

# Climate Change Agreements in the UK

## Fact sheet

*for:*

### **Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)**

On behalf of:



European  
**Climate Initiative**  
EUKI

of the Federal Republic of Germany

*by:*

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The information and views set out in this study are those of the author(s) and do not necessarily reflect the official opinion of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

This study is based on a policy paper with an overview of greenhouse gas emission reductions and policy instruments in non-ETS sectors across Europe (hereafter referred to as 'Policy Paper'). The Policy Paper can be downloaded from the EUKI website.

## ABBREVIATIONS

BEIS	Department for Business, Energy and Industrial Strategy
BMU	German Environmental Ministry
CCAs	Climate Change Agreements
CCL	Climate Change Levy
CCP	Climate Change Programme
CHP	Combined heat and power
CP	Certification Period
CPS	Carbon Price Support
CRC	Carbon Reduction Commitment
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food & Rural Affairs
ECA	Enhanced Capital Allowances
EEN	Energy Efficiency Networks
EPR	Environmental Permitting Regulations
ETS	Emissions Trading System
EU	European Union
EUR	Euro
GBP	Great British Pound
GHG	Greenhouse gas
GJ	Gigajoule
IPPC	Integrated Pollution Prevention and Control
kgC	Kilogramme of carbon
kWh	Kilowatt hour
LPG	Liquefied petroleum gas
LSE	London Stock Exchange
LULUCF	Land use, land-use change and forestry
MtCO <sub>2</sub> e	Million tonnes of carbon dioxide equivalent
Mtoe	Million tonnes of oil equivalent
MWh	Megawatt-hour
NAPE	National Action Plan on Energy Efficiency
OECD	Organisation for Economic Co-operation and Development
PJ	Petajoule
TP	Target Period
USD	United States Dollar

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## 1 SUMMARY

The United Kingdom (UK) has been a global forerunner in climate policy. In its first comprehensive national climate strategy released in 2000, a 'levy package' was introduced. It was composed of the Climate Change Levy (CCL), an energy tax applying to a broad scope of non-domestic energy users including industrial, commercial, agricultural, and public services sectors, and the Climate Change Agreement (CCA) scheme that proposes voluntary agreements in which eligible industrial sectors commit to energy efficiency or carbon reduction targets and, in turn, enjoy a discount to the levy. CCL is a tax on the consumption of electricity (excluding renewable electricity and combined heat and power (CHP), but including nuclear), coal, natural gas, and liquefied petroleum gas (LPG). The rates of CCL are GBP 5.83 (EUR 6.55) per MWh for electricity, GBP 2.03 (EUR 2.28) per MWh for gas, GBP 13.04 (EUR 14.64) per tonne for LPG, and GBP 15.91 (EUR 17.87) per tonne for other fuels. The CCA discount currently sits at 90% for electricity and 65% for gas and other fuels. The primary objectives of this package are to protect the competitiveness of concerned industries and incentivise mitigation efforts. It has a two-tier structure composed of sector targets and individual targets, each signed with the sector associations and companies, respectively. The CCA continues to be a key instrument in the British industry energy and climate policy mix and is expected to run until at least March 2023.

According to the bi-annual performance reports under the CCA, there have been a considerable amount of carbon emissions savings compared to baseline year levels (i.e. between 3.1 and 10.5 million tonnes CO<sub>2</sub> (MtCO<sub>2</sub>)/year), which is attributable to several factors. Some economic models have shown substantive 'additional' reductions of carbon emissions and energy demand attributed to the agreements. This is mainly driven by the 'awareness effect', i.e. managers becoming aware of more cost-effective efficiency enhancement potentials as they begin to benchmark their energy use. This effect has been confirmed by participant surveys.

However, other modelling work has concluded that there is minimal to no additional mitigation effect. Moreover, some analyses indicate that the CCA-CCL package provides a weaker incentive to decrease energy use as compared to the full price incentive of the CCL alone. In UK, the industrial sector faces higher carbon related costs as compared to most of the other European countries - analysis has shown that, the CCL, a tax instrument, which CCA is linked with, plays a significant role in driving energy efficiency and climate mitigation (Grubband Drummond, 2018).

Overall, with its unique feature of a 'stick-and-carrot' approach, the CCA could be effective in driving energy efficiency improvements and lead to emission reductions, while two factors would be crucial for its environmental effectiveness: 1) stringent targets, and 2) sound eligibility criteria to limit the discount to those with real leakage risks.

Germany enjoys a relatively high level of comparability with the UK regarding the economic, political and administrative context, climate ambition as well as a similar industrial energy fuel mix. The role of industry in Germany is much more prominent, which means that industries are more important for delivering Germany's climate targets. Introducing a CCA-type instrument, a voluntary agreement in combination with a 'credible threat', in Germany has potential to enhance the industrial sector's mitigation efforts. This may be done via two potential pathways: introducing CCA as a pre-condition for energy-intensive industries to the entitlement of exemption or discount from existing energy surcharges or a new carbon tax; or using CCA as a reference to strengthen and modify the relatively new Energy Efficiency Networks initiative which is currently designed as a pure 'carrot' approach.

Success factors and lessons from the UK may be of help to fed into Germany's policy design discussions, particularly the two-tier structure; the combination of mid-term and interim targets; a sound and credible monitoring and enforcement regime; a similar role of sector associations; and a periodic review process (to enable tightening of targets among others). In addition, an assessment of the potential interactions with other existing and planned policies is necessary, to avoid potential conflicts and facilitate higher synergy.

## 2 INTRODUCTION TO THE INSTRUMENT

Climate Change Agreements (CCAs) are voluntary agreements in which energy-intensive industries commit to energy efficiency or carbon-saving targets and receive a discount from the Climate Change Levy (CCL) upon fulfilling their commitment. CCL is a tax on the consumption of electricity (excluding renewable electricity and combined heat and power (CHP), but including nuclear), coal, natural gas, and liquefied petroleum gas (LPG). It applies to the following sectors: industrial, commercial, agricultural, and public services. The rates of CCL are GBP 5.83 (EUR 6.55) per MWh for electricity, GBP 2.03 (EUR 2.28) per MWh for gas, GBP 13.04 (EUR 14.64) per tonne for LPG, and GBP 15.91 (EUR 17.87) per tonne for other fuels.

CCAs were introduced to address the need to maintain the competitiveness of energy-intensive sectors subject to international competition<sup>1</sup>.

On the one hand, CCAs are a typical example of voluntary approaches in environmental policy, i.e. agreements on environmental performance negotiated with industry and public authorities (OECD, 2003). They display the characteristics of a ‘carrot’ approach, e.g. by providing information, incentives, and technical assistance to encourage energy-efficient investment<sup>2</sup>.

On the other hand, CCAs are fairly unique for their ‘stick-and-carrot’ approach (this characteristic is also referred to as a ‘credible threat’ by OECD, 2003)<sup>3</sup>. CCAs function as a package in coordination with the CCL. Although participation in a CCA is fully voluntary, the alternative of abstention means paying a full tax rate under the CCL.

As a tool in a climate-policy-instrument mix, CCAs mainly correspond to the category of ‘energy efficiency and consumption’ policy because their focus has been primarily on energy efficiency improvement, rather than direct carbon emissions reductions<sup>4</sup>, see also the list of climate landscape instrument classification in Table 1.

Table 1: Climate landscape instrument classification, UK, 2013 (Drummond, 2013: 7)

Policy instrument	Policy landscapes			
	Carbon pricing	Energy efficiency and energy consumption	Promotion of renewable energy sources	Non-carbon dioxide GHGs
Climate Change Levy		√	√	
Climate Change Agreements		√		
EU ETS	√	√	√	√

<sup>1</sup> When CCAs were first implemented, an emissions trading scheme was included in the policy package to reward over-achievement and increase cost effectiveness. However, in the scheme implemented after 2013, emissions trading for those who do not meet their target was removed. Hence, this paper largely excludes a discussion related to the UK emissions trading scheme.

<sup>2</sup> For example, the Carbon Trust provides information and technical expertise, as well as interest-free loans; the Enhanced Capital Allowance Scheme and a ‘light touch’ of facilities that meet their CCA targets are deemed to have met the EU Integrated Pollution Prevention Control conditions (Liu et al., 2016: 7-8).

<sup>3</sup> Although the reverse term carrot-and-stick is more common, the term chosen is to express CCAs as being introduced mainly to address the competitiveness concern of CCL.

<sup>4</sup> Reflected by the type of targets set under the CCAs; see more in section 4.3.

Policy landscapes				
Policy instrument	Carbon pricing	Energy efficiency and energy consumption	Promotion of renewable energy sources	Non-carbon dioxide GHGs
Renewable Obligation			√	
Renewable Energy Feed-in Tariff			√	
Renewable Heat Incentive			√	
CRC Energy Efficiency Scheme	√	√		
Carbon Trust Standard		√		
LSE Carbon Reporting Requirement		√		
Green Deal		√		
Energy Company Obligation		√		
Renewable Transport Fuel Obligation			√	
Vehicle Excise Duty		√		
Landfill Tax				√
Greenhouse Gas Action Plan			√	√

## 3 NATIONAL CONTEXT

### 3.1 National climate policy

The United Kingdom (UK) has been a global forerunner in climate policy and has developed a comprehensive set of measures to reduce emissions since the late 1980s. Since 2008, its climate policy framework has been underpinned by the Climate Change Act. This flagship legislation was the first legislative act to translate climate mitigation targets into law, committing the government to reduce greenhouse gas (GHG) emissions by at least 80% below 1990 levels by 2050 (Climate Change Act, 2008)<sup>5</sup>.

This long-term goal is translated into a series of five-year carbon budgets, which are adopted 12 years in advance to allow policy makers and businesses time to plan accordingly. Each budget places a cap on the amount of GHG emitted over a five-year period. The legislative targets of -26% and -31% below 1990 levels were met for the first two target periods of 2008–2012 and 2013–2017. Forecasts confirm the country's successful performance, indicating that the UK is on track to meet its third target of a 37% emission reduction by 2022 (Grantham Research Institute, 2015). However, analysis reveals a significant gap between emission targets and realised policy performance for the 4<sup>th</sup> and 5<sup>th</sup> carbon budgets (Fankhauser et al, 2018).

Each carbon budget's target is recommended by the Committee on Climate Change (CCC), an independent advisory body of experts set up by the Climate Change Act; next, the carbon budget is debated and legislated by Parliament. The government then presents Parliament with a carbon plan that contains instruments and measures to ensure that each sector of the economy achieves its mitigation milestones, and that the overall budget is met.

