figure B.2 depicts plants' annual investments in environmental protection in the appendix.

Figure 4: Firms' annual investments in climate protection - type of investments



The figure depicts the annual investments in climate protection on firm-level. The annual investments are divided according to the variables EF 20, EF 21, and EF 22. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

picture of the units' efforts for environmental protection. To achieve comparability with the investment data, only the reinstatement value of first-time rented or leased tangible assets is recorded (RDCs 2020b).
The IEP data set distinguishes between four different types of rented or leased tangible assets (RDCs 2020b) listed in Table 11. Following the same structure as the investment variables, the expenditures in rented tangible assets for environmental protection are divided into additive and integrated tangible assets. Information on both variables is available for all years but with different variable names. The expenditures in rented tangible assets for climate protection are just reported in total and are available from 2006 on.

Table 11: Overview: variables on rented tangible assets

Variable		Description
2003 - 2005	2006 - 2016	
Environmental protection		
-/-	EF 23	Total expenditures for rented tangible assets [EUR]
EF 251	EF 24	Expenditures for rented additive tangible assets [EUR]
EF 265	EF 25	Expenditures for rented integrated tangible assets [EUR]
Climate protection		
-/-	EF 26	Total expenditures for rented tangible assets [EUR]

The table is based on the questionnaire in RDCs (2020b).

4.4.2 Number of Cases

The number of firms renting tangible assets to prevent environmental pollution is shown in Table 12. Table 13 shows the same for the plant-level data set. The number of units renting tangible assets for environmental or climate protection is relatively low compared to those investing in new assets with the same purpose.[22] Furthermore, the number of units renting tangible assets to protect the environment exceeds the number of units renting assets for climate protection. As previously seen

[22] Compare the number of cases with those described in Section 4.2.2 and Section 4.3.2.

in the investment data, this follows the same trend.

Table 12: Number of cases: firm-level expenditures in tangible assets

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	31374	5258	4807	6397	6060	6997	7887	7647	9018	9698	10042	10204
Environmental protection												
EF 23	133	153	156	153	132	131	167	151	188	208	209	254
EF 24	113	98	109	121	115	107	133	117	145	163	142	184
EF 25	26	70	64	41	26	34	47	44	58	56	79	85
Climate protection												
EF 26	0	51	65	69	59	64	60	62	83	95	113	129

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Table 13: Number of cases: plant-level expenditures in tangible assets

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. plants	37957	6314	5608	7426	7127	8216	9328	9122	10525	11303	11839	11995
Environmental protection												
EF 23	140	153	155	168	147	146	190	177	206	249	279	283
EF 24	121	96	109	138	130	122	152	137	156	191	201	208
EF 25	25	71	62	40	26	34	50	50	66	68	89	87
Climate protection												
EF 26	0	53	67	71	63	70	63	65	79	97	111	126

Notes: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

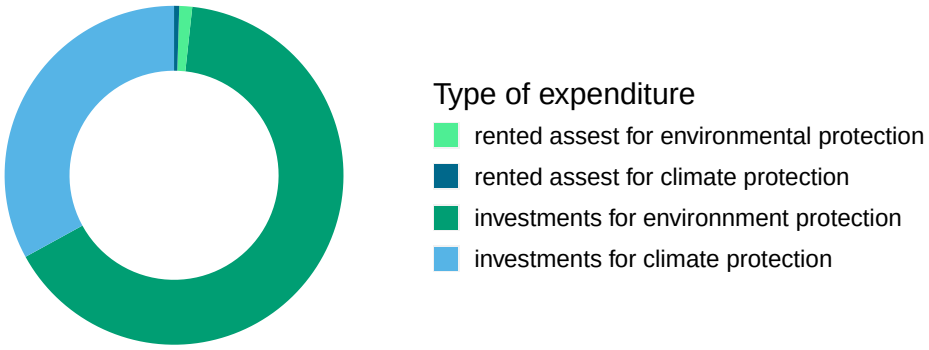
4.4.3 Descriptive Analysis

Figure 5 depicts the proportion of firms' expenditures to reduce their environmental impact in 2016. These expenditures consist of the reinstatement value of first-time rented or leased tangible assets and of investments in new tangible assets.[23] The doughnut in Figure 5 shows the share of firms' total expenditures either in environmental or climate protection relative to all sustainable expenditures in 2016. About two-thirds of the expenditure volume is spent on environmental protection; only one-third is spent on climate protection. In both cases, the expenditures consist of a large share of investments. Less than 3 % of the expenditures are used to rent tangible assets to protect the environment and climate.

Figure 6 depicts the development of the annual expenditures in rented tangible assets.[24] The left panel shows the amount spent on environmental protection; the right panel shows the amount spent on climate protection. In comparison, the expenses in environmental protection follow an increasing trend over the whole period; expenses in climate protection only increase from 2013 onwards.

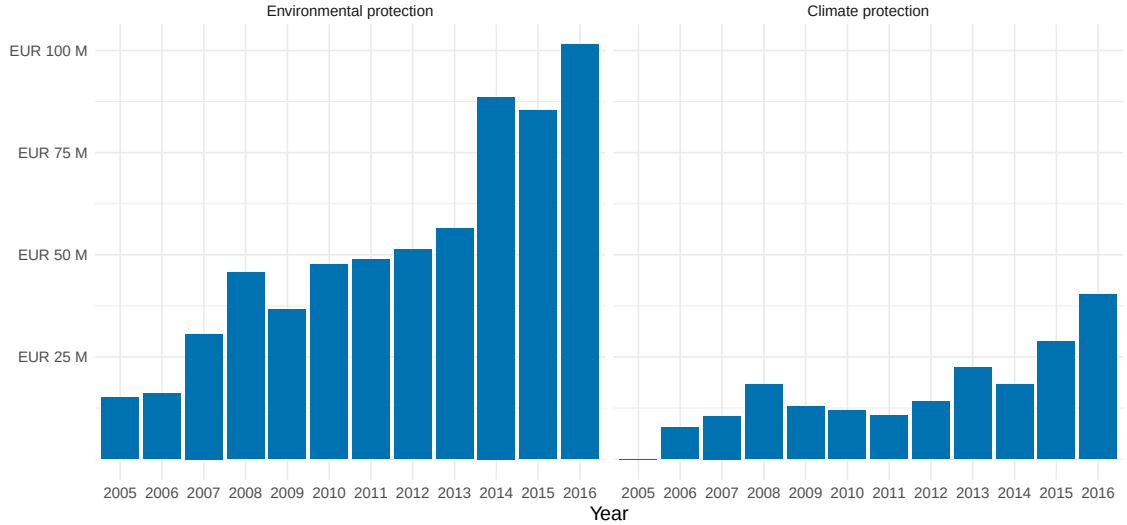
[23] Figure C.1 shows the same for the plant-level data set in the appendix.
[24] Figure C.2 depicts plants' annual expenditures in rented tangible assets in the appendix.

