



# Choosing Efficient Combinations of Policy Instruments for Low-carbon development and Innovation to Achieve Europe's 2050 climate targets

## Country report: United Kingdom

WP 1 – Taking stock of the current instrument mix

Contribution to Deliverable 1.2: Review of the existing instrument mix at EU level and in  
selected Member States

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## 0 Executive summary

The first comprehensive UK strategy to tackle climate change came in 2000, with the UK Climate Change Programme, put in place to meet and exceed the UK's Kyoto target of 12.5% below 1990 emission levels by 2010 (with a CCP target of 20%). The instruments introduced with this strategy aimed at stimulating growth in renewables and energy efficiency across the economy. This led to the Climate Change Act in 2008, which legally requires an 80% emissions cut by 2050 from 1990 levels, achieved through binding 5-yearly 'carbon budgets' – the second of which begins in 2013. A new 2013 Energy Bill is set to alter the climate policy landscape in the UK, especially in relation to the electricity sector. The UK has a broad range of climate policy instruments, with varied objectives and mechanisms to encourage emissions abatement. The key policies and interactions within each 'policy landscape' are:

- **Carbon Pricing** – The EU-ETS provides an upstream price on CO<sub>2</sub>, whilst the CRC provides a downstream price. This provides a relatively sub-optimal scenario for the CRC target group, which is subject to double taxation for the same emissions (electricity).
- **Energy Efficiency & Energy Consumption** – Along with the EU-ETS and CRC, the CCL, CCAs and Green Deal are the primary instruments. The CCAs provide an exemption to energy-intensive sectors (generally EU-ETS sectors) from the CCL. The optimality of this is unclear, although efficiency is reduced. CCA and EU-ETS organisations are to be fully exempt from the CRC, reducing the cost burden and potential efficacy of the instrument mix, but increasing long-term acceptability. The Green Deal only indirectly interacts with the CCL (through the CPF) and the EU-ETS, which appears sub-optimal, as gas rather than electricity savings are expected from this instrument. The design of the Green Deal itself is also subject to heavy criticism, placing doubts on its effectiveness.
- **Promotion of Renewable Energy** – The RO and RTFO, along with the EU-ETS and CCL (CPF) are the key instruments. The RO obligates and creates a market for large-scale renewable electricity generation, and whilst seemingly effective in increasing renewable generation in the UK, its targets are purposely missed. The RTFO holds a similar profile. The EU-ETS exhibits a supporting relationship with the RO, but appears to have had little influence independently. The CPF under the CCL is likely to produce a highly supportive relationship with these instruments in the promotion of renewable electricity,
- **Non-Carbon Dioxide GHGs** – The Landfill Tax and the agriculture industry's GHG Action Plan (GHGAP) are the primary instruments. The former is mandatory, but appears to have had relatively little impact in reducing methane emissions, the latter is a voluntary instrument still in early stages of design. There is no direct interaction between these instruments.

Many instruments fall into more than one landscape, and thus interaction is inevitable. Increasing the relative price of carbon emissions encourages energy efficiency and investment in renewables. Some cross-landscape interactions have already been described. Other instruments, such as FiTs and RHI, recognise that efficiency in using the renewable energy produced increases their own effectiveness, thus linking with the Green Deal in the latter case. The GHGAP in turn will use these instruments in meeting its own objectives, for example.

In general, the UK climate policy mix is inefficient, although generally feasible in its approach and implementation to meet stated objectives. Despite achieving more than double the UK's Kyoto target, the efficacy of the mix in its final impact (emissions mitigation) however, especially in relation to influences stemming from the global financial crisis and underlying cost of fossil fuels, is difficult to determine.

## I Description of policy landscapes

### I.1 Classification of the instruments previously selected into policy landscapes

The objective of this report (and report series) is to perform an initial 'stock-take' of the climate policy instrument mix at the EU-Level and a representative group of Member States – the United Kingdom, Germany, France, Spain, Italy, the Netherlands, Poland and the Czech Republic. An initial list of up to 50 instruments from each country and EU-level was created, from which up to 15 key instruments for each state covering a broad selection of the economy, instrument type and objectives were selected for further analysis. Please refer to the Taxonomy of Instruments, developed under Task 1.1 of CECILIA 2050, for a full description of instrument classification. For each report, the selected instruments were categorised into policy 'landscapes', described below.

- (1) **Carbon Pricing:** this includes policies that price CO<sub>2</sub> emissions or otherwise change the relative prices of fuel use, depending on the carbon intensities of fuels. Apart from the obvious candidates (carbon taxes and emissions trading) this would also include the reform or removal of fossil fuel subsidies;
- (2) **Energy Efficiency and Energy Consumption:** this includes measures targeted at either increasing the efficiency of the energy sector, including power generation / combustion processes, transmission of energy (heat, electricity) and end-use efficiency, or at reducing overall energy consumption (demand-side management, energy saving, sufficiency);
- (3) **Promotion of Renewable Sources of Energy:** this includes policies aimed at increasing the share of energy from renewable sources (solar, wind, hydro, biomass, geothermal);
- (4) **Non-Carbon Dioxide Greenhouse Gases:** this covers policies geared at reducing non-CO<sub>2</sub> greenhouse gas emissions, typically from sectors other than the energy sector. It may include emissions like methane emissions from landfills or animal husbandry, N<sub>2</sub>O emissions from agriculture, or greenhouse gas emissions from chemical industries (SF<sub>6</sub>, NF<sub>3</sub>, HFC etc.)

The list of instruments for the United Kingdom, along with their landscape classifications may be seen in Table 1, below. This report describes each instrument based on a set of tabulated information found in Annex 1, and an attempt at assessing their individual 'optimality', based on the concept developed for use in the CECILIA 2050 project also developed in Task 1.1, is provided. Descriptions of interactions between instruments within each landscape are also provided, based on tables found in Annex 2. The categories and methods of interaction are based on best practice in instrument interaction assessment, and are completed in pairs

against a single key instrument, or when important interactions between non-key instruments are present.

The resulting optimality of each landscape based on instruments and their interactions are then assessed, followed by interactions between each landscape and, finally, an analysis of the optimality of the climate policy mix as a whole in each country and at the EU-level is provided.