A number of laws, policies, and measures have been implemented by the British government to deliver the emissions reductions necessary to meet the carbon budget, including the 2011 Carbon Plan, which replaced the 2009 Low Carbon Transition Plan; the 2011 Energy Act; the launch of the Green Investment Bank in 2012; and, most recently, the 2017 Clean Growth Strategy (Department for Business, Energy and Industrial Strategy, BEIS, 2017).

Among key instruments for improving energy efficiency and reducing emissions currently in place are those deployed in November 2000 by the Climate Change Program legislative package: the Climate Change Levy (CCL), which is a tax on businesses for using fossil fuel energy; the Climate Change Agreements (CCAs), which provide rebates on the CCL to industrial companies that achieve their set targets; and the Emission Trading System (ETS)<sup>6</sup>.

So far, sectors covered by the European Union (EU) ETS have produced the majority of emission reductions in the UK, and evidence suggests that the carbon price support (CPS) rates of the CCL<sup>7</sup>, which act as a carbon price floor for the EU ETS, have played an important role in accomplishing this.

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<sup>5</sup> Because this study corresponds to a larger project and is one in a series of similar case studies, the section on national climate policy may share some similarities to other case studies on the same country.

<sup>6</sup> Originally, the operating emission trading scheme was the voluntary UK emission trading scheme introduced in 2002; however, it later became the mandatory EU ETS introduced in 2007.

<sup>7</sup> CPS rates are paid by owners of electricity generating stations and operators of combined heat and power (CHP) stations.

Table 2: UK carbon budgets (taken from Committee on Climate Change website)

Budget	Carbon budget level	Reduction below 1990 levels
1 <sup>st</sup> carbon budget (2008–2012)	3,018 MtCO <sub>2</sub> e	25%
2 <sup>nd</sup> carbon budget (2013–2017)	2,782 MtCO <sub>2</sub> e	31%
3 <sup>rd</sup> carbon budget (2018–2022)	2,544 MtCO <sub>2</sub> e	37% by 2020
4 <sup>th</sup> carbon budget (2023–2027)	1,950 MtCO <sub>2</sub> e	51% by 2025
5 <sup>th</sup> carbon budget (2028–2032)	1,725 MtCO <sub>2</sub> e	57% by 2030

### 3.2 Sector context

CO<sub>2</sub> emissions from nine economic sectors are shown in Figure 1: transport, energy supply, business, residential, agriculture, waste management, industrial processes, public, and land use, land-use change and forestry (LULUCF). Transport, energy supply and business are the largest emitters.

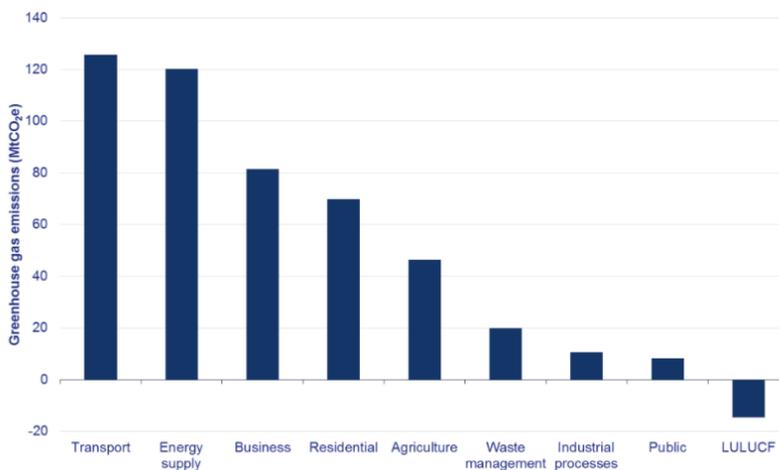


Figure 1: Greenhouse gas emissions by source sector, UK, 2016 (in MtCO<sub>2</sub>e) (BEIS, 2018: 16)

Industrial energy use accounts for around 21% of total delivered energy use and 29% of CO<sub>2</sub> emissions (Griffin et al., 2016: 684-685). There is a large variation across the UK's industrial sector in terms of manufacturing processes, which range from highly energy-intensive (EI) processes like steel production and petrochemicals processing, to non-energy-intensive (NEI) systems like electronics fabrication. There are around 350 separate combinations of sub-sectors, devices and technologies, each offering different prospects for energy efficiency improvements and carbon reductions (Ibid).

The considerable drop in aggregate energy intensity between 1973 and 2007 was driven by several factors: energy efficiency (a decrease in industrial energy demand); structural change (the transition from energy-intensive industries to non-energy-intensive industries); and fuel switching (the substitution of coal and oil with cleaner fuels such as electricity and gas) (Ibid: 690). Emissions from industry continue to demonstrate a downward trend (BEIS, 2018:15).

Furthermore, Figure 2 presents final energy consumption by sector; Figure 3 presents final energy consumption in primary energy equivalents by fuel type. Industry is the only sector that has faced a striking decrease in final energy consumption and, overall, the UK is moving towards cleaner fuels.

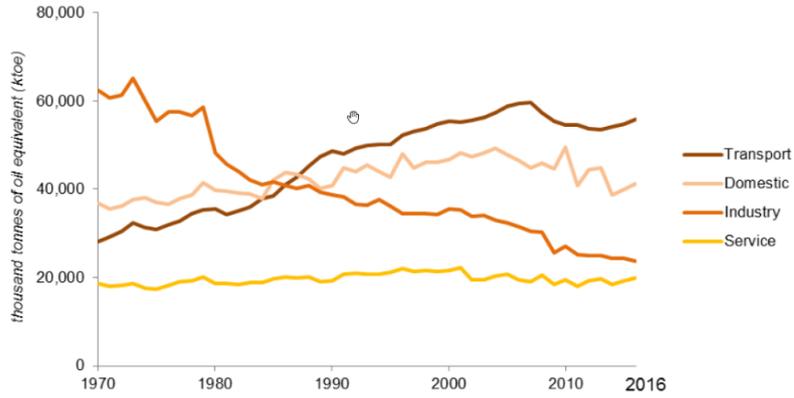


Figure 2: Final energy consumptions by sector, UK, 2016 (BEIS, 2017a: 7)

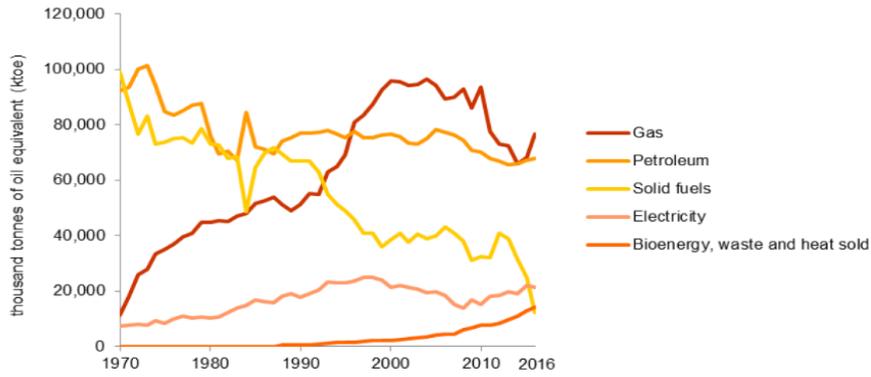


Figure 3: Final energy consumptions in primary energy equivalents by fuel type, UK, 2016 (BEIS, 2017a: 9)

## 4 GENERAL DESCRIPTION OF THE POLICY INSTRUMENT

### 4.1 History

The CCA scheme was introduced to address potential harm to the competitiveness of energy-intensive industries that are especially affected by the CCL, which is the energy tax first announced in March 1999 and implemented in April 2001 by non-domestic energy users. In response to the 1998 Marshall Report on 'Economic Instruments and the Business Use of Energy' (Lord Marshall, 1998),<sup>8</sup> the 'levy package' (CCL and CCA), the UK Emissions Trading Scheme, and the Enhanced Capital Allowances (ECA)<sup>9</sup>, were born by the Climate Change Program (CCP) in 2000. CCP was the first comprehensive national strategy of the UK to tackle climate change and meet/exceed its Kyoto target. CCL is a tax on the consumption of electricity (excluding renewable electricity and combined heat and power (CHP), but including nuclear), coal, natural gas, and liquefied petroleum gas (LPG). It applies to the following sectors: industrial, commercial, agricultural, and public services. CCAs provide a discount on the CCL to eligible industrial sectors who achieve voluntary energy efficiency and emissions reductions targets. The declared objectives of the CCA scheme are two-fold: to protect sectors, which may be at risk for negative impacts on competitiveness from tax costs, and to incentivise improvements in energy efficiency and carbon reduction.

The implementation of CCAs is broken into two, distinct phases which the UK government refers to as the old and new CCA schemes:<sup>10</sup>

- 1) 1<sup>st</sup> phase (old scheme; April 2001–March 2013): administration under the Department for Environment, Food & Rural Affairs (Defra) until 2006, and then under the Department of Energy and Climate Change (DECC) (now the Department for Business, Energy and Industrial Strategy (BEIS));<sup>11</sup>
- 2) 2<sup>nd</sup> phase (new scheme; April 2013–March 2023): the current scheme shifts the responsibility of administration from DECC to the Environment Agency.<sup>12</sup>

### 4.2 Legal basis

The legal basis for the CCA is provided by the Finance Act 2000 (as amended), which introduces the CCL and prescribes changes to excise duties, value added tax, income tax, corporate tax, stamp duty, and capital gains tax etc. Besides introducing the CCL, the Act also outlines the legal foundation for the CCA. In addition, a series of ministerial regulations such as Climate Change Agreements (administration) Regulations 2012 (as amended), the Environmental Permitting Regulations 2010 (as amended) and the Climate Change Agreements (eligible facilities) Regulations 2012 (as amended)

<sup>8</sup> In March 1998, the government appointed Lord Marshall (then President of the Confederation of British Industry) to investigate ways in which economic instruments could be used to make effective reductions in GHG.

<sup>9</sup> ECA scheme is designed to encourage UK business to invest in high performance energy-efficient equipment by providing them 100% accelerated tax relief on the purchase of eligible equipment within the year of purchase.

<sup>10</sup> Both between and within phases, consultations and reviews were held to introduce policy changes that enhanced simplification, accountability and transparency.

<sup>11</sup> On the other hand, CCL has been under the administration of the HM Revenue and Customs since its introduction.