Figure 5: Firms' total expenditures in environmental and climate protection in 2016



The figure depicts firms' expenditures in rented or leased tangible assets and investments to protect the environment or climate in 2016. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Figure 6: Firms' expenditures in rented tangible assets in environmental and climate protection



The figure depicts firms' expenditures in rented or leased tangible assets to protect the environment or climate. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

4.5 Variables on Total Investments

4.5.1 Variable Description

The IEP data contains variables from the general investment survey, which is originally part of the *AFiD panel industrial companies* and the *AFiD panel energy supply companies* and describes the total investments. These investments also contain investments in environmental and climate protection (RDCs 2019; RDCs 2011). Investments in intangible assets are reported separately and are included from 2015 on (RDCs 2020b). The IEP data also reports the total expenditures of first-time rented tangible assets. Again, these include expenditures to decrease the units' environmental burden. Table 14 summarizes the variable names.

Table 14: Overview: variables on total investments

Variable		Description
2003 - 2005	2006 - 2016	
Total investments		
EF 13	EF 33	Investments in tangible assets [EUR]
EF 16	EF 34	Expenditures for rented tangible assets [EUR]
Investments in intangible assets		
-/-	EF 38	Investments in concessions, patents, licenses, trademarks, etc. [EUR]
-/-	EF 39	Investments in software [EUR]

The table is based on the questionnaire in RDCs (2020b).

4.5.2 Number of Cases

The number of cases of the variables on total investments are reported in Table 15 for firms and Table 16 for plants. The variable on total investments (EF 33) is well filled in the firm- and plant-level data set. Over the entire observation period, nearly all units included in this data set report total investments. The number of units renting tangible assets (EF 34) is considerably lower every year. From 2015 on, two variables on investments in intangible assets have also been polled. The number of units reporting their investments in licenses, concessions, etc. (EF 38) and software (EF 39) is relatively small. Moreover, the short observation period of two years makes a panel analysis not feasible yet.

Table 15: Number of cases: firm-level total investments

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	31374	5258	4807	6397	6060	6997	7887	7647	9018	9698	10042	10204
Total investments												
EF 33	27060	4926	4727	6343	6005	6953	7847	7604	8950	9641	9981	10120
EF 34	8824	1918	1623	1601	1280	1396	1510	1432	1626	1752	1775	1821
Investments in intangible assets												
EF 38	0	0	0	0	0	0	0	0	0	0	248	318
EF 39	0	0	0	0	0	0	0	0	0	0	636	845

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Table 16: Number of cases: plant-level total investments

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. plants	37957	6314	5608	7426	7127	8216	9328	9122	10525	11303	11839	11995
Total investments												
EF 33	31889	5883	5519	7370	7068	8171	9285	9077	10459	11220	11775	11909
EF 34	9762	2048	1742	1751	1403	1560	1632	1606	1757	1902	1997	1962
Investments in intangible assets												
EF 38	0	0	0	0	0	0	0	0	0	0	205	263
EF 39	0	0	0	0	0	0	0	0	0	0	519	723

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

4.5.3 Descriptive Analysis

The following section only focuses on the variable total investments (EF 33). The descriptive analysis depicts how the unit's environmental and climate protection investments behave compared to their total investments. Table 17 reports the share of sustainable investments relative to total investments. It shows that the proportion of sustainable investments raises steadily until 2009. For the years 2009 to 2016, the share remains at a constant level.

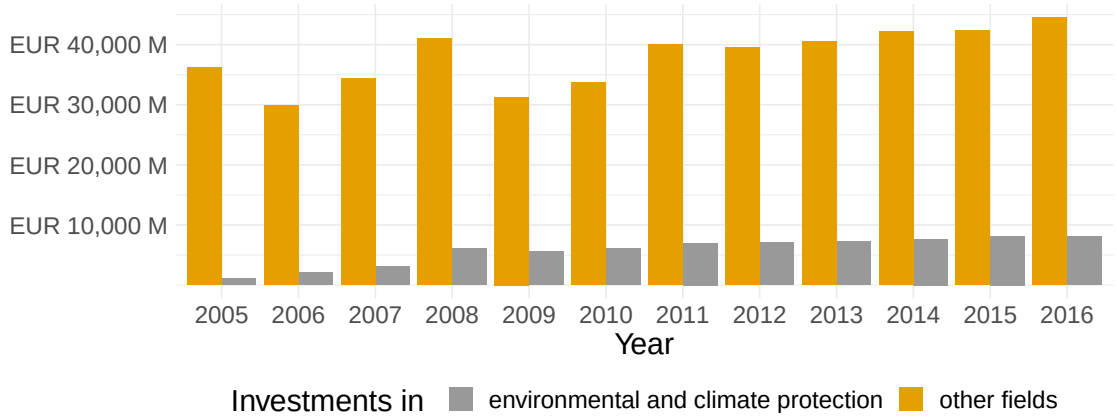
Table 17: Share of sustainable investments relative to total investments

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
% in sustainable investments	2.83	6.41	8.27	12.84	15.13	15.20	14.92	15.16	15.24	15.39	16.21	15.39

Note: The table reports the share of annual investments in environmental and climate protection on annual total investments in percentage. The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Figure 7 contrasts firms' sustainable investment with their investments in other fields.[25] Since the variable EF 33 contains all kinds of investments, environmental and climate protection investments are subtracted from the total investments. That way, firm's residual investments are obtained, which are spent in various areas except for environmental and climate protection. Notably, firms' annual residual investments are subject to fluctuations, especially during the Financial and European Debt crises. Simultaneously, firms' sustainable investments grow staidly.