Although there was some disparate policy with leanings towards emissions abatement, the first comprehensive UK strategy to tackle climate change came in 2000, with the UK Climate Change Programme, put in place to meet and exceed the UK's Kyoto target of 12.5% below 1990 emission levels by 2010 (with a CCP target of 20%). The instruments introduced with this strategy aimed at stimulating growth in renewables and energy efficiency across the economy. This led to the Climate Change Act in 2008, which legally requires an 80% emissions cut by 2050 from 1990 levels, achieved through binding 5-yearly 'carbon budgets' – the second of which begins this year. A new Energy Bill, currently before parliament, is set to alter the climate policy landscape, especially in relation to the electricity sector. Specific measures are discussed in the report, where relevant.

**Table 1 - Climate landscape instrument classification**

Policy Instrument	Policy Landscapes			
	Carbon Pricing	Energy Efficiency and Energy Consumption	Promotion of Renewable Sources of Energy	Non-Carbon Dioxide GHGs
Climate Change Levy		✓	✓	
Climate Change Agreements		✓		
EU ETS	✓	✓	✓	✓
Renewables Obligation			✓	
Renewable Energy Feed-In Tariff			✓	
Renewable Heat Incentive			✓	
CRC Energy Efficiency Scheme	✓	✓		
Carbon Trust Standard		✓		
LSE Carbon Reporting Requirements		✓		
Green Deal		✓		
Energy Company Obligation		✓		
Renewable Transport Fuel Obligation			✓	
Vehicle Excise Duty		✓		

Landfill Tax				✓
Greenhouse Gas Action Plan			✓	✓

## I.2 Detailed description of instruments within each policy landscape

### I.2.1 Carbon Pricing

#### EU Emissions Trading System (EU-ETS)

The EU-ETS is the world's first large-scale, multi-country, multi-sector CO<sub>2</sub> emissions cap-and-trade scheme with the objective of reducing CO<sub>2</sub> emissions within the EU-15 (as existed in 2004), largely in response to the Kyoto Protocol agreement to reduce union-wide emissions by 8% below 1990 levels by 31<sup>st</sup> December 2012. It applies to upstream, primary energy consumption. Discussion of economic instruments to tackle EU carbon emissions began in the early 1990s and primarily centred on a proposed EU-wide carbon/energy tax. This met with heavy opposition from some member states who did not want to cede any right of taxation to the EU, along with resistance from industry groups (Convery, 2009). During negotiations for what became the Kyoto Protocol, the EU was firmly against an emissions trading mechanism on the basis that some states would benefit from additional 'hot air' allocations. Subsequent to signing the Protocol, the EU became in favour of emissions trading as a cost-effective domestic measure to meet its proposed targets, building on experience of member state mechanisms (e.g. UK ETS) (Ellerman & Buchner, 2007). The EU-ETS was established in October 2003 by Directive 2003/87/EC and came into effect on 1<sup>st</sup> January 2005. It is composed of three initial 'Phases' (EA, 2013):

- **Phase 1** (2005 – 2007) – initial 'learning-by-doing' phase. Did not cover aviation.
- **Phase 2** (2008 – 2012) – revised monitoring and reporting rules, stricter emissions caps and additional combustion sources. Aviation is covered from 2012.
- **Phase 3** (2013 to 2020) – Harmonised EU allocation methodologies, centralised CO<sub>2</sub> cap and additional GHGs and emission sources, with increased auctioning.

Under the EU's 'burden sharing' agreement, through which national emissions caps vary according to member state circumstances as agreed by the Commission, the UK's Kyoto reduction commitment was 12.5% from 1990 levels by 2012. All member states were required to submit a National Allocation Plan (NAP) for Phases 1 and 2, stating the total quantity of EU Allowances (EUAs) the state intends to issue for that phase, and which installations will receive them, for approval by the Commission. The Department for Energy and Climate Change (DECC) is the lead national department for implementation of the EU-ETS, but the Devolved Administrations (Northern Ireland, Scotland and Wales) hold responsibility for management within their geographic regions (as stated under regulation 18 of the Greenhouse Gas Emissions Trading Scheme Regulations 2003, which transpose the Directive into UK law (Defra, 2005)). DEFRA hold administrative responsibilities through the Environment Agency (England & Wales), the Scottish Environmental Protection Agency and the Northern Ireland Environment Agency, which are responsible for issuing guidance documents and data



collection. 'Natural Resources Wales' also joined the list of regulatory agencies with responsibility for the EU-ETS in the UK from 1<sup>st</sup> April 2013.

In Phase 1 (2005-2007), the government allocated a total of nearly 740 million allowances – each permitting the emission of a single tonne of CO<sub>2</sub>. This is around 8% below projected emissions of eligible installations within this phase. All permits were 'grandfathered', with 93.7% provided to existing installations in three instalments (at the beginning of each year of the phase), and the remaining 6.3% held as a new entrant reserve. Allowances were issued to around 1,100 installations in the UK (around 11,000 EU-wide), across high-emission eligible sectors such as power stations ('Electricity Supply Sector' - the largest recipient, and also the sector which bore the entirety of the 8% shortfall upon allocation), refineries, iron and steel, cement, pulp and paper and the chemical manufacturing industries. These installations covered around 45% of UK emissions in 2002. 64 eligible installations were granted an 'opt-out' option due to participation in the UK-ETS, but were required to enter the scheme at the closure of the UK-ETS in December 2006 (Defra, 2005).

In Phase 2 (2008-2012) around 739 million allowances were available for UK emissions. 90% of these were available for existing installations and sectors and the newly included sectors of glass, mineral wool, gypsum, flaring from offshore oil and gas production and petrochemicals - all via grandfathering. The remaining 10% were auctioned – the largest proportion in the EU (and the maximum permitted) (DECC, 2013). All grandfathered permits were distributed in equal proportions annually throughout the Phase, with 6% of the total volume held as a new entrant reserve. As with Phase 1, the entirety of the deficit between permits and projected 'business as usual' (BAU) emissions fell to the Large Electricity Producers (LEP) sector (as renamed). With the scope expansion, eligible installations increased to cover 52% of UK emissions with permits available for 47%. This 5% deficit translated to a 30.3% deficit in BAU emissions for the LEP sector upon allocation (Defra, 2007), to be filled by the expansion of renewables.