<sup>12</sup> Although it was the DECC that negotiated with the sector associations and agreed upon the sector comments in 2012, which form the overall energy and carbon efficiency percentage improvements until 2020.

provide detailed guidance and rules for the implementation of the CCA (Environment Agency, 2017: 6; see also Figure 4).

The agreements themselves are not contracts, but they have the force of a public law agreement (NAO, 2017: 20), and there are concrete monitoring and enforcement provisions (see more details in the following section). So once companies have opted for it, the CCA is considered legally binding for them.

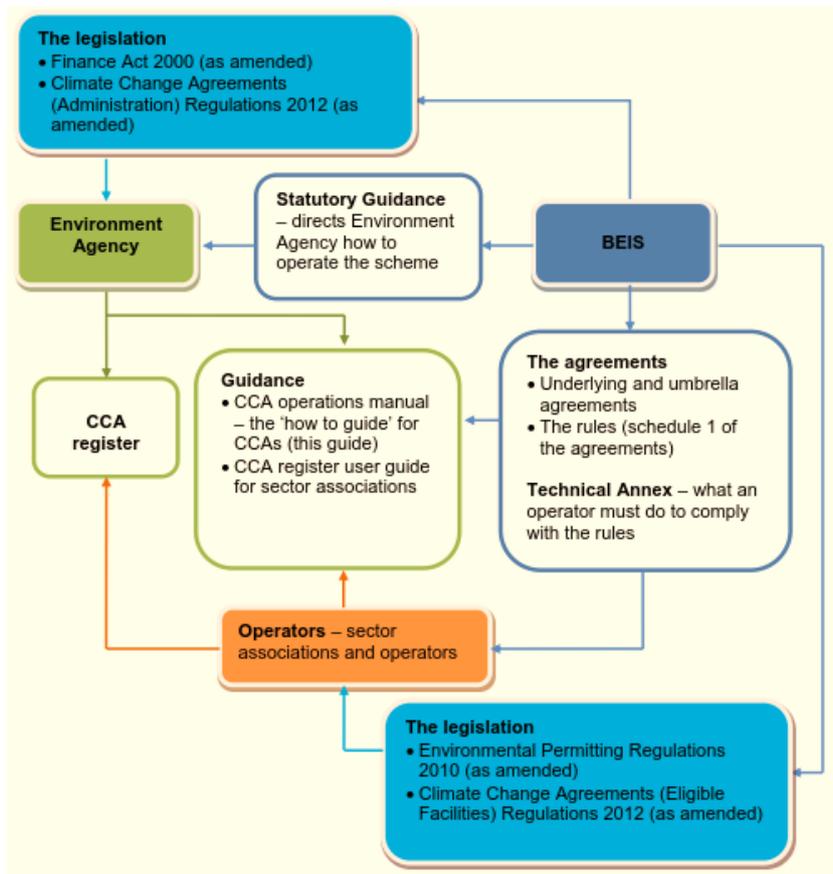


Figure 4: CCA scheme framework (Environment Agency, 2017: 6)

### 4.3 Functioning

CCAs are voluntary agreements under which operations of facilities of certain energy-intensive sectors can receive a discount on the CCL. The rates of CCL are GBP 5.83 (EUR 6.55) per MWh for electricity, GBP 2.03 (EUR 2.28) per MWh for gas, GBP 13.04 (EUR 14.64) per tonne for LPG, and GBP 15.91 (EUR 17.87) per tonne for other fuels. The discount level is currently 90% for electricity and 65% for gas and other fuels.<sup>13</sup> Both CCL rates and the discounts received under CCAs are to be raised from 1 April 2019 within the context of a broader reform of the carbon tax landscape (see more in section 4.4.2). When launched in 2001, the CCA scheme covered 44 sectors, around 12,000 facilities (5500 companies), and nearly 44% of total UK industry emissions (Glachant and De Muizon, 2006: 4). In the latest TP reported, 49 industrial sectors encompassing 7814 facilities were covered by

<sup>13</sup> Originally 80% for all eligible fuels before April 2011, which then changed to 65% until April 2013, the end of the old scheme.

CCA, emitting approximately 25 MtCO<sub>2</sub>e in the base year 2008 (Environment Agency, 2017b)<sup>14</sup>. They are often smaller units of larger companies/businesses<sup>15</sup>.

CCA targets are set and tracked through two-year periods<sup>16</sup> called Target Periods (TPs). The Certification Period (CP) is the time during which a target unit is certified to receive the CCL discount. The discount is given prospectively upon entering into an agreement. If the targets for a given TP are not met by the end of that TP, the discount is not renewed for the next two-year period (i.e. the sequencing CP).

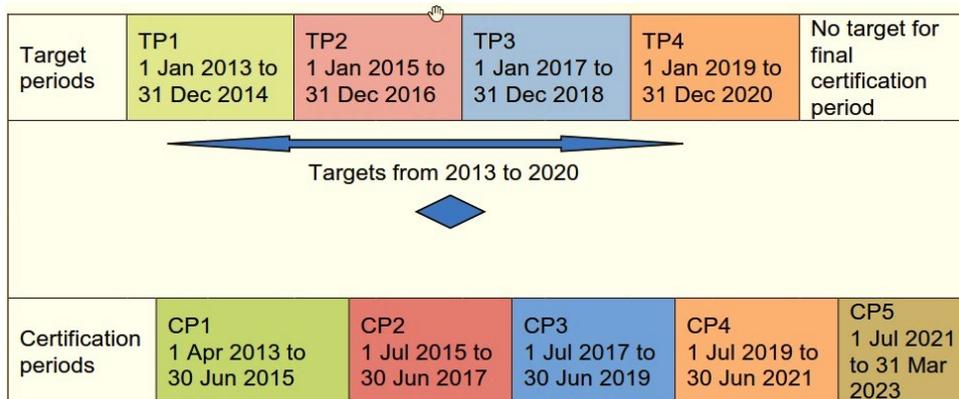


Figure 5: TPs and CPs for the new scheme of CCA (Environment Agency, 2017: 25)

#### 4.3.1 Targets and contractual design

CCAs are a combination of two types of agreements, following a two-tier structure:

- **Umbrella agreements** set commitments for eligible industrial sectors ('sector commitments')<sup>17</sup>.
- **Underlying agreements** allow individual operators to set targets for their target units comprising one or more specific facilities<sup>18</sup>. These targets ('target unit targets') must be of the same type (carbon- or energy-based) as the respective sector commitments can differ in their nature (i.e. being either relative or absolute targets).

Targets can be expressed in terms of energy (kWh, MWh, GJ or PJ) or carbon (kgC), and as either absolute or relative. As a result, there are four possible types of targets: relative energy (e.g. kWh/m<sup>2</sup>),

<sup>14</sup> The emissions are only referring to those covered under CCAs not the total emissions of the companies of concern. See the full list of the sectors in section 4.3.3.

<sup>15</sup> No recent estimate is available of percentage of the emissions associated with companies that have CCAs against total industry emissions.

<sup>16</sup> In the old scheme, the final TP ends at the end of December 2010; then, results are analysed and published in 2011 and entities that have failed to meet their targets lose their discount for the CCL until March 2013.

<sup>17</sup> For phase 1, the umbrella agreements set both a final 2010 target but also interim targets for each of the two-year TPs (2002, 2004, 2006 and 2008). Similarly, for phase 2, the umbrella agreements cover four 2-year target TPs running until December 2020.

<sup>18</sup> A facility can be a piece of machinery, a process, a factory, or an entire site depending on which operations meet the eligibility criteria.

absolute energy (e.g. MWh), relative carbon (e.g. kgC/tonne) or absolute carbon (e.g. tonnes C). The majority of CCA targets have been relative energy targets (Glachant and De Muizon (2006), DECC (2011), and Environment Agency (2017b)).

Initially, three contractual options were offered: 1) one full sector model with one target shared by the whole sector (i.e. performance is measured and assessed collectively only); 2) umbrella agreements between the government and the sector association, with underlying agreements between the government and individual companies; 3) similar to option 2, but with underlying agreements retained and managed by the sectors and approved by the government. Since 2006, option 1 has been discontinued, and a majority of participants have consistently opted for option 2. Therefore, the contractual options were further narrowed down to option 2 in 2013.

### 4.3.2 Governance and key actors

Functioning policy requires a clear and thorough governance framework. Table 3 summarises the key actors and their respective roles under the CCA scheme.

Table 3: Key actors and their roles and responsibilities under CCA (based on NAO, 2007; Environment Agency, 2017a)

Actors	Main roles and responsibilities
Responsible government body i.e. the scheme administrator	<ul style="list-style-type: none"> <li>Negotiate the targets and sign contracts with sector associations and companies</li> <li>Register participants and approve new entrants</li> <li>Assess performance against targets</li> <li>Manage the auditing and penalties regime</li> </ul>
Technical consultant	<ul style="list-style-type: none"> <li>Provide technical support and advice</li> <li>Support and facilitate the target negotiation process</li> <li>Compile the reported results</li> <li>Audit at both target unit and sector association level</li> </ul>
Sector associations	<ul style="list-style-type: none"> <li>Negotiate the sector targets and sign umbrella agreements with the government</li> <li>Facilitate the negotiation of underlying agreements for businesses in their sector</li> <li>Collect and report required data bi-annually, including checking the quality of the data submitted by those in their sector</li> </ul>
Companies	<ul style="list-style-type: none"> <li>Work with their sector association to develop appropriate target unit targets</li> <li>Measure and report its energy use and carbon emissions against agreed targets</li> <li>Collect and report own data bi-annually</li> <li>Take measures to meet own targets</li> </ul>
Indirect actor: HM Revenue and Customs	<ul style="list-style-type: none"> <li>Implement CCL relief</li> </ul>

### 4.3.3 Sector coverage and eligibility

A wide range of industrial sectors, from major energy-intensive processes such as chemical and paper production, to supermarkets and agricultural businesses like intensive pig and poultry farming engage with CCAs<sup>19</sup>. See Table 4 for a list of sectors that had entered into a CCA by the end of TP2.

According to the Operations Manual (Environment Agency, 2017a), the eligibility criteria defining which processes and products may enter into a CCA are defined through two pieces of legislation:

- Industries covered by the Part A(1) or A(2), in Part 2 of Schedule 1 of the Environmental Permitting (England and Wales) Regulations (EPR) 2010 (as amended), which are listed as specific activities and sub-sectors such as energy combustion, metal production, minerals, waste management etc.
- Applying the energy intensity (EI) criteria:
  - Energy-intensive (i.e. energy costs divided by the production value) of at least 10% for the installation, site or sector; or
  - Energy-intensive of at least 3% and an import penetration ratio of at least 50%. The import penetration ratio is the total value of sector imports, divided by the total value of UK sector sales, plus the total sales value of imports, minus the total value of sector exports.