Figure 7: Comparison: firms' residual investments and sustainable investments



The figure depicts the annual total investments and the total investments in environmental and climate protection (sustainable investments) of all firms. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

4.6 Variables on Unit's Characteristics

4.6.1 Variable Description

The variables in this section describe the unit's characteristics, including its location, some economic key figures, and its structure. That information can be valuable for the analysis of the IEP data. They enable data users to categorize units into groups and detect different investment behaviors. Table 18 summarizes the variables' names. The variables describing the unit's **location** are based on the variable EF 29, the official municipality key (*Amtlicher Gemeindeschlüssel* (AGS)), which identifies every municipality uniquely. It is an 8-digit number with the following structure: The first two digits indicate the federal state and are equivalent to the variable EF 29U1. The first three digits describe the governmental district (EF 29U2), and the first five identify the county (EF 29U3). Data users can use these variables to perform their analysis on different regional levels. Moreover, the official municipality key can be used to merge other regional data sets with the IEP data. In the plant-level data set, the variable EF 36 indicates the federal state where the associated firm is located. In the firm-level data set, the variables EF 36 and EF 29U1 should contain the same information; however, this is different for 22 % of all firms. If researchers want to identify the firm's federal state, they should rely on the variable EF 29U1.
The variable EF 25 describes the unit's **structure** by categorizing units into seven categories. The different categories depend on the data set's level and are recorded in Table 19. The group allocation is based on the number of plants associated with the unit.
Moreover, the IEP data contains variables describing the unit's **economic key figures**. They hold information on the unit's annual revenue (EF 31) and the number of working people (EF 32).[26] Based on these variables, data users can group the units, e.g., into different size categories: micro, small, medium, and large enterprises.[27]
The variable EF 30 describes the unit's main economic activity according to the economic activities classification system, the *WZ 2008* code. These categories are reported as a 5-digit number. The

[25] Figure D.1 shows the same for the plant-level data set in the appendix.
[26] The variable EF 32 contains both the number of employers and the number of employees (RDCs 2020b).
[27] See eurostat (2016) for the exact group definition.

Table 18: Overview: variables on unit's characteristics

Variable 2003 - 2005	Variable 2006 - 2016	Description
	Location	
EF 6	EF 29	Official municipality key
-/-	EF 29UG1	County
-/-	EF 29UG2	Governmental district
EF 6U1	EF 29U1	Federal state key
EF 6U2	EF 29U2	Governmental district key
EF 6U3	EF 29U3	County key
EF 6U4	EF 29U4	Municipality key
EF 1	EF 36	Federal state key of the assigned firm
	Company structure	
EF 5	EF 25	Category of the company structure
	Economic key figures	
EF 7	EF 30	Economic sector
EF 18	EF 37	Economic sector of the assigned firm
EF 8	EF 31	Number of working people
EF 9	EF 32	Revenue [EUR]

Note: The table is based on the questionnaire in RDCs (2020b).

Table 19: Structure of the company: definition

Firm-level data		Plant-level data	
1	= One-plant firm		
2	= Multi-plant firm	5	= Plant of a multi-plant firm
3	= Multi-state firm	6	= Plant of a multi-state firm
4	= Consortium	7	= Plant of a foreign firm

Note: The table is based on the questionnaire in RDCs (2020b).

first two digits of the variable EF 30 describe the economic section the unit is active in. When the unit's *WZ 2008* number starts, e.g., with the two digits "35", it belongs to the energy supply industry. The five-digit codes represent a more accurate description of the unit's economic activity. For example, a unit with the *WZ 2008* number "35112" generates electricity also with an external production for further electricity distribution. In this way, data users can decide how granular they want to group the units according to their main economic activity in the IEP data set. A complete list of all economic sectors and their *WZ 2008* numbers is provided by the Statistisches Bundesamt (2008a). Table 20 summarizes all *WZ 2008* sections (first 2-digits), which are contained in the IEP data set. Even though the IEP metadata report states that the EF 30 variable follows the *WZ 2008* classification system, the data set still contains observations assigned to an economic section according to the old *WZ 2003* system. These cases are listed separately in Table 21. Data users should always check if some particular keys of the main economic activity appear only from 2003 to 2007. Afterward, users can verify whether these keys are listed in the *WZ 2003* catalog.[28] This could indicate that the *WZ 2003* classification system was used for those observations.

Furthermore, the plant-level data set contains information on the main economic activity of the associated firm (EF 37), which can differ from the plant's main activity. In the firm-level data set, both variables should hold the same information. An analysis of both variables shows that this is not always the case. For 24 % of all observations in the firm-level data set, the entries in the variables EF 30 and EF 37 differ. If data users want to include the firm's main economic activity in their analysis, it is recommended to use the variable EF 30 instead of EF 37.

[28] See Statistisches Bundesamt (2003) for detailed definition of the economic sections using the *WZ 2003* classification system.

Table 20: Number of observations per economic section

Section key (WZ 2008)	Section name	No. of observations firm-level	plant-level
	B: Mining industry		
05	Coal mining[1]		
06	Extraction of oil and natural gas[1]	86	309
07	Ore mining[1]		
09	Provision of services for the mining industry[1]		
08	Extraction of stone and earth, other mining industry	637	926
	C: Manufacturing industry		
10	Manufacture of food and feed products	5147	5806
11	Beverage production[2]	891	1094
12	Tobacco processing[2]		
13	Textile production	908	947
14	Clothing production	545	1028
15	Manufacture of leather, leather goods, and footwear	5201	5942
16	Manufacture of articles of wood, straw and cork, wickerwork; except furniture[3]	3211	3437
17	Manufacture of paper, paperboard, and articles thereof[3]		
18	Manufacture of printed matter; reproduction of recorded media, images, data carriers	1222	1306
19	Coking plant and mineral oil processing	381	456
20	Manufacture of chemical products	4395	5106
21	Manufacture of pharmaceutical products	1561	1802
22	Manufacture of rubber and plastic products	6058	6870
23	Manufacture of glass and glass products, ceramics, processing of stones and earths	2528	3613
24	Metal production and processing	4659	5640
25	Manufacture of metal tanks and vessels; manufacture of radiators and -boilers for central heating	11139	11952
26	Manufacture of data processing equipment, electronic and optical products	3590	5171
27	Manufacture of electrical equipment	3749	4243
28	Mechanical engineering	12592	14096
29	Manufacture of motor vehicles and vehicle parts	8035	9843
30	Other vehicle construction	548	668
31	Furniture production	2946	3453
32	Manufacture of other goods	1788	2003
33	Repair and installation of machinery and equipment	2856	3455
	D: Energy supply industry		
35	Energy supply	4512	5465
	E: Water supply industry		
36	Water supply	4588	4428
37	Sewage disposal	10078	13283
	E: Waste industry		
38	Collection, treatment and disposal of waste; recycling	9258	11642
39	Removal of environmental pollution and other disposal	227	279