The EU-ETS was expanded to cover the aviation industry from January 1<sup>st</sup> 2012, and includes emissions from all flights departing or arriving at EU airports (both domestic and international), despite significant international opposition (especially from the US and China). It was announced on the 12<sup>th</sup> November 2012 that the EU would suspend the international aspect of the scheme, in response to progress by the International Civil Aviation Organisation (ICAO) in encouraging international emissions reduction efforts. This amendment remains in place for a year, and will be reversed if a satisfactory international arrangement on aviation emissions is not reached (Hedegaard, 2012).

For Phase 3 (2013-2020), the system became more EU-centric rather than country-focussed. The emissions cap became EU-wide rather than country specific, and will decrease by at least 1.74% per year. NAPs have been abolished in favour of National 'Implementation' Plans (NIP), in which a harmonised EU methodology for allocation must be followed to allocate permits to sectors and installations. Up to 50% of allowances may be grandfathered, with the remainder auctioned. No permits may be grandfathered to the LEP in this Phase. The UK NIP was submitted in December 2011, and resubmitted in April 2012 in response to comments. Assessment of all member states submissions must be completed and accepted simultaneously under the new operating regime. Additional sectors and GHGs (N<sub>2</sub>O from nitric,

adipic and glyoxalic acid production, and perfluorocarbons from aluminium production) also now fall under the remit of the EU-ETS. Prior to June 2012, individual Member States held separate registries for EUAs and installations in each state (Environment Agency in the UK). Since then, a single European registry has operated centrally.

The UK's Small Emitter and Hospital Opt-out Scheme, approved by the EC under Article 27 of the EU-ETS Directive, allows eligible installations to opt-out of Phase 3 in exchange for participation in a domestic scheme that may be expected to deliver equivalent emissions reductions. The scheme intends to reduce regulatory burden on these installations by, for example, replacing the requirement to surrender allowances with an emissions reduction target and simplified monitoring, reporting and verification requirements. 248 installations are approved to participate in the scheme (DECC, 2013), and are estimated to save a total of £39 million in compliance costs over Phase 3. The threshold for 'small emitters' is below 25,000tCO<sub>2</sub> a year for stationary installations (aviation is not included in this opt-out – although a *de minimis* clause exists for aviation). This accounts for 1% of the UK's EU-ETS emissions, but around 25% of total installations.

ICE Futures Europe, the organisation contracted to perform EUA auctions on behalf of DECC, held the first Phase 3 auction on 21<sup>st</sup> November 2012, and are held fortnightly since. During Phase II of the EU ETS, the UK held 30 auctions for 123 million EUAs, and raised approximately £1.3 billion for the exchequer (DECC, 2013). Any installation that cannot surrender the requisite number of allowances when required is subject to a £100 fine per unaccounted permit. There are plans for a Phase 4 of the EU-ETS, running from 2021 to 2028, but the specific design of this Phase is so far unclear.

The optimality of the EU-ETS has been the subject of intense debate since the scheme's inception. As it is a cap-and-trade scheme, with high and expanding coverage of GHGs and emission intensive sectors, it generally allows emissions abatement to occur in the lowest-cost parts of the economy with guaranteed emissions ceilings. As such, the emission reductions that are realised are achieved at low societal cost, with high static efficiency. However, the lack of a significant carbon price and uncertainty of this price into the future does not provide significant incentive to invest in the present to reduce future emissions. The incidence of windfall profits in the early years of the mechanism, in which electricity producers simply passed on the 'cost' of their free (grandfathered) permits to customers, increasing corporate profits, reduces the equality of distributional cost burden. During the first years of the EU-ETS, emissions from obligated installations in the UK were around 20% lower than the number of allocated permits (Ellerman & Buchner, 2008). In the energy sector, there is evidence to suggest that during the first two years of operation (2005 – 2007 – with a higher EUA price than more recently), consumption of coal was 18% lower than it would have been in absence of the EU-ETS (with lower-carbon gas around 20% higher to compensate) (McGuinness & Ellerman, 2008). This continued and strengthened the UK's 'dash for gas' in the 1990s, resulting from electricity sector privatisation (a trend that appears to be now reversing). As such, the EU-ETS in the UK may be (or at least has been), environmentally effective, but a much stricter cap would, by definition, have produced significant additional emissions reductions. Also, as embodied emissions from non-EU production are not considered, there is significant risk of carbon leakage.

The feasibility in implementation has been generally high. Rules and mechanisms have altered based on lessons learned, although a flexible intra-phase cap that can be altered to take advantage of reduced-cost abatement opportunities, or reduced activity as a result of the financial crisis, for example, are lacking. Political difficulties for the inclusion of international aviation have been discussed, and discussions surrounding the inclusion of shipping emissions are also experiencing difficulty. There is little significant political or public resistance in the UK to this instrument, although this may be in part due to the lack of awareness amongst the general population of its existence.

A 'Carbon Price Floor' (CPF) also exists in to underpin the EU-ETS price in the UK. This will be discussed under the Climate Change Levy, as this is the instrument through which the CPF was adopted.

### CRC Energy Efficiency Scheme (CRC)

The CRC Energy Efficiency Scheme (originally the 'Carbon Reduction Commitment'), is a mandatory instrument aimed at improving energy efficiency and reducing emissions from large non-energy intensive and private sector organisations, cumulatively responsible for around 10% of the UK's emissions. The Scheme was announced in the 2007 Energy White Paper as a method of capturing the significant energy and carbon saving potential in a sector thus far largely untouched by such efforts, as opposed to the energy-intensive sector (DTI, 2007). The mandatory, rather than voluntary nature of the scheme is a result of significant support for such a design in consultation responses in 2006. The CRC was enabled by the 2008 Climate Change Act, and introduced under the CRC Energy Efficiency Scheme Order 2010.

The CRC is a carbon tax, in which mandated participants pay a set price (decided by the UK Treasury), on their annual carbon emissions. This covers both direct and indirect carbon emissions (Scope 1 plus electricity), although emissions associated with transport are excluded, as are renewable direct fuel sources (e.g. biomass). Energy-from-waste is included, as is electricity from CHP – however any heat produced and used or exported is exempt (EA, 2012).