Table 4: Sectors at the end of TP2, 2016 (Environment Agency, 2017b)

No.	Sector	No.	Sector
1	Aerospace	26	Metal packaging
2	Agricultural supply	27	Metal forming
3	Aluminium	28	Motor manufacturing
4	Bakers	29	Non-ferrous metals
5	Brewing	30	Packaging and industrial films
6	Calcium carbonate	31	Paper
7	Cement	32	Pigs
8	Ceramics	33	Plastics
9	Chemicals	34	Poultry meat processing
10	Cold storage	35	Poultry meat rearing
11	Compressed gases	36	Printing
12	Dairy	37	Rendering
13	Data centres	38	Sawmills - dry
14	Egg processing	39	Sawmills - wet
15	Eggs and poultry meat	40	Semiconductors
16	Food and drink	41	Spirits

<sup>19</sup> Before the launch, a limited number of industrial activities were initially identified based on the Integrated Pollution Prevention and Control (IPPC) criteria, including aluminium, cement, ceramics, chemicals, food and drink, foundries, glass, non-ferrous metals, paper and steel. Under current eligibility criteria, sector coverage is much larger. There were also lobby efforts made by sectors that would benefit from the tax exemption. Furthermore, all eligible sectors opted for a CCA upon commencement. (Glachant and De Muizon, 2006: 4).

No.	Sector	No.	Sector
17	Foundries	42	Steel
18	Geosynthetics non-woven	43	Supermarkets
19	Glass	44	Surface engineering
20	Horticulture	45	Surface engineering heat treatment
21	Kaolin and ball clay	46	Textiles
22	Laundries	47	Textiles energy intensive
23	Leather	48	Tyres
24	Malting	49	Wallcoverings
25	Meat	50	Wood panels

#### 4.3.4 Monitoring and enforcement

The CCA has set up rules and processes for monitoring and enforcement. At the end of each TP, energy consumption and throughput data for every target unit must be reported via the register (by 1 May of the following year). Audits on selected facilities and sector associations are carried out to verify eligibility and performance. This selection of facilities is made by either a risk-based approach<sup>20</sup> or random selection. The assessment may be desktop-based or a full-site audit (more details on the CCA auditing system, see Environment Agency, 2017a: 64-70).

The CCA was originally based on a combination of principles of collective and individual liability. If the sector commitment was achieved, all facilities under that sector were considered to be in compliance. If a sector commitment was not achieved, facilities within that sector were assessed individually and those who did not meet their targets became ineligible for the following TP's. However, these facilities did not need to pay-back the rebate they received during the non-compliance period. At the end of the next TP, a facility could again benefit from the discount if it complied with the next interim target<sup>21</sup>.

To enhance fairness and accountability, compliance standards have been shifted to purely individual liability, meaning that target units are each required to meet their own targets in order to qualify for compliance, regardless of whether the sector as a whole has met its target. Following the principle of individual accountability, individual target unit performance data is also published (while in the old scheme only aggregate sector data was published).

Furthermore, operators who miss their targets but wish to remain compliant with the scheme and hence eligible for discounts have two alternatives. Operators may use banked surpluses accrued by over-performing during previous TP(s); or they may pay a 'buy-out fee' of GBP 12 (EUR 14) per tCO<sub>2</sub>e for TP1 and TP2<sup>22</sup>, which will be raised to GBP 14 (EUR 16) per tCO<sub>2</sub>e for TP3 and TP4<sup>23</sup>.

<sup>20</sup> A scenario where one or more factors increase the likelihood of errors in the information held about the facility.

<sup>21</sup> In 2010, under the old scheme, if a facility missed its overarching 2010 target, then it was potentially liable to a fine equal in value to the discounts accumulated over the whole phase.

<sup>22</sup> This was in line with the study comparing interim prices for phase I of CRC and is also close to the CCL rate for electricity (DECC, 2011).

<sup>23</sup> Such fees are paid to a consolidated fund administrated by Her Majesty's Treasury.

Finally, there are also financial penalties for minor infringements, e.g. missed reporting deadlines or inaccuracies in data. For instance, if a facility fails to provide the request information by the given deadline or fail to inform the government any changes as required by the underlying agreement, a penalty which is the amount of the greater of GBP 250 (EUR 278) or 10% of the annual value of its CCL discount would apply. Furthermore, if a facility provides inaccurate baseline data or target period data, the penalty is based on the extent of inaccuracy i.e. the greater of GBP 250 (EUR 278) or GBP 12 (EUR 14) per tonne of CO<sub>2e</sub> of the difference would apply. See more details regarding all the cases that would face financial penalties and the corresponding level of penalties in the CCA Operation Manual (Environment Agency: 2017: 59-60).

#### 4.4 Interlinkages with other policy instruments

Like many other countries, the UK's approach to mitigation consists of a collection of varied policies and instruments. Such a complex landscape usually leads to significant policy overlap and interactions. While the extent to which companies are subject to these overlaps varies by sector and is dependent on the characteristics of the business, Figure 6 illustrates the main UK policies and their overlap<sup>24</sup>. This includes CCL-CCA interactions, which will be addressed in chapter 5 and the reporting requirements policy basically provides the indirect and reputational driver to achieve the energy efficiency and conservation (Drummond, 2013: 44). Hence, the analysis of this section focuses on the other two interlinkages, namely CCA with EU ETS and CRC, respectively.

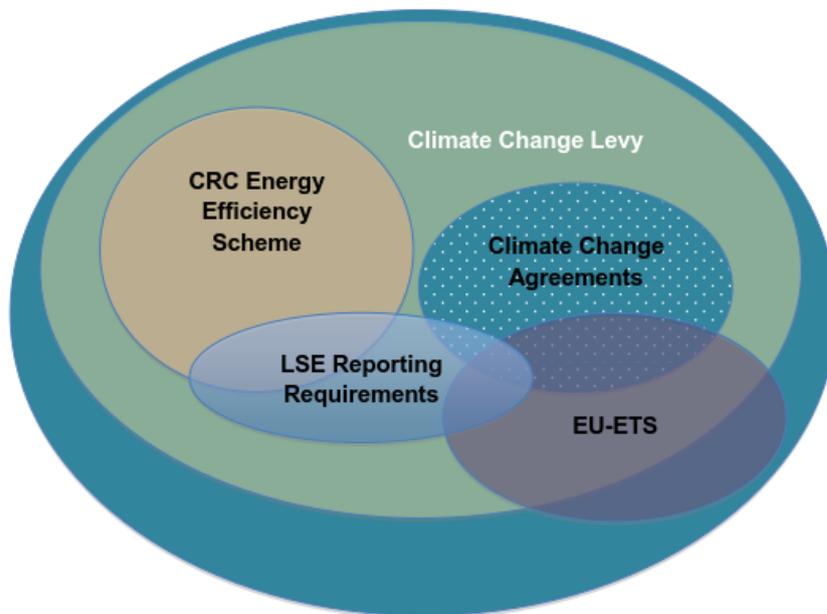


Figure 6: Policy landscape and scope overlap (Drummond, 2013: 42)

<sup>24</sup> London Stock Exchange (LSE) Reporting was a policy developed when Drummond (2013) was published and is usually referred to as the GHG Director's Report, or mandatory carbon reporting. It imposes a duty on all quoted UK companies to calculate and report their annual GHG emissions in their Director's Report.

#### 4.4.1 CCA and EU ETS

EU ETS was introduced in 2005 covering power plants and manufacturing installations, with certain overlap of coverage with the CCA.<sup>25</sup> At that time, an option where facilities that were already in equally stringent energy or carbon reduction agreements were allowed to opt out of the EU ETS existed tentatively<sup>26</sup>. Among the approximately 500 installations covered by both the EU ETS and CCAs, about 330 opted out back then (DEFRA, 2011: 3). For those remaining under both policies, a 'double counting' rule was applied in the reporting methodology for CCAs and adjustments to CCA targets were performed, affecting 23 sectors<sup>27</sup>. This was a rather complex process that increased the administrative burden on both the government and companies<sup>28</sup>. To avoid this overlap, energy used in EU ETS installations is exempt from reporting and compliance requirements under CCA targets in the new scheme<sup>29</sup>. The CCA targets are adjusted correspondingly.

#### 4.4.2 CCA and CRC

Introduced in 2010 and aiming to incentivise energy efficiency and emission reductions in large energy users, the Carbon Reduction Commitment Energy Efficiency Scheme (CRC) operates as a tax on CO<sub>2</sub> emissions from energy consumption. Levied at the company rather than facility level (unlike the CCL or EU ETS), CRC is mandatory for all companies and public sector organisations that use over 6000 MWh of electricity through half hourly meters. They are required to report their annual electricity and gas use, which is converted into a carbon allowance that must be purchased<sup>30</sup>. The CRC acts as a downstream carbon tax, focusing on large, non-energy-intensive businesses and the public sector. Initially, there was some overlap in the coverage between the CRC (an organisation-based scheme) and the CCA (a site-based scheme). During consultation to design the new CCA scheme, the government also decided to reduce overlap by applying a simpler rule under which energy supplied to a CCA facility does not count towards qualification or requirements under the CRC<sup>31</sup>. Some analysts argue that excluding energy covered under the CCA and the EU ETS from the CRC reduces the potential efficacy of the policy mix by favouring the CCA over the potentially more effective CRC tool (Drummond, 2013: 5). At the same time, CCAs may contribute to the feasibility of successful implantation of the CCL in broad terms (Ibid: 44).

After reviewing how to simplify and improve the effectiveness of the carbon tax landscape, the government has decided to abolish the CRC, effective at the end of the 2018–2019 compliance year, and shift to a single tax CCL. Its standard rates will be increased to recover the tax revenues lost by closing CRC. Meanwhile, the discount rate for firms with a CCA will increase to 93% for electricity,

<sup>25</sup> The EU ETS, which covers 40% of UK emissions, is a key EU measure driving energy efficiency improvements in the industrial sector (Rosenow and Misra, 2015: 17).

<sup>26</sup> This opt-out was suspended for the fifth target period of CCA during the old scheme (2009-2010).