Note: The table shows the number of observations in each economic section based on WZ 2008. Some sectors were combined to comply with the data protection rule. Different high-figured numbers indicate the groups. The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Table 21: Number of observations using the old WZ 2003 classification system

Section key (WZ 2003)	Section name	No. of observations firm-level	plant-level
34	Manufacture of motor vehicles, trailers and semi-trailers	1259	1672
40	Electricity, gas, steam, and hot water supply	420	459
41	Collection, purification and distribution of water	374	366

Notes: The table shows the number of observations in each economic section based on WZ 2003. The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

4.6.2 Number of Cases

Table 22 and Table 23 show the number of cases for the variables describing the unit's characteristics on plant and firm-level. All variables on the unit's location and also the variables on the unit's main economic activity are excluded from both tables because they are available for all observations. Nevertheless, data users should check the variable EF 37 before using it. When units do not report the main activity of the associated firm, the variable has the value "9999" (RDCs 2020b), which is equivalent to a missing value. The other two variables describing the unit's number of working people and revenue are mostly completely filled in. This applies to both data sets. The variable representing the company's structure contains many missing values and is only available for a small subsample.

Table 22: Number of cases: characteristics of the firms

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	31374	5258	4807	6397	6060	6997	7887	7647	9018	9698	10042	10204
Company structure												
EF 25	26	70	64	41	26	34	47	44	58	56	79	85
Economic key figure												
EF 31	31374	5065	4786	5025	4997	6735	7026	7335	8027	9429	9177	9057
EF 33	27060	4926	4727	6343	6005	6953	7847	7604	8950	9641	9981	10120

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Table 23: Number of cases: characteristics of the plants

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. plants	37957	6314	5608	7426	7127	8216	9328	9122	10525	11303	11839	11995
Company structure												
EF 25	25	71	62	40	26	34	50	50	66	68	89	87
Economic key figure												
EF 31	37957	6054	5514	5559	5434	6976	7424	7573	8415	9580	9663	9551
EF 33	31889	5883	5519	7370	7068	8171	9285	9077	10459	11220	11775	11909

Note: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

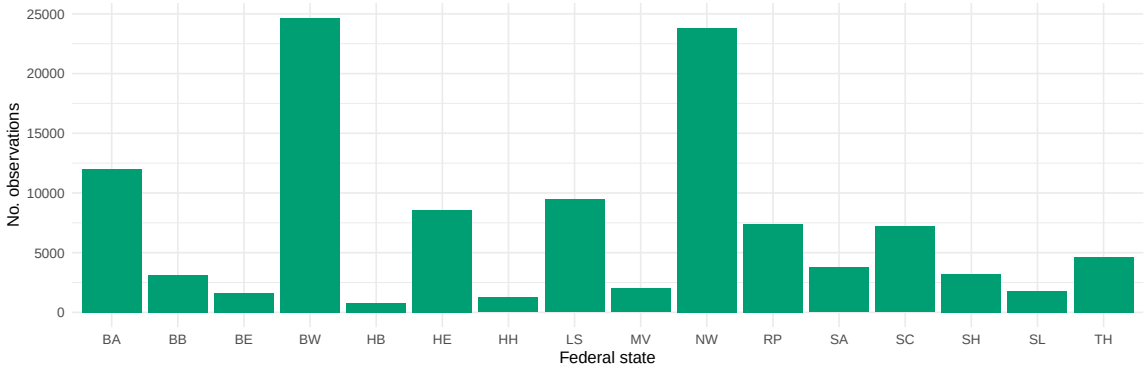
4.6.3 Descriptive Analysis

Exemplary for the descriptive analysis of the location variables of the IEP data, Figure 8 depicts the number of observations in each federal state in Germany based on the firm-level data set.[29] Most firms investing in environmental and climate protection are located in Baden-Wuerttemberg, North Rhine-Westphalia, and Bavaria. This coincides with the position of the regional economic centers in Germany. The fewest firms are observed in the federal state of Bremen. This is expected since Bremen is a city-state and the smallest federal state in Germany.

The information on the firm's main economic activity allows us to analyze the annual sustainable investments per industry. Figure 9 depicts the annual investments in environmental protection, and Figure 10 the annual investments in climate protection per industry.[30] In both cases, the division of the firms into different industries is based on the definition presented in Section 2.2. Only industry E is again subdivided to distinguish between the water supply and waste industries. From 2005 to 2007, the manufacturing industry invests the largest share in environmental protection. While the annual investment volume of this industry remains at a similar level for the following years, the

[29] Figure E.1 shows the number of observations per federal state based on the plant-level data set in the appendix.
[30] The equivalent graphs for the plant-level data set are in the appendix; see Figure F.1 and Figure F.2.

Figure 8: Number of firms per federal state



Explanation of abbreviations: SH: Schleswig-Holstein, HH: Hamburg, LS: Lower Saxony, HB: Bremen, NW: North Rhine-Westphalia, HE: Hesse, PR: Rhineland-Palatinate, BW: Baden-Wuerttemberg, BA: Bavaria, SL: Saarland, BE: Berlin, BB: Brandenburg, MV: Mecklenburg-Western Pomerania, SC: Saxony, SA: Saxony-Anhalt, TH: Thuringia. The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Figure 9: Annual firms' investments in environmental protection per industry