Participation in the 'introductory phase' (April 2010 – March 2014) is required by any private sector organisation with a consumption of at least 6,000MWh of electricity, delivered through at least one half-hourly meter, in the 2008 calendar qualification year. All public institutions are mandated to participate, although Budget 2013 announced that from April 2014 English schools would be excluded. Qualifying organisations must have registered within the 'registration period' (April – September 2010), and a completed 'footprint report' for the year April 2010 – March 2011, including sources of supplied energy. From this, qualifying associated emissions were identified and should be reported on in subsequent annual reports.

For each year, participants must purchase and surrender ex-post allowances for all eligible CO<sub>2</sub> emissions reported, with the exception of 2010/11 emissions, which was designated a 'reporting only' year, with no allowance purchasing required. The 2012 sale window for 2011/12 year emissions was 1<sup>st</sup> June to 31<sup>st</sup> July, coinciding with the annual report deadline. The price for each allowance (equalling one tonne of emissions), was £12, and will remain so until it rises to £16 in 2014/15, and will increase annual henceforth in line with the Retail Price

Index (RPI) (EA, 2012c), into Phase 2. All reporting and purchasing of allowances is managed through the online 'CRC Registry', maintained by the Environment Agency.

Phase 2 begins in 2014, and concludes in 2019, with the 'eligibility year' falling between April 2012 and March 2013. Participants must register between April 2013 and March 2014. Any organisations that become eligible in the first Phase will join the scheme at the beginning of Phase 2, as long as they reach the qualification requirements in the eligibility year.

The scheme featured two annual report tables, called the 'Performance League Table' (PLT) and 'Achievement Table'. The PLT ranked each organisation based on three weighted metrics termed the 'Early Action Metric', the 'Absolute Metric' and the 'Growth Metric'. The Early Action Metric favoured those organisations with a large proportion of emissions covered by one of the Environment Agency approved carbon management schemes (i.e. Carbon Trust Standard, discussed on p.22), or a high proportion of non-mandatory CRC gas and electric supplies measured through voluntarily installed automatic meter reading devices, and daily/hourly gas meters. This metric was removed after the 2012/13 reporting year.

The Absolute Metric measures annual percentage change in emissions from an historic average (up to five years previously), and the Growth Metric reflected annual percentage change in emissions intensity against turnover/revenue expenditure (EA, 2012b). Initially, the CRC was designed so that revenue was recycled back to organisations in different proportions depending on PLT positioning. This was scrapped under the government's October 2011 'Comprehensive Spending Review', with revenue of nearly £1 billion annually now benefiting the treasury.

All participants are required to maintain an 'evidence pack', with auditable records of qualifying energy supplies and associated emissions. Third-party verification of evidence packs is not required, but may be subject to mandatory spot-checks by the Environment Agency. As of early 2013, there were 2,757 participants (EA, 2013). Emissions already subject to regulation under the EU-ETS and CCAs (discussed on p.22) are exempt – as is any organisation in its entirety with more than 25% of its emissions covered by CCAs (DECC, 2013b)

DECC is responsible for the implementation and all policy aspects of the scheme, in partnership with the Devolved Administrations (Scottish Government, Welsh Assembly and Department of Environment of Northern Ireland). The Environment Agency administers the scheme across all regions, including the CRC Registry and PLT. Financial penalties are liable by organisations failing to meet their requirements. Late registration or late submission of footprint or annual report incurs a set fine of £5,000, plus £500 per day. Any shortfall in 'allowances' purchased, or the discovery of inaccurate reporting, is liable to a fine of £40/tCO<sub>2</sub> reported shortfall. The imposition of any penalties is also subject to publication (*The CRC Energy Efficiency Scheme Order 2010*).

In December 2012, following a public consultation, it was announced that the CRC will be 'simplified' for the remaining two years of Phase 1 and beyond into Phase 2. The key changes introduced in May 2013 were: (EA, 2012c);

- Only electricity and natural gas supplies must be reported. A new *De Minimis* criterion means any natural gas supplies used for heating that is equal or less than 2% of total electricity consumption, does not need to be reported or associated allowances purchased.
- The PLT was abolished from July 2013. Public reporting will fall under a new framework, yet to be designed.
- Facilities participating in EU-ETS and CCAs are entirely removed from the scope of CRC.
- Extension of the scheme to 2039.

The instrument may be seen as generally cost-effective from both the static and dynamic perspectives as it is a pricing instrument, which provides continued incentive for innovation, dissemination and investment in abatement technologies and practices. This is especially the case with the planned price increase. However, it only includes around 10% of the UK's emissions, and although all obligated organisation experience the same marginal carbon price, the lack of allowance trading means there is little provision that most abatement will take place in the least-cost industries. It is too early to determine whether the CRC has been or will be effective in reducing direct and indirect emissions amongst large non-energy intensive industry, and with the lack of an emission cap this is less certain than under a cap-and-trade scheme. The configuration of the CRC as a tax on both direct and indirect emissions may reduce the efficacy of the instrument from a broad perspective. Most of the energy consumption of the CRC obligation organisations is electricity. A tax on these organisations based on the carbon intensity of the grid provides very little direct decarbonisation incentive, as these entities have little control over this and little flexibility to draw energy from other carriers. In addition, the 2013 reduction in fuel coverage and removal of organisations participating in the EU-ETS and CCA schemes, along with the removal of revenue recycling and abolition of the PLT, abatement from this instrument is likely to reduce further. These changes are linked to the political feasibility of the instrument. Whilst the scheme has strong support amongst the general public, it is felt amongst compliance entities that the current scheme is too complex and the administrative burden too high. The recent changes attempt to achieve a balance, with an estimated 55% reduction in administrative costs (£272 million) by 2030 (2013b), and revision of the rules for ease of compliance.

## 1.2.2 Energy Efficiency and Energy Consumption

As noted on Table 1, the EU-ETS and CRC Instruments discussed under 'Carbon Pricing', also fall under the Energy Efficiency and Energy Consumption Category. Please see the previous section for the description of these instruments.

### Climate Change Levy (CCL)

The CCL was first announced in March 1999, and came into force on the 1<sup>st</sup> April 2001 under the Finance Act 2000, with The Climate Change Levy (General) Regulations 2001 providing detail. The objective of the CCL is to encourage energy efficiency in the commercial, industrial and public sectors in order to reduce GHG emissions (by at least 2.5MtCO<sub>2</sub> by 2010). It attempts to achieve this through a tax on consumption of electricity (excluding renewable electricity and CHP, but including nuclear), coal, natural gas and liquefied petroleum gas (LPG). Increasing public awareness of climate change in the UK was reflected in the 1997

New Labour government's commitment to reduce emissions to 20% below 1990 levels by 2010. This, coupled with the UK's international commitment of 12.5% reduction below 1990 agreed later that year, led to the introduction of the CCL as recommended by Sir Colin Marshall in his 1998 report 'Economic Instruments and the Business use of Energy'.