<sup>27</sup> The modification adjusted the target unit as well as the sector target.

<sup>28</sup> See more details in DECC, 2011.

<sup>29</sup> According to the Environment Agency (2017a), the eligible facility is the installation or part of a site, which is eligible to be covered by a CCA. The target facility is the eligible facility, less any part(s) consuming energy covered by EU ETS. The target facility is the part to which CCA targets apply and whose energy use must be reported under CCA.

<sup>30</sup> Participants have the option of paying a 'forecast' price at the beginning of each year, or a higher 'compliance price' at the end of each year. In the financial year 2016/17, the forecast price was GBP 16.10/tCO<sub>2</sub> (EUR 18.75/tCO<sub>2</sub>), whilst the compliance price was GBP 17.20/tCO<sub>2</sub> (EUR 20/tCO<sub>2</sub>).

<sup>31</sup> Energy already covered under the EU ETS is also excluded in the CRC.

and 78% for other fuel types, so that participants will not pay more in CCL than they would under the currently expected Retail Prices Index increase for that year<sup>32</sup>.

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<sup>32</sup> See more on the main and reduced rates for CCL in the government policy paper published 16 March 2016:  
<https://www.gov.uk/government/publications/climate-change-levy-main-and-reduced-rates/climate-change-levy-main-and-reduced-rates>

## 5 IMPACTS OF THE POLICY INSTRUMENT

### 5.1 Effectiveness

In principle, the energy-related emissions in any specific sector of an economy can be reduced by influencing any of the key factors illustrated in the formula below.

Formula 1: Decomposing emissions

$$(a) \text{ Energy – related emissions in sector } X = (b) \text{ Output level in sector } X \times (c) \text{ Energy intensity in sector } X \times (d) \text{ Carbon intensity of energy in sector } X$$

CCAs mainly address factor *c* (targets are typically set with a focus on reducing energy intensity)<sup>33</sup>. Note that with the recent coal phase-out in electricity generation, factor *d* is also on a downward trend, which could accelerate the contribution of the energy intensity factor to overall emissions reductions.

#### 5.1.1 Reported emission savings and different estimations of ‘real’ additional reductions

Based on the reports produced bi-annually by the CCA administrators, there have been considerable carbon emission savings compared to the baseline year<sup>34</sup>. Table 5 provides an overview. Note that there is little comparability between the TPs as the sectors and facilities covered vary and that throughout Phase 1, the steel sector, which accounted for about a quarter of all primary energy consumption in CCA sectors and a majority of the reported savings, has experienced serious operational difficulties and structural changes<sup>35</sup>.

Table 5: Reported emission savings against base line year emissions (AEA, 2011; Environment Agency, 2017b)

Target Periods	Reported absolute emissions reduction against base line year emissions (MtCO <sub>2</sub> /year)
TP1, Phase 1	10.4
TP2, Phase 1	8.9
TP3, Phase 1	7.3
TP4, Phase 1	9.2
TP5, Phase 1	10.5
TP1, Phase 2	3.1
TP2, Phase 2	4.9

<sup>33</sup> There is a so-called ‘rebound effect’, whereby some or all of the expected reductions in energy consumption from energy efficiency improvements may be offset by an increasing demand for energy services in the same or other sectors.

<sup>34</sup> By calculations based on energy (mainly) and reported carbon data.

<sup>35</sup> For each TP of Phase 1, the reported savings from the steel sector only were 8.0, 5.2, 4.6, 5.9, and 8.7, respectively.

Not all of these are additional reductions brought about by the CCA, as multiple factors may have contributed to the emission reductions.<sup>36</sup> Several economic modelling studies have tried to quantify the 'real' additional savings<sup>37</sup>:

- Defra's modelling estimated that if sector targets were met, the additional reductions brought by CCAs would be 1.9 MtC in both 2006 and 2010 (NAO, 2007: 31); making it one of the key policy contributors to the expected carbon savings towards 2010 (Ibid: 10)<sup>38</sup>.
- Ekins and Etheridge (2005) concluded that the CCL package as implemented, including the 'carrot' CCA, "achieved a greater carbon reduction than a no-rebate CCL would have done by itself". They attribute this to the 'awareness effect':<sup>39</sup> managers would become aware of cost-effective efficiency enhancement projects as they started to benchmark their energy use (so called).
- Barker et al. (2007) focused on estimating total energy demand reduction (rather than emission reductions) by comparing two scenarios: the base case (includes the introduction of CCAs and the associated Carbon Trust incentives) and the reference case (without policies). Overall, the system-wide reduction modelled in the base case was estimated at 4.2 million tonnes of oil equivalent (Mtoe), or 2.6% of the total energy demand in 2010. This model further demonstrates a macroeconomic rebound effect of 19%; a 3.3% reduction of CO<sub>2</sub> emissions; negligible effects on inflation; and a slight increase in economic growth through improved international competitiveness.
- However, modelling by Cambridge Econometrics in 2005 suggested that most sectors in CCA would have met their targets without any efficiency improvements additional to what they would have done in its absence, driven by a combination of technological change and relative decline in energy-intensive sub-sectors of UK's manufacturing sector (NAO, 2007: 27).

Overall, a majority of the analyses have shown the CCA to be effective. Besides quantitative analyses, there are also qualitative analyses that provide evidence of the 'awareness effect'. For example, in a 2007 survey, 23 out of the 33 businesses subject to CCA made reference to a 'refocusing of attention on energy use' following the announcement introducing the package policy. A number of companies surveyed also noted that significant efforts were undertaken at the start of the scheme to negotiate targets, gather data, install monitoring and reporting equipment, and develop procedures (Ibid: 30)<sup>40</sup>.

### 5.1.2 Assessment of CCA-CCL package versus CCL alone

More recent evidence suggests that the CCL alone has been responsible for a more pronounced increase in energy efficiency than the CCL-CCA package, indicating that the energy efficiency targets in CCAs provide a weaker incentive to decrease energy use than the stand-alone price incentives of the CCL (Napp et al., 2013:636-637). One of the most recent studies points out that, in theory, an omniscient government could implement a combination of a tax discount and reduction targets that induce at least as much abatement as would exist under the full tax rate. However, the government is unlikely to have perfect information about firm-specific abatement costs, and it might not even be

<sup>36</sup> The reported numbers do not differentiate between reductions directly as a result of CCAs and those that would have occurred regardless (NAO, 2007: 6).

<sup>37</sup> The validity of studies that use simulated trajectories of energy use as a baseline against which to measure the impacts of a policy instrument depend critically on whether the counterfactual baseline is well defined (Martin et al., 2014: 4).

<sup>38</sup> Together with EU ETS, CCL, Renewable Obligations and Voluntary Agreements with car manufacturers package, as top five mitigation policies.

<sup>39</sup> See also Liu et al. (2016: 7).

<sup>40</sup> The 'announcement effect' is a similar effect upon the CCL. Both effects tend to be stronger at the instruments' onset.

willing to impose stringent targets for fear of jeopardising international competitiveness and exacerbating distortions in marginal abatement costs (Martin et al., 2014:3). Martin et al. (2014) further attempts to estimate the effect of the CCL by comparing plants that pay the full tax rate with plants that pay just 20% of the tax because they are in a CCA. Their results clearly show that the CCL (without a CCA) produced substantially more reductions in plant-level energy intensity than the CCA.

## 5.2 Cost efficiency

As pointed out by the OECD, the economic efficiency of voluntary approaches is generally low because they seldom incorporate mechanisms to equalise marginal abatement costs across all entities, and because environmental targets tend to be set for individual firms or sectors rather than at a national level (OECD, 2003: 12). However, they can outperform traditional ‘command-and-control’ regulations because they provide a more flexible path to reach a given target (Ibid.). Cost estimates for emission reductions achieved through the CCA are unavailable at this point, so a valid evaluation of the instrument’s cost efficiency is impossible.

In 2006, the UK government developed a ‘cost-effectiveness indicator’ for CCA and estimated that the scheme would bring the UK a net benefit of GBP 90 (EUR 102) for every tonne of carbon the policy saves (NAO, 2007: 24). This net benefit arises because businesses were expected to save more in energy bills than they would spend on new investments. AEA Technology calculated the value of lifetime savings in energy costs, net of investment expenditure, to be between GBP 2.3–3.2 billion (EUR 2.6–3.6 billion) (Ibid.). The GBP 90/tC (EUR 102 tC) indicator also reflected the benefit of improved air quality as a result of fewer emissions, valued at GBP 0.5 billion (EUR 0.6 billion) over the lifetime of the policy.

Another relevant factor for cost efficiency is administrative costs for both the government and scheme participants. Some surveys have shown that most businesses considered administration of the CCA to be simple (NAO, 2007). The government has also provided estimates of the administrative costs of CCAs (with the old scheme design) for the period of 2012–2020, which totalled GBP 52 million (EUR 29 million) (see details in Table 6). An impact analysis showed further net savings for admin costs for industry upon simplifying and streamlining the scheme design for phase 2 (DECC, 2011: 35). This shows that the administration cost of the CCA scheme is rather low, for example in comparison with another peer policy CRC, which was estimated to be GBP 534 million (EUR 606 million) for the period of 2011–2030 (NAO, 2011)<sup>41</sup>.

Table 6: Administration costs (2012–2020), estimated based on old scheme design (DECC, 2011: 35)

Cost category	£ (000), (2009 Figures)
Sector association	4,235
Operator	31,573
Total admin costs for industry	43,740
Cost to government	7,933

<sup>41</sup> The administration costs of CCA would be GBP 115 million (EUR 130 million) over the course of 20 years.

### 5.3 Co-benefits and side-effects

CCAs deliver a variety of co-benefits that are similar to those delivered by other policies driving energy efficiency improvement for industry:

- Reduce operating costs and lower energy bills of industry;
- Reduce emissions of other air pollutants;
- Improve international competitiveness of industry and create new market opportunities.

Building the market for products, tools and services that promote energy efficiency would place UK businesses and industry in a prime position to increase the export of knowledge, skills and products, and to attract flows of external finance (BEIS, 2017: 68). As a reference, the UK energy efficiency sector already turns over GBP 20.3 billion (EUR 23.0 billion), employs 144,000 people, and sells exports worth over GBP 1 billion (EUR 1.1 billion) (Ibid.). This refers to the entire energy efficiency market for the economy, not only the industrial sector.