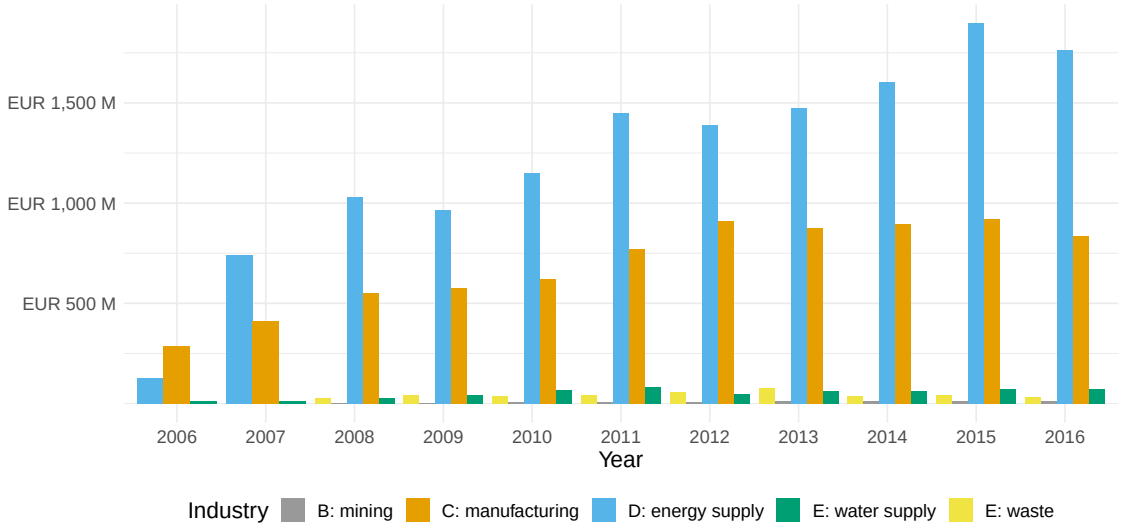
The figure depicts the annual investments in environmental protection of all firms. Firms are grouped into different industries according to their WZ 2008 number. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

water supply industry's annual investments exceed the manufacturing industry's. The sharp rise in environmental investments can be explained by the change in the classification system of the unit's main economic activity, which results in the inclusion of wastewater and waste disposal companies in the survey for the first time. As a result, the number of units in the water supply and waste industries increases. Moreover, wastewater and waste disposal units' total investments are accounted as environmental investments. This explains the significant increase. Still, the water supply industry's annual environmental investments also grow from 2008 on. Environmental investments of the waste industry are listed for the first time in 2008. In the following years, the investment volume of this industry also rises. The investments of the energy supply industry remain at a lower level. After slightly increasing environmental investments until 2008, they decrease again and stay on a constant level from 2014 on. The investments in the environmental protection of the mining industry are negligibly small.

A different picture emerges when looking at the annual investment in climate protection. Figure 10 summarizes those investments. Here, investments of the waste and water supply industry play only

a minor role. The climate investments of the mining industry are even lower than those in environmental protection. The energy industry accounts for the largest share of the investment volume in climate protection, followed by the manufacturing sector.

Figure 10: Annual firms' investments in climate protection per industry



The figure depicts all firms' annual investments in climate protection. Firms are grouped into different industries according to their WZ 2008 number. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

5 Merge the Data With Further AFiD Modules

Depending on the targeted empirical analysis, data users can extend the IEP data set with one or more *AFiD* modules and the *statistics of annual accounts of public funds, institutions, and enterprise* (JAB panel). Those modules can be merged using the firm or plant ID and the year variable. Data users can execute the merge themselves.
The IEP data set consists of two data sets, one firm-level data set and one plant-level data set. Both data sets can be merged to **AFiD panel energy**. When linking the firm-level data to the *AFiD* data, the variables *firm ID* and *year* can be used as identifiers. When merging the plant-level IEP data, the *plant ID* is used instead of the *firm ID*.[31] Table 24 summarizes the number of firms and plants of the IEP data set, which can be successfully merged with the *AFiD panel energy*.

Table 24: AFiD panel energy: number of successful merges

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	X	X	384	2064	2193	2619	2921	3060	3209	3455	3455	3612
No. plants	6	403	390	2416	2586	3112	3597	3749	3967	4318	4330	4530

Note: Because of data protection reasons, the number of successful merged firms in 2005 and 2006 cannot be reported. The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, and the AFiD module energy supply companies, DOI: 10.21242/43221.2017.00.01.1.1.0, own calculations.

Moreover, the IEP data can be joined with the **JAB panel**. The merging procedure for the firm-level data follows the same strategy as for the merge with the *AFiD panel energy*. When merging the plant-level data, users must consider that the *JAB panel* contains only firm-level data. Still, the plant-level data can be linked with the *JAB panel* using the ID of the plant's associated firm as an identifier. Table 25 shows the number of successfully merged firms and plants from the IEP data with the JAB panel.

Table 25: JAB panel: number of successful merges

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
No. firms	16	250	254	996	1086	1250	1421	1454	1513	1577	1621	1691
No. plants	48	252	238	1150	1267	1489	1722	1759	1860	1948	1995	2078

Notes: The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, and the JAB panel, DOI: 10.21242/71811.2019.00.00.1.1.0, own calculations.

The **AFiD panel industry** was not available to me, so I could not compute the number of successful mergers for this data set, but the RDCs (2020b) records this number for the plant-level IEP data.
Overall, the number of successful mergers increases with time, but especially in the first years, only a few units of the IEP data can be linked to other *AFiD* modules. Data users should consider this when choosing the period for their empirical analysis.

[31] See Section 4.1 for the definition of the unit identifier in the IEP data sets.

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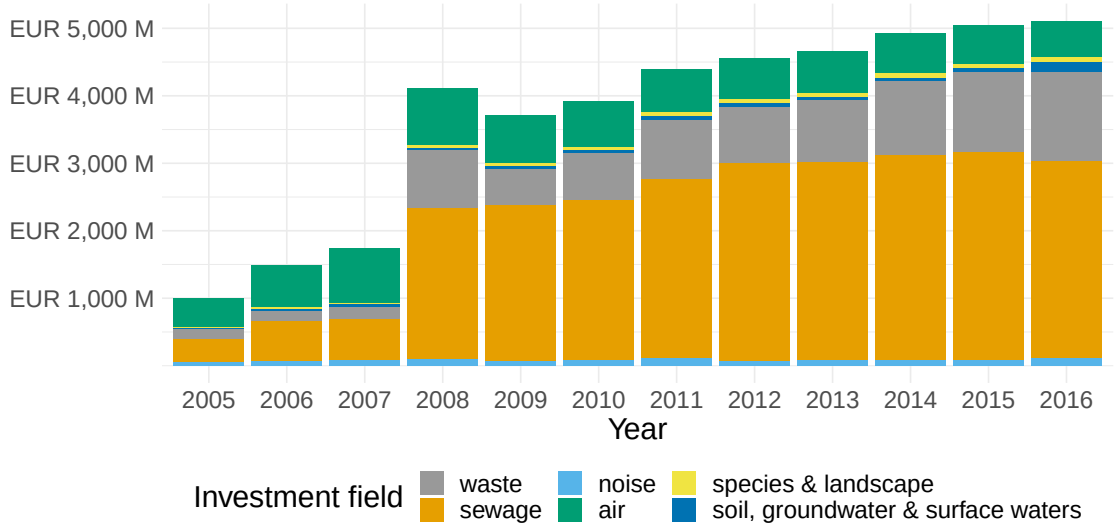
Appendices