Both direct CO<sub>2</sub> emissions, from the direct consumption of coal (also coke, semi-coke of coal or lignite and petroleum coke), natural gas (when supplied by a gas utility) and LPG (and other gaseous hydrocarbons in a liquid state), and indirect emissions from consumption of electricity, are covered. Fuels used for electricity generation and non-energy uses, along with waste derived fuels and solid fuel worth below £15/tonne are exempt. Oil based fuels are exempt as they are subject to other duties. Sectors liable are industry, commerce, agriculture, public administration and other services. The domestic sector, along with transport and consumption by charities for non-business use, are excluded. Transport is excluded due to the imposition of separate market-based instruments on the sector, such as the fuel duty escalator and changes to vehicle excise duties (the latter is discussed on p.21), amongst others. Pearce (2005) notes that the exclusion of the household sector was taken on political grounds, partly due to the backlash from proposed increases in VAT for household energy in 1993 from zero rated to 8% and eventually the full standard rate of 17.5% (although this final increase was not introduced). In June 1997, the new government immediately reduced this to 5%, and this rate remains applicable at the time of writing (providing a perverse incentive to domestic energy efficiency). Differential rates are placed on the mandated energy carriers as follows (HMRC, 2011b):

**Table 2 - Climate Change Levy Rates**

Commodity	Rate from 1st April 2012	Rate from 1st April 2013
Electricity	0.509p/kWh	0.524p/kWh
Natural Gas	0.177p/kWh	0.182p/kWh
Coal	1.387p/kg	1.429p/kg
LPG	1.137p/kg	1.172p/kg

At the introduction of the CCAs in 2001, rates were fixed. Since 2007 however, rates increase annually at the rate of inflation. Natural gas consumption in Northern Ireland is taxed at a different rate of 0.062p/kWh (0.064p/kWh from 1<sup>st</sup> April 2013). The table below demonstrates the originally proposed and subsequent actual implicit carbon prices imposed by the CCL at its introduction, based on the carbon content of the energy carriers considered (Pearce, 2005).

**Table 3 - Climate Change Levy implicit carbon prices**

Commodity	Implicit £/tonne CO <sub>2</sub>		
	Proposed Rate (1999)	Actual Imposed Rate (2001)	Actual Imposed Rate – CO <sub>2</sub> (2001)
Electricity	£43	£31	£8
Natural Gas	£42	£30	£8
Coal	£23	£16	£4
LPG	£31	£22	£6

This table demonstrates the comprehensive reduction of originally proposed rates and actual rates imposed at the CCL's introduction, and continued decrease to 2010. As natural gas has amongst the lowest carbon to energy content ratio, and coal amongst the highest, it is clear that the CCL is not a pure carbon tax. This would also be the case if considering the rate imposed on electricity consumption alone, as the carbon content of production is continually fluctuating. As such, it may be considered an energy tax with non-uniform rates (OECD, 2005). This may be attributed to administrative simplicity, or as Pearce (2005) suggests, it may stem from a desire by the government at the time to protect the ailing industry, which had suffered greatly from the 'dash for gas' in the 1990s (OECD, 2005).

Her Majesty's Revenue and Customs (HMRC) manage all aspects of the CCL. Suppliers of liable commodities to liable consumers must register with HMRC and a 'Climate Change Levy return' completed and returned periodically to HMRC. As such, it is the supplier of the energy commodity that is directly liable for the CCL, but is in effect levied on the consumer as the charge is passed on. If a supplier fails to register with HMRC by the correct time a fine of £250 or 5% of the CCL concerned (whichever is greater) is payable, alongside the CCL in deficit. A fine of £250 is also due if a supplier fails to notify HMRC that it is no longer liable to be registered, and also in cases of failure to maintain records and a failure to make payments on time – the latter of which also incur penalty interest (HMRC, 2011a).

The Levy was designed to be revenue neutral, and most of the estimated annual £1 billion revenue was recycled to business through a reduction of 0.3% in employer's National Insurance (social security) contributions (Bailey & Rupp, 2005). It is not clear whether this effect remains neutral, but between 2001 and 2007 the effect was actually revenue negative (UNESCAP, 2012). A small proportion of funds raised were partially earmarked to fund the Enhanced Capital Allowance Scheme (ECAs), which provides tax relief to organisations for approved technologies that reduce energy consumption and emissions. In 2001, funds from the CCL also allowed the government to provide £150 million worth of support for energy efficiency improvements, delivered through the 'Carbon Trust'. In 2012, the Carbon Trust became an independent limited company when its funding was withdrawn. In March 2011, it was announced that the CCL would be extended until 2023.

The UK introduced, in April 2013, a 'Carbon Price Floor (CPF)' (originally announced in Budget 2011) to underpin the EU-ETS in the electricity sector, as part of a wider package of electricity market reform. The CPF removes the exemption from CCL for fuels used to generate electricity, and imposes a tax based on carbon content through the 'CCL Carbon Price Support Rate' (CPSR) (translated to £/kWh or Kg of fuel). The other existing CCL rates remain unaffected. This rate, once added to the estimated EUA price, is designed to be equivalent to total carbon prices of £16 per tonne/CO<sub>2</sub> from 1<sup>st</sup> April 2013, leading to £30 by 2020. The purpose of the CPF is to encourage additional investment in low-carbon power generation (HMRC, 2012c), to boost the currently inadequate signal provided by the EU-ETS and prevent high-carbon energy lock-in as a result, reducing the cost of CO<sub>2</sub> emission mitigation in the future (leading to dynamic if not static efficiency).