There is however a risk of windfall profit. Between 2001 and 2013, some businesses had benefited from the tax discount despite not meeting their individual targets. They had relied on others' overachievement within their sector (NAO: 2007, 5)<sup>42</sup>. In addition, the scheme's design allowed businesses to enjoy the tax discount at the beginning of the first CP by simply committing to CCA targets during the first TP (without delivering them). Compliance (actually delivering the targets of a certain TP) guarantees entitlement to the discount for the following period<sup>43</sup> (see section 4.3).

By setting relatively easy to achieve targets, sectors may as a whole receive huge financial gains. In the current scheme, the data centre sector, as one of two newly joined sectors, has set nonlinear targets in which the intensity improvement for TP1 is only 1%. As reported by sector association, the sector as a whole has paid much less in top-off fees of GBP 61,000 (EUR 69,000) than they have received in financial gains, i.e. CRC exemption and CCL rebates (estimated 29.7 million (EUR 33.7 million)) for this TP (techUK, 2015).

### 5.4 Success factors and challenges

In reviewing the experience of the CCA over the past 18 years, some success factors and lessons can be distilled, some of which are reflected in the evolution of the scheme's design.

#### 5.4.1 A stick-and-carrot approach

As mentioned earlier, a unique feature that distinguishes the CCA from other voluntary climate policy instruments is its stick-and-carrot approach. Despite its participation being fully voluntary, the CCA is embedded in a broad policy package (i.e. with CCL), where the cost of not participating (i.e. paying full rate under CCL) is a clear, credible threat that provides industry with a strong incentive to participate.

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<sup>42</sup> As mentioned in chapter 4, this loophole was closed in April 2013 upon implementation of the new scheme.

<sup>43</sup> There is no numbers available for calculating the amount if there is a respective repayment for the tax discount of the corresponding period.

#### 5.4.2 Target structure and setting

Another creative feature of the CCA is its two-tier structure: the combination of sector targets and individual targets. This structure, as well as the target negotiation, reporting, and enforcement processes, have also brought the sector associations into the centre of the scheme. Rather than relying on direct government-company interactions, the sector associations smooth operations and communication processes; enhance administrative efficiency; and offer sector-specific expertise, e.g. the identification of cost-effective mitigation potentials. Despite these various positive effects, cautious attitude must be taken, especially regarding their role in the target negotiations and target setting because they could also play a lobbying role in protecting the companies under them (who wish to avoid 'environmental policy burdens').

Target setting is critical to ensure the overall environmental effectiveness, so the following elements are important to consider:

- **Type of targets:** As described previously, CCA allows targets to be expressed in terms of energy or carbon and as either absolute or relative. In practice, the vast majority of CCAs are set as energy intensity targets. Given that the UK defines its reduction goals in terms of carbon budgets, it could be argued that there should be a greater push towards absolute carbon targets. That being said, there is no direct link between stringency and the type of target,<sup>44</sup> so the key is still to ensure stringency.
- **Stringency of targets:** Stringency is demonstrated by the difference between the target level and 'business-as-usual' level of the relevant sectors or facilities. In CCAs, targets are negotiated between industry and the government. Some studies have demonstrated the potential for improvement in CCA target stringency (NAO, 2007; Glachant and De Muizon, 2006; Martin et al., 2014).
- **Importance of data and third-party analysis:** The collection of concrete and credible data and information regarding sector activities, trends, mitigation potential and costs, best available technologies, etc., to inform target setting is very important. The involvement of independent third-party actors with high qualifications, and sector or technical experts, e.g. in forms of expert committee or advisory group (see more in the sub-section of 'monitor and enforcement') are also critical along the implementation phase of the policy as data quality needs to be continuously ensured).
- **Long-term certainty:** CCAs include end-of-scheme as well as interim targets (every two years). The former covers a spectrum of eight (in the new scheme) or ten years (in the old scheme). This long-term perspective encourages CCA participants to invest in energy efficiency measures with longer pay-back periods. The interim targets ensure that companies do not postpone cost-efficient measures until the end.
- **Target review and revision:** Like many other policies, CCA also has built in review processes. The 2006 and 2008 reviews were mainly to review targets under CCA while consultations on changes to CCA scheme occurred in 2009 and 2010 (DECC, 2011). Between the first and second phases there was a more comprehensive review of the scheme. During the phase of the new scheme a target review and buy-out price review was conducted in 2016<sup>45</sup>. A full

<sup>44</sup> For example, for sectors or sub-sectors whose economic output is rapidly declining, e.g. due to external factors or economic structural shift, having an absolute carbon target based on current emissions level could also create windfall profits. Maybe it is not surprising that the steel sector is one of the very few sectors that has been opting for absolute targets since 2001.

<sup>45</sup> See more on the government webpage: <https://www.gov.uk/government/consultations/climate-change-agreements-discussion-paper-on-the-target-review-2016-and-buy-out-price-review>

scheme review is scheduled for 2018. Such review processes also provide opportunities for the review and revision of targets. However, despite this provision there has been some evidence that the revised post-review targets were still not stringent enough in some sectors<sup>46</sup>.

### 5.4.3 *Monitoring and enforcement*

Unlike pure voluntary agreements, the CCA has set up a system to monitor and assess target achievements and sanctions for non-compliance, including both disqualification of the levy discount for the following TP, and financial penalties in case of minor infringements (see more in section 4.3). Besides defining a clear timeline, rules, and processes for monitoring and reporting, the government also makes the target assessment results transparent, which increases credibility and accountability. The technical support and service provided by a qualified third-party has proven as key for validating and verifying submitted data and information. In addition, the use of an electronic register further enhances administrative efficiency; reduces costs (for both administrator and participants); and improves the data quality checking process, i.e. automating some data consistency cross checks and identifying missing data.

Generally speaking, the CCA has also built up a credible compliance regime. One of the key lessons learned is the importance of individual accountability: In the new scheme companies are also accountable for their own targets as set by the underlying agreements and cannot simply be 'free-riders', i.e. rely on others in their sector to deliver. Perhaps, another improvement of the compliance regime of CCA may be requiring non-compliance companies to pay-back the rebate corresponding to the non-compliance period.

### 5.4.4 *Simplification, streamlining and reducing policy overlap*

As a policy that works with relatively broad base sectors and a large number of participants, it is important for the CCA to be continuously improved by simplifying, streamlining, and, perhaps most importantly, addressing and reducing policy overlap. Some key examples are as follows:

- Removing overlaps with the EU ETS and the CRC (see more in section 4.4);
- Streamlining the content of agreements, baseline years (i.e. from different baselines to a single year), and administration (i.e. moving from DECC to the Environment Agency, which already administrates EU ETS and the CRC);

There is still more space to further streamline reporting with, e.g., the reporting-scope-overlaps illustrated by SLR Global Environmental Solution (2017).

### 5.4.5 *Enabling environment*

Besides the 'stick-and-carrot' approach itself, mandatory carbon budgets provide a strong enabling environment for voluntary agreements to perform more effectively. As detailed by in Fankhauser et al (2018), the Climate Change Act provides both a statutory long-term target (for 2050) and a set of statutory medium-term targets (over a period five years). It also assigns the CCC to produce independent annual progress reports with details on whether or not the government is on track to stay under its carbon budgets. The reports are debated in Parliament and the government has a statutory

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<sup>46</sup> For example, some sectors' 2006 revised targets for 2010 were still below their already achieved level then, meaning that little efforts would be needed for the four years ahead (Glachant and de Muizon, 2006).

obligation to respond. This creates a binding process to hold government to account not just to Parliament but to third parties and, potentially, to the courts (i.e. a judicial review).

#### **5.4.6 *Role of the instrument in the policy mix***

Finally, looking into the future, energy efficiency alone will not be enough to deliver the mitigation target of the industrial sector in the UK, accounting for 25% of its total emissions (BEIS, 2017b: 40). Energy-intensive industries will require steps beyond energy efficiency. Towards 2030, this will require industry to make progress in switching from fossil fuel use to low-carbon fuels such as sustainable biomass (Ibid. 64). Thus, the key challenge ahead for the CCA scheme (and CCL) is to evaluate, whether it is ‘fit for purpose’, and how to best design the industrial sector mitigation policy mix.

## 6 TRANSFERABILITY

### 6.1 General comparability of the context

Both UK and Germany are highly developed, industrialised economies with similar ambitious emission reduction objectives.

With its Energy Concept ('Energiekonzept') from September 2010 and the decisions from the summer of 2011, Germany initiated a far-reaching transformation of its energy system, the 'Energiewende', which is underpinned by ambitious mid- and long-term targets for reducing GHG emissions with two strategic level core objectives: developing renewable energy and improving energy efficiency. With primary energy consumption and electricity consumption to be cut by 20% and 10% by 2020 and 50% and 25% by 2050 (all against 2008 levels), and a relatively high share in final energy consumption of almost 30% from the industrial sector, the latter will have to contribute to the national target, too (Ibid: 77). This is becoming increasingly urgent, as Germany is not on track to meet its 2020 targets. In the Climate Change Action Plan ('Klimaschutzplan'), Germany has also set sectoral targets up to 2030 among which target for the industry sector, covering both large industries under EU ETS and small ones belonging to the Effort Sharing Decision.

The political and administrative context, e.g. regarding the capacities of government and industries to design and implement climate policies, are also fairly comparable. Indeed, both Germany and the UK have implemented a series of industry energy efficiency policies across all types of instruments in their policy mix (Schlomann et al., 2015a: 51-51; see also Schlomann et al., 2015b, and Rosenow and Misra, 2015).

There is one difference regarding the overall climate policy architecture of the two countries: While the UK government is legally obligated to reduce emissions via the carbon budgets, and can be held accountable by Parliament, an equivalent legal context does not exist in Germany. This provides also an opportunity to establish a similar legislative framework in Germany<sup>47</sup>.

There is a significant difference between the role of the industry in the two economies: The UK is shifting towards a service economy and is already significantly more deindustrialised than Germany. This impacts energy intensity (higher in Germany), imports (lower intensity in Germany, likely because high-carbon goods are produced domestically), and economic importance of the industrial sector, among others. This further means that industrial emissions reductions are more important in order for Germany to achieve its climate ambitions.

UK has a lower carbon electricity mix and greater domestic access to natural gas, i.e. a good availability for low-carbon substitution; whereas Germany is more reliant on coal. Yet, the industrial energy fuel mix is surprisingly similar, with very comparable shares of electricity, natural gas, and the highest carbon alternative.

Table 7 provides an overview of key indicators that assess the comparability of the context between Germany and the UK, which supports the key observations above. Overall, the general comparability can be considered rather high.