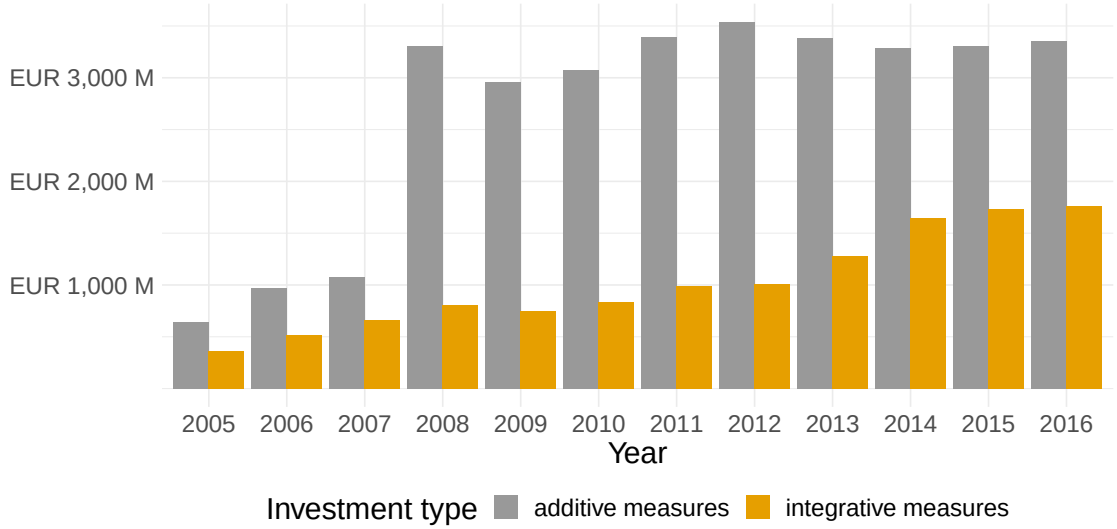
A Plants' Investments in Environmental Protection

Figure A.1: Annual plants' investments in environmental protection - field of investments



The figure depicts the annual investments in environmental protection of all plants. The investment division is done according to the variables EF 2, EF 5, EF 8, EF 11, EF 14, and EF 17. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

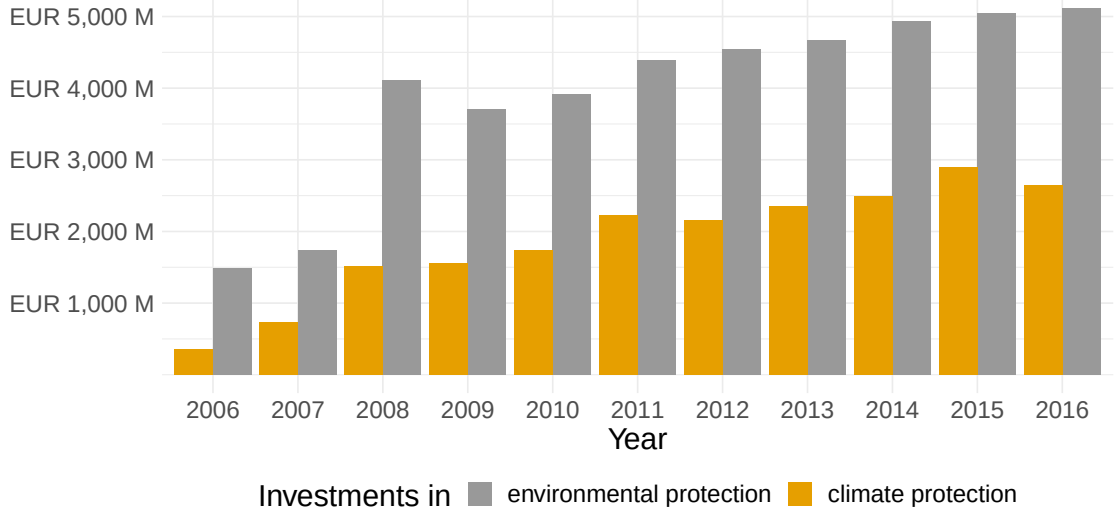
Figure A.2: Annual plants' investments in environmental protection - type of investments



The figure depicts the annual investments in environmental protection of all plants included in the IEP data set. It distinguishes between investments in additive and integrative measures. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

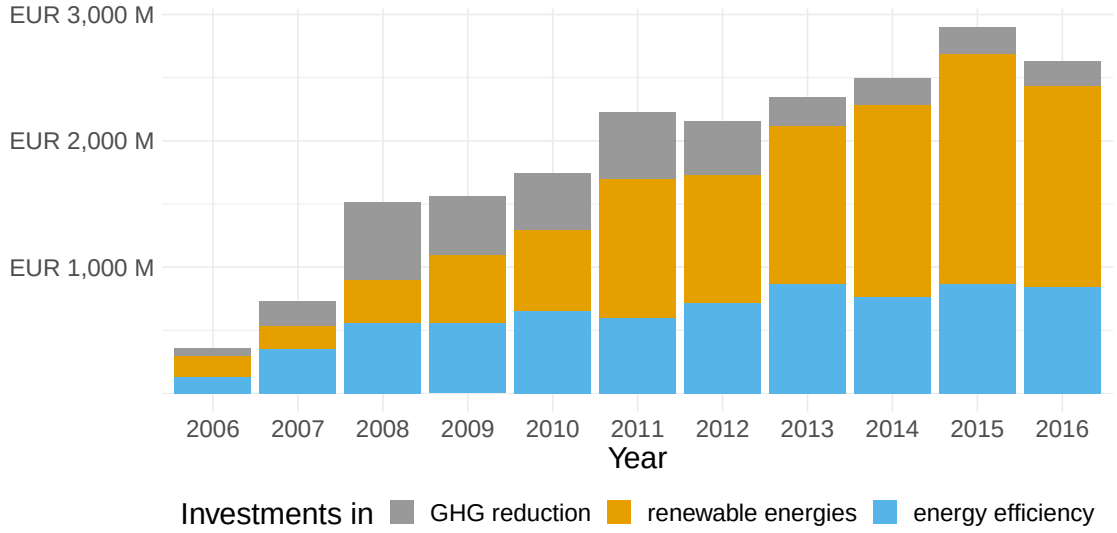
B Plants' Investments in Climate Protection