**Figure 1 - Carbon Price Floor (Source: HM Treasury, 2010)**

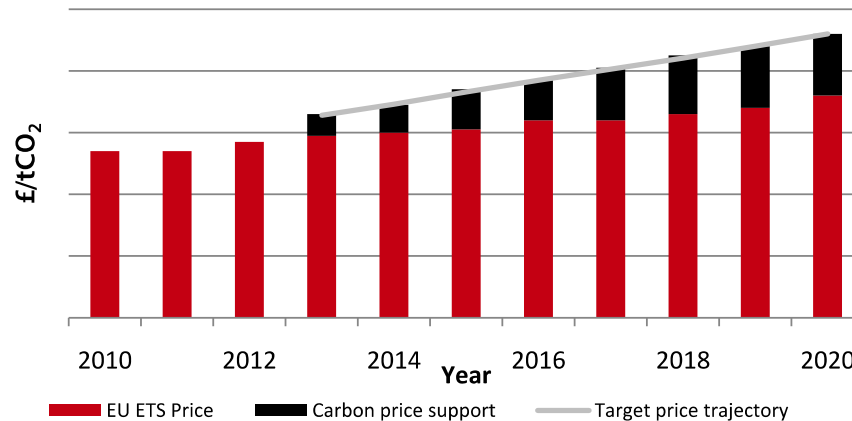


Figure 1 illustrates the effect of the CPF. The CPSR from 1<sup>st</sup> April 2013 is £4.94/tCO<sub>2</sub>. This rate is based on an expected EUA price of around £15, as it was at the time of the CPF announcement. This rate has since dropped to below £5/tCO<sub>2</sub>, leading to an actual floor price of under £10/tCO<sub>2</sub> if EUA prices do not recover. Based on the assumption of a continuation of the current price, Budget 2013 set the 2015/16 CPSR at £18.08 (against the initial rate of £9.86 set in Budget 2011). The required two-year lag between the setting of the CPSR and its imposition mean it is unresponsive to relatively short-term EUA price fluctuations, raising the possibility of both dramatically increasing the cost burden on electricity producers beyond the target price, and also falling well below it (as is likely to be the case in the initial period). The government projects this CPF will generate an additional £6.1 billion investment in low-carbon electricity.

As the CCL imposes an additional cost on energy consumption, it encourages energy efficiency and conservation in both static and dynamic dimensions (until 2023 at least, but it is likely the instrument, or a similar replacement, would continue past this date). It is estimated the CCL adds around 15% to energy bills of some organisations, but the reduction in National Insurance contributions makes the CCL conceptually revenue neutral (although it provided a net benefit to industry until 2007, it is not clear whether this remains the case. This is also a reduced tax on labour, promoting a secondary goal of stimulating employment). It is estimated that the 2010 target of a 2.5MtCO<sub>2</sub> was exceeded, to as much as 3.5MtCO<sub>2</sub> savings (UNESCAP, 2012). As the levy is not directly linked to the carbon content of the energy produced, it cannot be considered fully cost-effective in emissions abatement. However, cost-efficiency is now increased as exemptions are removed for electricity-producing fuels and levies linked to carbon content (although existing levies for non-electricity producing fuels and on electricity itself remain the same). Despite the wide sectoral coverage there are significant exemptions through application of Climate Change Agreements (discussed next), which allow significant discounts for the most energy-intensive industries using the justification of not impeding international competitiveness through punitive energy charges. Some commentators suggest this heavily impedes the efficacy of the CCL, since there has been little evidence of adverse effects on productivity, output or employment in the sectors not open to discounts through CCAs (Bowen & Rydge, 2011). However, without this concession, it is likely that political feasibility would be much reduced. It has also been suggested that simply announcing the introduction of the instrument in 1999 led to a reduction in energy demand in service



sectors (but not manufacturing), prior to the commencement of the instrument itself ('announcement effect') (Cambridge Econometrics, 2005).

### Climate Change Agreements (CCAs)

CCAs were introduced in the Finance Act 2001 alongside the CCL in response to concerns of adverse effects of competitiveness on energy-intensive industry especially affected by the Levy. Participation in the scheme entitles the energy-intensive facility to receive a 90% discount (originally 80%, before April 2011, and then 65% until April 2013), on the CCL in exchange for meeting binding energy efficiency or carbon saving targets negotiated between industry representatives and government.

First, the trade association of an eligible sector negotiates an 'umbrella' agreement with the government (originally DEFRA, now DECC), to determine sector-wide reduction targets. Targets are defined either in absolute terms or relative to sector output (the most common – around 94% of facilities hold relative targets) (DECC, 2011). Qualifying sites may then apply for a reduced-rate certificate to obtain the CCL discount, which if approved, is subject to an 'underlying' agreement with the government, which stipulates site-specific targets against the eligible facility.

Originally, eligible sectors were those covered by the Integrated Pollution Prevention and Control Regulations (IPPC), an acknowledged 'blunt' proxy of energy intensity, which excluded many energy-intensive industries. Agreements were originally reached in 2001 with 44 sector associations as wide-ranging as aluminium, food and drink, ceramics and motor, aerospace and retail industries (Bailey & Rupp, 2005). In 2006 eligibility criteria were extended to cover the energy-intensive industries as defined by the EU Energy Products Directive, which brought in additional plastics industries and industrial laundering services (HMRC, 2006), bringing the total number of sectors to the current number of 54. However, in key metallurgical and mineralogical industries (steel and ceramics) became full exempt from the CCL (and therefore CCAs).

Initial agreements lasted until 2010, with 'milestone periods' in 2002, 2004, 2006 and 2008, after which the sector associations reported whether sector-wide interim targets were achieved. If the sector-wide target was achieved, all facilities within that sector continue to receive the discount until the following milestone period. If the sector-wide target was not met, facilities within the sector in question were assessed individually. Any underlying agreements that did not meet their interim targets were ineligible to receive the levy discount until after the following milestone period (i.e. two years hence). If a facility missed the overarching 2010 target it was potentially liable to a fine equal to the value of the accumulated discount over the full agreement period (OECD, 2005).

The UK-ETS, introduced in 2002 as the third element of the UK's Climate Change Programme (with CCL and CCAs), allowed CCA participants to purchase allowances to cover their shortfall or conversely sell excess allowances credited to them by excess achievement against their targets. These credits could also be 'ring-fenced' for use in meeting future targets (Bailey & Rupp, 2005). The scheme closed to new participants in December 2006 and ceased altogether in December 2012.