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<sup>47</sup> This may be done in the context of the planned climate change law to be developed in 2019.

Table 7: Key indicators to assess comparability of the UK and German context

	Germany	United Kingdom	Comparability
<b>General information</b>			
GDP per capita (in USD; 2017) <sup>48</sup>	44,549.69	39,734.59	Comparable
Exports (in billion USD, 2017) <sup>49</sup>	1,401 (33.8% of GDP)	436.5 (15.2% of GDP)	Not comparable, Germany is considerably more export-oriented
Percentage of emissions imported relative to domestic emissions (2014) <sup>50</sup>	14.66%	37.9%	Not comparable, the UK has considerably more imported emissions likely related to higher deindustrialisation.
Carbon intensity of exports (kg CO <sub>2</sub> /USD traded) <sup>51</sup>	0.21	0.21	Comparable
Carbon intensity of imports (kg CO <sub>2</sub> /USD traded) <sup>52</sup>	0.52	0.63	Roughly comparable, UK imports goods with a higher carbon intensity.
<b>Climate policy ambition</b>			
2020 GHG emission reduction goal (compared to 1990 in %) <sup>53, 54</sup>	As close as possible to -40	-42	Comparable
2050 GHG emission reduction goal (compared to 1990) <sup>53, 54</sup>	At least 80-95	At least -80	Comparable
GHG emission reduction targets for industry <sup>55, 56</sup>	49-51% below 1990 levels by 2030	34% below 1990 levels by 2020	Difficult to compare given different time frames and industrial histories.

<sup>48</sup> Statista 2018a and 2018b

<sup>49</sup> Central Intelligence Agency 2018a and 2018b

<sup>50</sup> Ritchie & Roser 2018

<sup>51</sup> Ritchie & Roser 2018

<sup>52</sup> Ritchie & Roser 2018

<sup>53</sup> Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

<sup>54</sup> Committee on Climate Change 2016

<sup>55</sup> Clean Energy Wire 2018

<sup>56</sup> Department for Business, Energy, & Industrial Strategy 2018

	Germany	United Kingdom	Comparability
<b>Relevant features of the energy system</b>			
Carbon intensity of electricity supply (gCO <sub>2</sub> e/kWh), 2013 <sup>57</sup>	485	469 (has significantly decreased since)	Comparable, becoming less comparable as UK has made fast progress since 2013, but comparable for overall period.
Overall energy intensity (ktoe/GDP) (2016) <sup>58</sup>	0.089	0.073	Not fully comparable, energy intensity significantly higher in Germany (in line with expectation given difference in industrial structure)
Dominant fuels used in industry (2016) <sup>59, 60</sup>	Natural Gas (31%), Electricity (31.6%), Hard Coal (14%)	Natural Gas (36%), Electricity (33%), Petroleum (17%)	Comparable
<b>Relevant data on industrial emissions</b>			
Emissions from energy use by manufacturing industries and construction (MtCO <sub>2</sub> e) <sup>61</sup>	127	54	Not comparable, lower in UK (in line with economic structure and low-carbon energy mix)
Emissions from energy industry (MtCO <sub>2</sub> e) <sup>62</sup>	335	134	Not comparable, lower in UK (in line with economic structure and low-carbon energy mix)

## 6.2 Properties of the instrument

As a well-designed, voluntary agreement policy embedded in a bigger policy package (with a ‘stick-and-carrot’ approach), CCA is generally a flexible and adjustable instrument and is transferable to Germany as a model.

Over the past two decades, the UK government has also developed numerous and detailed technical guides, operation manuals, templates and samples, etc., alongside consultation papers (in the different rounds of reviews), which others may draw on and adjust to their own specific situation. The high comparability of the two countries’ contexts and policy landscapes also illustrates the value of the

<sup>57</sup> Moro & Lonza 2017

<sup>58</sup> OECD Stat 2016b

<sup>59</sup> AGEB 2016

<sup>60</sup> Department for Business, Energy, & Industrial Strategy 2017b

<sup>61</sup> OECD Stat 2016a

<sup>62</sup> OECD Stat 2016a

existing materials and approaches of analysis from the UK, e.g. on policy interactions and cost-benefit assessments.

Furthermore, there are additional benefits for the companies, e.g. reducing energy bills and developing technologies and products in the energy efficiency markets that could be exported overseas.

The exact pathway to introduce a similar instrument in Germany would need further review of the current and planned policy landscape as well as specific sector context.

There is no carbon or energy tax like the CCL applied to energy-intensive industry in Germany yet. After briefly reviewing the policy landscape and based on an interview with an academic expert from the UK<sup>63</sup>, two potential pathways to transfer the CCA model to Germany have been identified<sup>64</sup>:

- 1) As a pre-condition to the entitlement of exemption or discount from existing energy levies, e.g. from the renewable energy surcharge (EEG-Umlage), or a new carbon tax<sup>65</sup>.
- 2) As a reference to strengthen and modify the relatively new Energy Efficiency Networks (EENs) initiative, which is currently designed as a purely voluntary agreement, e.g. by adding a tax rebate element to beef up these networks (linking to option 1), or enhancing requirements related to target setting, monitoring, reporting and compliance. The EEN initiative is implemented by the German Energy Agency (dena) on behalf of the Federal Ministry for Economic Affairs and Energy (BMWi) and in partnership with the German Environmental Ministry (BMU)<sup>66</sup>. An EEN consists of eight to 15 companies in a region or industry that voluntarily agree to form the network, with each company setting an energy conservation target alongside an overall network efficiency target. The government is providing different support, e.g. in the form of information and instruments for practical implementation. Implementation of a network is subject to annual monitoring. In December 2014, a voluntary agreement was signed by the German government and 18 industry associations to generate 500 EENs until 2020. Despite being a purely voluntary approach, the German government expects EENs to be the highest contributor to energy and CO<sub>2</sub> savings towards 2020 among all policy measures that address the industrial sector in the National Action Plan on Energy Efficiency (NAPE), which is a comprehensive strategy launched in December 2014 (Schlommann et al., 2015a: 78).

In any case, when considering introducing a new CCA-like instrument, an overall assessment of the potential interactions between such an instrument and other existing and planned energy efficiency and climate policy instruments for the industrial sector is needed to avoid potential conflicts; facilitate higher synergy; and streamline administration.

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<sup>63</sup> Telephone interview with the expert conducted on 26 June 2018.

<sup>64</sup> The potential pathways are outlined here to generate further policy discussions; while the details of these existing policies and initiatives still need to be further examined to make more specific recommendations, which are out of the scope of this study.

<sup>65</sup> In Germany, there are discussions of carbon tax proposals but no decisions have been made. Please refer to another case study in this project, 'The Carbon Tax in Sweden', to learn more about how a new carbon tax could potentially work in Germany.

<sup>66</sup> See more information on the initiative: <http://www.effizienznetzwerke.org/>

### 6.3 Potential impacts

As a reference, the table below provides an estimate of the EEN initiative's impacts on final energy, primary energy, and CO<sub>2</sub> emissions. As mentioned above, it is a purely voluntary agreement (carrot without stick), so a CCA-like policy could potentially lead to even more energy savings and emission reductions in Germany<sup>67</sup>.

Sector	Key policy measures of the NAPE (partly) addressing industrial companies	Impacts		
		Final energy [PJ]	Primary energy [PJ]	CO <sub>2</sub> emissions [Mt CO <sub>2eq.</sub> ]
Cross-sectoral	Introduction of a competitive tendering scheme for energy efficiency	10.7-21.5	25.7-51.6	1.5-3.1
	Support of Energy Performance Contracting	3.2	5.4	0.3
Industry & Tertiary	Energy Efficiency Networks Initiative	50.0	75.0	5.0
	Upgrading the KfW efficiency programme	10.9	29.4	2.0
	Obligation to perform energy audits for non-SMEs (implementation of Art. 8 EED)	33.3	50.5	3.4
Appliances & Products	National Top Runner Initiatives	15.8	37.9	2.3

Figure 7: Main policies addressing industrial sector of the NAPE and their impacts (Schlommann et al., 2015a: 78)

### 6.4 Conclusion

The CCA, packaged together with the CCL, is one of the oldest climate policies in the UK and is one of the key instruments to deliver both its carbon budget targets as well as its clean growth strategy. Based on a comprehensive review of its operation, effectiveness, and transferability to the German context, the following general conclusions could be drawn:

1. In UK, the industrial sector faces higher carbon related costs as compared to most of the other European countries - analysis has shown that, the CCL, a tax instrument, which CCA is linked with, plays a significant role in driving energy efficiency and climate mitigation (Grubband Drummond, 2018).
2. The industrial sector is a key focus of the German government to achieve its energy and climate targets. Introducing a CCA, a voluntary agreement, in combination with a 'credible stick' (e.g. a unified carbon price), has the potential to enhance the industrial sector's efforts.
3. In order for it to be effective, the targets need to be set at stringent levels; and reasonable eligibility criteria need to be developed, e.g. to limit to those with real leakage risks.
4. A two-tier structure of the agreements could be applied where both sectors and individual companies are held accountable for their targets. A combination of both end-of-phase targets (e.g. over a horizon of 8–10 years) and interim targets (e.g. every two years) are also recommended to provide both longer term certainty and immediate incentives to tap lower cost potential. Monitoring, reporting and verification as well as enforcement regimes shall be built up to ensure transparency and accountability.
5. Sector associations could play a similar role as in the UK CCA, and a credible third-party actor should be involved to provide analysis to feed into the policy design and target setting.

<sup>67</sup> However, studies that estimate of the potential savings of such a programme in Germany seem not available yet.

6. In any case, an assessment of the potential interactions between a new CCA-like instrument and other existing and planned industry energy efficiency and climate policy is needed, especially given the crowded policy landscape in this sector.
7. A credible review process should be built in upfront, so that there is a chance to review and revise the targets (towards more ambitious ones), as well as to continue to assess policy interactions and effectiveness, and make adjustments, if necessary.

The progress made in the recent past in Germany clearly shows that economic growth and falling energy consumption and carbon emissions are mutually compatible. More focused policy discussions to further accelerate the efforts from the industrial sector could benefit from a thorough learning of experience from other European countries such as the CCA in the UK.