Figure B.1: Comparison: annual plants' investments in environmental and climate protection



The figure depicts the annual investments in environmental and climate protection on plant-level. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

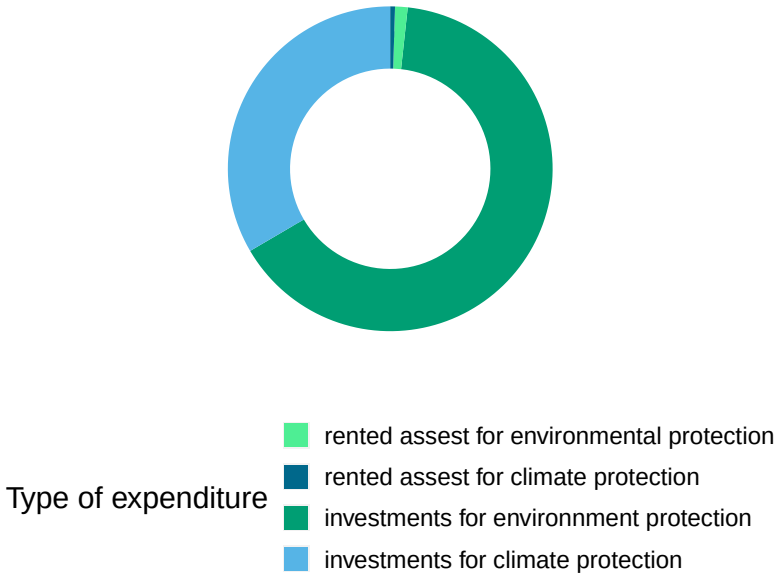
Figure B.2: Plants' annual investments in climate protection - type of investments



The figure depicts the annual investments in climate protection on plant-level. The devision of the annual investments is done according to the variables EF 20, EF 21, and EF 22. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

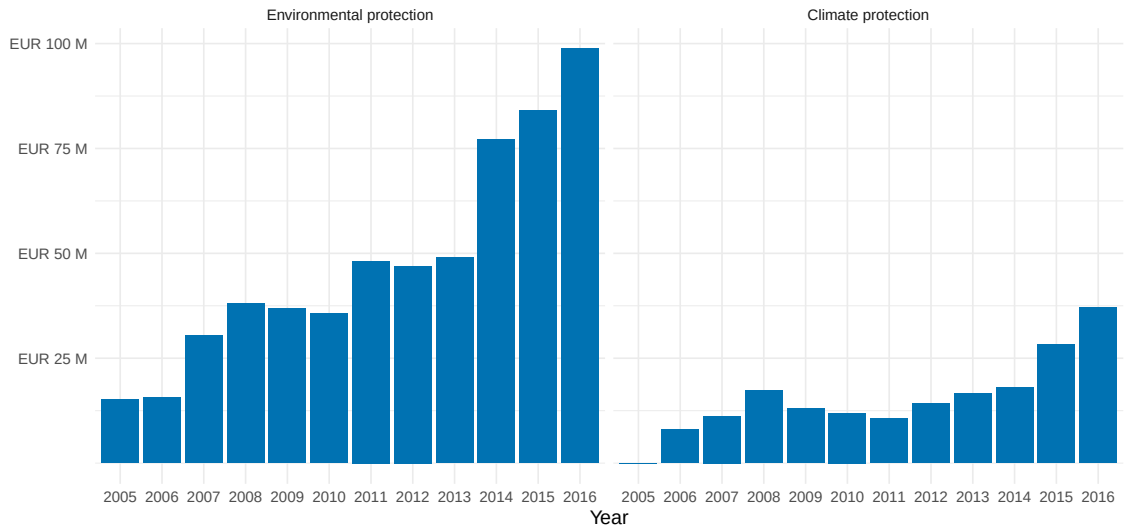
C Plants' Expenditures in Rented Tangible Assets

Figure C.1: Plants' total expenditures in environmental and climate protection in 2016



The figure depicts plantss' expenditures in rented or leased tangible assets and investments to protect the environment or climate in 2016. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

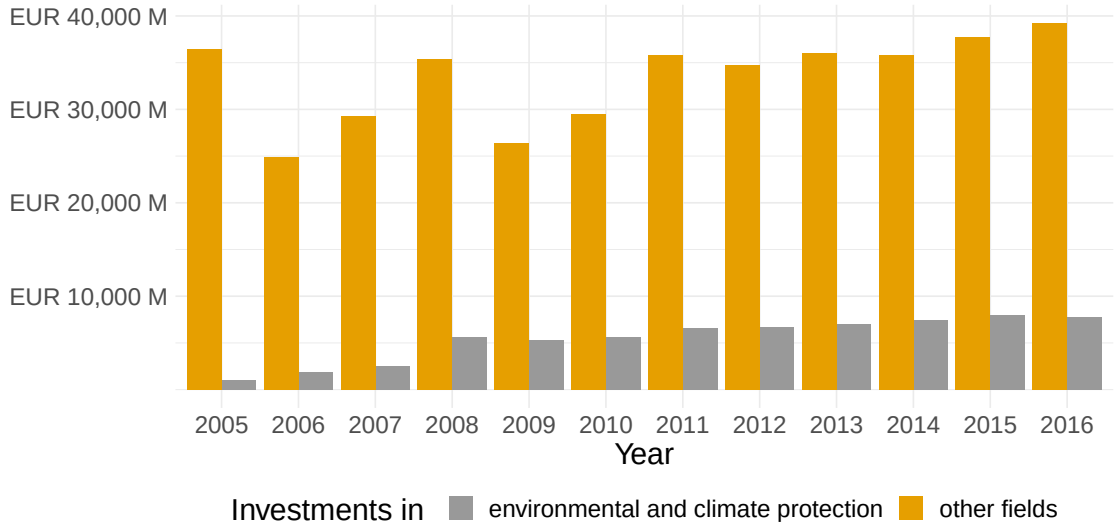
Figure C.2: Plants' expenditures in rented tangible assets in environmental and climate protection



The figure depicts plants' expenditures in rented or leased tangible assets to protect the environment or climate. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