Although the original agreement periods ended in 2010, the levy discount continued in the absence of targets. The new CCA scheme entered into force in April 2013, and extends until 2023. The first target period will end in 2016. The Environment Agency assumed responsibility for administering the Agreements from DECC in October 2012, although DECC retains policy oversight and responsibility for negotiating sector targets (EA, 2012). Upon commencement of the new scheme the levy discount rate increased to a new high of 90%%.

The CCAs act in a manner to reduce the cost burden on organisations that would otherwise be imposed by the CCL, whilst retaining emissions reduction targets. It may, to an extent, be considered cost-effective from a static point of view as it imposes no direct cost to organisations, and targets are set at a level appropriate to the sector and facilities concerned. However there is significant cost to government for administration, negotiating targets and monitoring. CCAs cannot be considered dynamically cost-effective as there is little continuing incentive to improve once the targets have been met (some remains - a small proportion of the CCL is still paid). Despite estimates that CCAs produce savings of nearly 1.9Mt/CO<sub>2</sub> a year by 2010, (UNESCAP, 2012), the instrument's efficacy in reducing emissions - especially in relation to imposition of the CCL is also highly questionable; with evidence suggesting CCAs actually increased energy intensity and expenditure in some sectors (Martin *et al*, 2009). Despite claims that the CCAs helped bring energy efficiency to managerial attention (Ekins and Etheridge, 2006), it has also been suggested that the negotiated targets were easily achievable (many sectors repeatedly over-achieved their target) (Bowen & Rydge, 2011), and in effect exempted these organisations from the objectives of the CCL altogether. As this instrument acts to remove regulatory and cost burden with the objective of maintaining competitiveness, it is highly popular amongst the organisations involved. However, as discussed, there is evidence to suggest that the application of the CCL generally shows no statistically significant impact on output, productivity or jobs – meaning the basic premise of the CCA may be misguided.

## The Green Deal

The Green Deal was introduced by the Energy Act 2011 and came into force on 1<sup>st</sup> October 2012, but only became fully operational on 28<sup>th</sup> January 2013. The Green Deal, along with the Energy Company Obligation (discussed next), replaces the Carbon Emissions Reduction Target (CERT) and Community Energy Saving Programme (CESP).

The objective of the Deal is to encourage the uptake of 'green' technologies in buildings, both commercial and domestic, by removing up-front costs through the issuance of a loan tied to the property rather than the occupier (although the non-domestic scheme has not yet begun – it is likely to begin in late 2013). Loan repayments are made through subsequent electricity bills based on the 'golden rule' that any payments are offset by equivalent or greater energy cost reductions (in gas and electricity). The government expects the Green Deal could reduce household and business emissions by 4.5MtCO<sub>2</sub>/year by 2020. A consultation was undertaken between late 2011 and early 2012. Few significant amendments to the initial proposal were made in response, only surrounding technicalities such as consumer credit protection (under the Consumer Credit Act), product guarantees and complaints management (DECC, 2012).

All residential and commercial buildings are potentially eligible. A householder, tenant (with owner's permission, or with Local Authority registration for social housing tenants) or business must approach a certified 'Green Deal Assessor' to visit the building to assess current energy use and potential for improvement, to be summarised in a Green Deal Advice Report. This report may then be discussed with a certified 'Green Deal Provider' to draw up a 'Green Deal Plan' for the property. The Provider will then, after the building owner and/or tenant's agreement, arrange for the work to be carried out. The owner is not bound to accept any recommendations made in the Advice Report or Green Deal Plan, and may consult several Providers before signing a binding suitable Green Deal Plan. Plans may include up to 45 specific measures, such as insulation, heating, draught proofing, double glazing and renewable energy technologies, and must be carried out by a certified Green Deal Installer.

A Green Deal Plan, however, must show expected cost-effectiveness and expect to meet the 'golden rule'. Although, as future energy costs cannot be certain, this cannot be guaranteed. Projected savings are also based on an average case, rather than case-specific. Despite this, once projected compliance with the golden rule is demonstrated, a Green Deal loan may be authorised by the Provider to fund the installations (up to £10,000).

Loans are repaid through electricity bills, and include a rate of interest at 6.92%, fixed for 20 years (this is the rate at which the Green Deal Finance Company lends to Green Deal Providers – who in turn may pass the costs on and charge interest up to nearly 11%). Repayments are tied to the property rather than the occupier of the building at the time of installation. Loans may be set for a maximum of 25 years. A Green Deal Plan set-up charge of £63 also applies, although this may also vary by supplier, along with a £20 annual fee. DECC has governmental responsibility for managing all aspects of the Green Deal, with Gemserv contracted as the Green Deal Oversight and Registration Body (GD OSB). Their responsibilities include operating the accreditation and registration databases for Assessors, Providers and Installers, and the Green Deal Central Charge Database, which tracks and record the details of all Green Deal Plans.

To encourage early uptake, the government introduced a 'cashback' scheme. Any household having accepted a quote from a Green Deal Provider (domestic properties only) is able to contribute their own funds (e.g. savings) to the cost of installation, in lieu of additional Green Deal finance. Different technologies are eligible for different cashback amounts, from £10 for a hot water cylinder to £650 for solid wall insulation. Total cashback values are capped at 50% of total householder-contributed costs. A total of £125 million is earmarked for the scheme, with the first £40 million guaranteed. Once this is depleted, cashback rates may be subject to change (DECC, 2013c).

There is significant uncertainty regarding the cost-effectiveness of the Green Deal, and therefore the efficacy in inducing emissions reductions in both the immediate and long term. Several commentators criticise the golden rule, and doubt it will be met over the long term in most cases, especially with a relatively high interest rate of nearly 7% on the loan, which must be included on the 'repayments' side of the equation. Additional costs, such as obtaining assessments in the first place, along with penalties for early repayments add to this argument. This may lead to the unintended consequence of increasing energy bills (however, this may produce a further incentive for energy conservation and efficiency). Because of these fears,

uptake of the deal may be lower than projected, producing far lower emission savings than hoped for. Whilst the instrument partially overcomes the landlord-tenant dilemma, as the costs of the measures are linked to the property rather than the individual, different behaviours by new occupants may not continue the savings that may otherwise have been realised – also pushing bills even higher. This may also lead to lack of fluidity in the housing market in the case of significant uptake of the instrument (Ekins & Spataru, 2012).