## 7 REFERENCES

- AEA (2009). *Climate Change Agreements: Results of the Fourth Target Period Assessment*. November 2009.
- AEA (2011). *Climate Change Agreements: Results of the Fifth Target Period*. October 2011.
- Ag Energiebilanzen e.V. (2017). *Evaluation Tables on the Energy Balance 1990 to 2016*. September 2017. <https://www.ag-energiebilanzen.de/4-1-Home.html>
- Barker, T., Ekins, P., Foxon, T. (2007). *Macroeconomic effects of efficiency policies for energy-intensive industries: The case of the UK Climate Change Agreements, 2000–2010*. Elsevier B.V. doi:10.1016/j.eneco.2006.12.008
- Department for Business, Energy Consumption in the UK (BEIS), (2017a). *Energy Consumption in the UK. July 2017*. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/633503/ECUK\\_2017.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/633503/ECUK_2017.pdf)
- BEIS. (2017b). *The Clean Growth Strategy: Leading the way to a low carbon future*. October 2017. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/700496/clean-growth-strategy-correction-april-2018.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf)
- BEIS. (2018). *2016 UK Greenhouse Gas Emissions, Final Figures*. 6 February 2018. [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/680473/2016\\_Final\\_Emissions\\_statistics.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/680473/2016_Final_Emissions_statistics.pdf)
- Calel, R. (2013). *Emissions Trading and Technological change*.
- Central Intelligence Agency (2018a). *The World Factbook. Germany*. June 2018. <https://www.cia.gov/library/Publications/the-world-factbook/geos/gm.html>
- Central Intelligence Agency (2018b). *The World Factbook. United Kingdom*. June 2018. <https://www.cia.gov/library/Publications/the-world-factbook/geos/uk.html>
- Chipman, R. (2007). *Reality Check: The Nature and Performance of Voluntary Environmental Programs in the United States, Europe and Japan*. DOI: 10.1111/j.1477-8947.2007.00159\_4.x
- Clean Energy Wire (2018). *Germany's greenhouse gas emissions and climate targets*. March 2018. <https://www.cleanenergywire.org/factsheets/germanys-greenhouse-gas-emissions-and-climate-targets>
- Climate Change Act, 2008. <http://www.legislation.gov.uk/ukpga/2008/27/contents>
- Committee on Climate Change. 2016. *UK climate action following the Paris Agreement*. October 2016. <https://www.theccc.org.uk/wp-content/uploads/2016/10/UK-climate-action-following-the-Paris-Agreement-Committee-on-Climate-Change-October-2016.pdf>
- Dagoumas, A.S., Barker, T.S. (2010). *Pathways to a low-carbon economy for the UK with the macroeconomic E3MG model*. Energy Policy. DOI:10.1016/j.enpol.2010.01.047
- DEFRA Department for Environment, Food and Rural Affairs (2007). *Climate Change Agreements: Results of the Third Target Period Assessment*. London: DEFRA
- Department of Energy and Climate Change (DECC) (2011). *Consultation on simplifying the Climate Change Agreements Scheme*. London: Department of Energy and Climate Change. September 2011. <http://www.decc.gov.uk/assets/decc/11/consultation/cca-simplification/2636-cca-simplification-condoc.pdf>
- Drummond, P. T. (2013). *Choosing Efficient Combinations of Policy Instruments for Low-carbon development and Innovation to Achieve Europe's 2050 climate targets. Country report: United Kingdom*

- Ekins, P., Etheridge, B. (2005). *The environmental and economic impacts of the UK climate change agreements*. Elsevier Ltd. doi:10.1016/j.enpol.2005.01.008
- Environment Agency (2015). *Climate Change Agreements: biennial progress report 2013 and 2014*. Bristol: Environment Agency. 29 October 2015.
- Environment Agency (2017a). *Climate Change Agreements: Operations Manual*. Bristol: Environment Agency. April 2017.  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/617716/LIT\\_7911.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/617716/LIT_7911.pdf)
- Environment Agency (2017b). *Climate Change Agreements: biennial progress report 2015 and 2016*. Bristol: Environment Agency. 16 November 2017.
- Fankhauser et al, 2018. *10 years of the UK Climate Change Act*, Grantham Research Institute  
[http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/03/10-Years-of-the-UK-Climate-Change-Act\\_Fankhauser-et-al.pdf](http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/03/10-Years-of-the-UK-Climate-Change-Act_Fankhauser-et-al.pdf)
- Federal Ministry for Economic Affairs and Energy (2016). *Green Paper on Energy Efficiency: discussion paper of the Federal Ministry for Economic Affairs and Energy*. Berlin: Federal Ministry for Economic Affairs and Energy (BMWi)
- Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. *Climate Action in Figures: Emission Targets Germany and EU*.  
[https://www.bmu.de/fileadmin/Daten\\_BMU/Download\\_PDF/Klimaschutz/klimaschutz\\_in\\_zahlen\\_klimaziele\\_en\\_bf.pdf](https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/klimaschutz_in_zahlen_klimaziele_en_bf.pdf)
- Glachant, M., and De Muizon, G. (2006). *Climate Change Agreements in UK: A Successful Policy Experience?*
- Grantham Research Institute (GRI), 2015. *Country profile United Kingdom*  
<http://www.lse.ac.uk/GranthamInstitute/country-profiles/united-kingdom/>
- Griffin, P.W., Hammond, G. P., Norman, J.B. (2016). *Industrial energy use and carbon emissions reduction: a UK perspective*. John Wiley & Sons Ltd.
- Grubb, M. and Drummond, P. T. (2018). *UK Industrial Electricity Prices: Competitiveness in a low carbon world*. Report commissioned by the Aldersgate Group. February 2018.
- Kotin-Förster, S., Cuntz, C., Monschauer, Y., Brand, K., Kahlenborn, W., Haug, C., Ackva, J., Hölscher, L., Zwagerman, N. (2018). *Übersicht zur EU-weiten Situation im Nicht-ETS-Sektor*. Ecofys und Adelphi
- Liu, X., Shen, B., Price, L., Lu, H., Hasanbeigi, A. (2016). *What China can learn from international experiences to improve industrial energy efficiency and reduce CO<sub>2</sub> emissions?*
- Lord Marshall. 1998. *Economic Instruments and the Business Use of Energy*. November 1998.  
<http://webarchive.nationalarchives.gov.uk/20120704144437/http://www.hm-treasury.gov.uk/d/EconomicInstruments.pdf>
- Martin R, de Preux LB, Wagner U. *The impacts of the climate change levy on business: evidence from microdata*. Centre for Economic Performance, London School of Economics, March 2009.
- Martin, R., De Preux, L.B., Wagner, U.J. (2014). *The impact of a carbon tax on manufacturing: evidence from microdata*. Elsevier B.V. Retrieved from  
<http://dx.doi.org/10.1016/j.jpubeco.2014.04.016>
- Moro, Alberto and Lonza, Laura (2017). *Electricity carbon intensity in European member States: Impacts on GHG emissions of electric vehicles*. In: Transportation Research Part D. July 2017.  
<http://dx.doi.org/10.1016/j.trd.2017.07.012>.
- Napp, T.A, Gambhir, A., Hills, T.P., Florin, N., Fennell, P.S. (2013). *A review of the technologies, economics and policy instruments for decarbonising energy-intensive manufacturing industries*. Elsevier Ltd.

- Norman, J.B. (2017). *Measuring improvements in industrial energy efficiency: a decomposition analysis applied to the UK*. Elsevier Ltd. Retrieved from <http://dx.doi.org/10.1016/j.energy.2017.04.163>
- National Audit Office (NAO) (2007). *The Climate Change Levy and Climate Change Agreements: a review by the National Audit Office*. [https://www.nao.org.uk/wp-content/uploads/2012/11/climate\\_change\\_review.pdf](https://www.nao.org.uk/wp-content/uploads/2012/11/climate_change_review.pdf)
- NAO. (2012). The CRC Energy Efficiency Scheme: Briefing for the House of Commons Energy and Climate Change Committee. March 2012. [https://www.nao.org.uk/wp-content/uploads/2012/08/ECCC\\_briefing\\_CRC\\_scheme.pdf](https://www.nao.org.uk/wp-content/uploads/2012/08/ECCC_briefing_CRC_scheme.pdf)
- OECD (2003). *Voluntary approaches for environmental policy, effectiveness, efficiency and usage in policy mix*.
- OECD (2016a). *Greenhouse Gas Emissions* [https://stats.oecd.org/Index.aspx?DataSetCode=AIR\\_GHG](https://stats.oecd.org/Index.aspx?DataSetCode=AIR_GHG)
- OECD (2016b). *Country Statistical Profiles*. [https://stats.oecd.org/Index.aspx?DataSetCode=AIR\\_GHG](https://stats.oecd.org/Index.aspx?DataSetCode=AIR_GHG)
- Rosenow, J., A. Misra. (2015). *Energy efficiency trends and policies in the United Kingdom*. September 2015. <http://www.odyssee-mure.eu/publications/national-reports/energy-efficiency-united-kingdom.pdf>
- SLR Global Environmental Solution (2017). *FDf CCA Note 08: How CCAs interact with other schemes*.
- Schlomann, B., M. Reuter, S. Tariq, K. Wohlfarth, B. Lapillonne, K. Pollier. (2015a). *Energy Efficiency Trends and Policies In Industry: An Analysis Based on the ODYSSEE and MURE Databases*. September 2015. <http://www.odyssee-mure.eu/publications/br/energy-efficiency-trends-policies-industry.pdf>
- Schlomann, B., W. Eichhammer, M. Reuter, C. Frölich, S. Tariq. (2015b). *Energy efficiency trends and policies in Germany*. November 2015. <http://www.odyssee-mure.eu/publications/national-reports/energy-efficiency-germany.pdf>
- Statista (2018a). *Germany gross domestic product (GDP) per capita in current prices from 2012 to 2022 (in U.S. dollars)*. <https://www.statista.com/statistics/295465/germany-gross-domestic-product-per-capita-in-current-prices/>
- Statista (2018b). *United Kingdom gross domestic product (GDP) per capita in current prices from 2012 to 2022 (in U.S. dollars)*. <https://www.statista.com/statistics/263600/gross-domestic-product-gdp-per-capita-in-the-united-kingdom/>
- Ritchie, Hannah and Max Roser (2018). *CO<sub>2</sub> and other Greenhouse Gas Emissions*. <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>
- Information Technology Telecommunications and Electronics Association (techUK). (2015). *Climate Change Agreement for Data Centres, Target Period One: Report on Findings*. [https://www.techuk.org/images/CCA\\_First\\_Target\\_Report\\_final.pdf](https://www.techuk.org/images/CCA_First_Target_Report_final.pdf)