D Plants' Total Investments

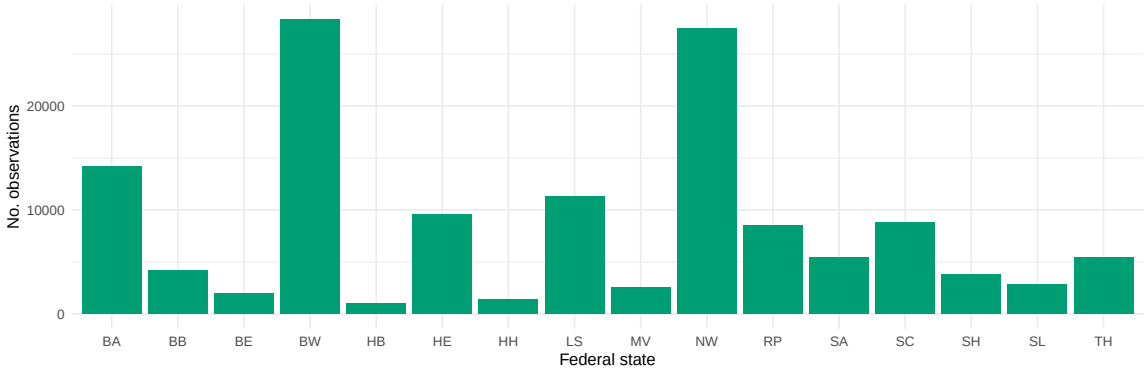
Figure D.1: Comparison: plants' residual investments and sustainable investments



The figure depicts the annual total investments and the total investments in environmental and climate protection (sustainable investments) of all plants. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

E Number of Plants per Federal State

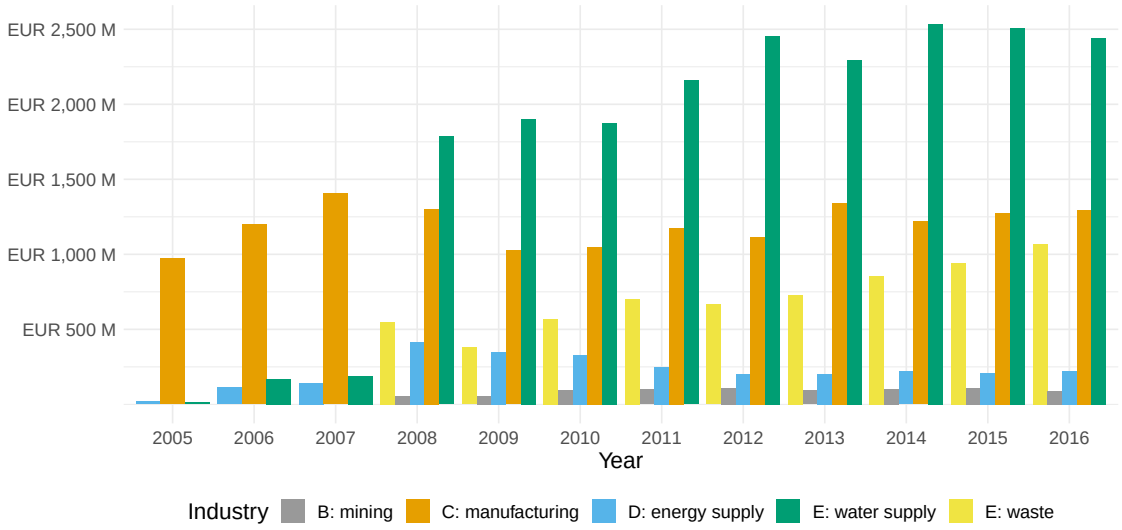
Figure E.1: Number of plants per federal state



Explanation of abbreviations: SH: Schleswig-Holstein, HH: Hamburg, LS: Lower Saxony, HB: Bremen, NW: North Rhine-Westphalia, HE: Hesse, PR: Rhineland-Palatinate, BW: Baden-Wuerttemberg, BA: Bavaria, SL: Saarland, BE: Berlin, BB: Brandenburg, MV: Mecklenburg-Western Pomerania, SC: Saxony, SA: Saxony-Anhalt, TH: Thuringia. The table is based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

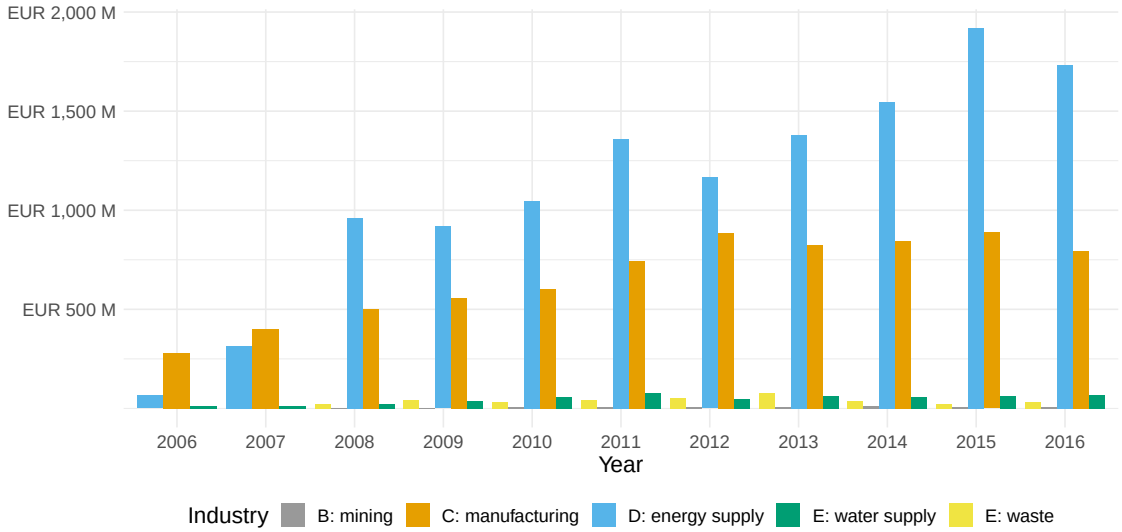
F Plants' Sustainable Investments per Industry

Figure F.1: Annual plants' investments in environmental protection per industry



The figure depicts the annual investments in environmental protection of all plants. Firms are grouped into different industries according to their WZ 2008 number. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.

Figure F.2: Annual plants' investments in climate protection per industry



The figure depicts all plants' annual investments in climate protection. plants are grouped into different industries according to their WZ 2008 number. All monetary values are reported in million EUR and are deflated using the PPI. All results are based on the official data on investments in environmental protection, DOI: 10.21242/32511.2017.00.03.1.1.0, own calculations.