As demonstrated, there are significant risks with this instrument, placing uncertainty on its long-term feasibility. However, if uptake is to the scale projected by government, it is hoped 250,000 jobs will be created in insulation and related industries by 2030. The government has also allocated funding for 1,000 apprenticeships.

### Energy Companies Obligation (ECO)

The ECO, also introduced under the Energy Act 2011, aims to complement the Green Deal by obligating energy companies to improve the energy efficiency of low-income households, especially through measures which may not be available to these households through the Green Deal (i.e. do not meet the 'golden rule'), thereby reducing emissions from domestic energy consumption and helping to alleviate fuel poverty. This instrument also replaces CERT and CESP. The ECO was passed on 4<sup>th</sup> December 2012 by the Electricity and Gas (Energy Companies Obligation) Order 2012, and came into effect in January 2013. Its current expiry date is 31<sup>st</sup> March 2015. The ECO is composed of three parts:

- **Affordable Warmth Obligation (AWO).** Designed to provide heating, hot water (including microgeneration measures, but excluding PV), and insulation measures to low-income households also in receipt of certain state benefits. Social housing tenants are not eligible. The AWO is expected to be worth around £350 million per year, and is aimed at reducing heating costs in the target group by £3.4 billion by closure of the ECO.
- **Carbon Saving Obligation (CSO).** Focussing specifically on the provision of internal and external insulation measures to domestic solid-walled and 'hard-to-treat' cavity-walled properties, and connection to district heating systems where appropriate. Any property with the required physical characteristics is eligible. The CSO is worth £760m a year and is expected to produce around 20.9mtCO<sub>2</sub> lifetime savings.
- **Carbon Saving Communities Obligation (CSCo).** The CSCo will deliver insulation measures to households and communities within the bottom 15% of the UK's Indices of Multiple Deprivation (IMD). There is a sub-target stating that 15% of each supplier's CSCo should be carried out in rural areas (population <10,000). Measures worth around £190m a year to 2015 are expected to be installed, with a target of 6.8mtCO<sub>2</sub> lifetime savings. The CSCo was not in the original design of the legislation, but was introduced after consultation following substantial support for promoting the reduction of fuel poverty as a twin goal of the policy instrument.

Overall, the ECO is expected to deliver carbon savings and heating cost reductions at a 75:25 split, from a total investment from energy suppliers of £1.3 billion a year (plus an estimated £16.3 million total administrative cost (DECC, 2012f)), benefiting around 230,000 low-income

households. Costs will be recouped through general energy billing. Responsibility for delivery will be apportioned to energy suppliers based on energy sales volume, with suppliers with less than 250,000 domestic customers exempt, and small suppliers who grow through this threshold experiencing a 'tapered' obligation.

With the objective of allowing competition and cost-effectiveness in installing these measures, a brokerage platform has been arranged from which Green Deal Providers can sell 'lots' (packages of installation work under the ECO) to energy companies. Sellers must deliver at least 90% of the promised carbon or energy bill savings promised on the contract, or face non-payment. Around 60 Green Deal Providers were registered with the brokerage platform soon after launch; however trading in this manner is not a regulatory requirement. DECC is in the process of consulting on what percentage of the ECO may be traded through this platform, and whether it should be mandated. A test auction was carried out on 18th December 2012, and the first 'live' auction was completed on 15<sup>th</sup> January 2013 (DECC, 2013d).

DECC is responsible for the policy design and operation of the brokerage platform of the scheme through the Government Procurement Service, whilst Ofgem (Office of Gas and Electricity Markets) is responsible for administering the scheme. Energy suppliers must report annually to Ofgem on their ECO delivery, to ensure a trajectory of meeting the 2015 target. For each package of installations completed, Ofgem issues 'points' to the obligated company responsible (based on expected CO<sub>2</sub> savings). If by the end of the obligation period the stated targets are not met with the required number of points, Ofgem is able to impose a financial penalty upon the offending company of up to 10% of global turnover.

By allowing the cost of the instrument to fall to energy companies, who in turn pay for measures through general energy billing, the cost of installing energy efficiency measures that would otherwise not be cost effective from an individual household point of view is borne by society at large (estimated at an additional £27 per fuel (electric and gas) annually, for the typical domestic customer (Ofgem, 2012)). This suggests relative static efficiency, but as the obligation currently ends in 2015, and once an obligated target is reached, there is no incentive to go further. Therefore, it cannot be considered dynamically efficient. In addition, DECC estimates an implicit price of a relatively high £77/tCO<sub>2</sub> avoided. It is too early to determine the efficacy of this instrument in achieving carbon savings, however as obligated companies are required to meet set targets, there is higher certainty than the Green Deal. However, this largely depends on the on-going carbon intensity of the energy supply. As a primary aim of this instrument is to alleviate fuel poverty, it is politically feasible and faces little public opposition. Consequential benefits such as increased activity in the insulation sector as discussed under the Green Deal, along with reduced cold-related illnesses and increased disposable income, and may enhance this (despite identified drawbacks).

### Vehicle Excise Duty (VED)

VED has been in effect in the UK since 1888, and currently applies to all vehicles that may be used or parked on public roads, with the exception of vehicles used by a disabled person or for disabled passengers, mobility scooters and powered wheelchairs, historic vehicles (constructed before 1937), mowing machines, vehicles used exclusively for agriculture,

horticulture and forestry, and vehicles powered by steam or electricity (DVLA, 2013a). A dated 'tax disc' is displayed on the vehicle (usually windscreen) to demonstrate compliance. The VED is treated as general taxation, and is a significant source of uncommitted revenue for central government.

When the Labour government took power in 1997, it stated it wished to overhaul the VED to encourage the purchase of more fuel-efficient vehicles. A public consultation in 1998 led to the announcement in Budget 1999 that vehicles would be placed in one of four VED bands, based on their rate of CO<sub>2</sub> emissions. Details were announced in Budget 2000, and the changes came into effect on 1<sup>st</sup> March 2001. Any vehicle registered after this date is charged in this manner. Vehicles registered before this date observe the older method of a two-tier charge based on engine size. Fifth, sixth and seventh bands were introduced in 2002, 2003 and 2006 respectively. An additional five were added in 2009, leading to thirteen bands in total. The rationale for these increases was to strengthen the environmental signal and to allow drivers to buy a lower-carbon vehicle within their preferred class (Butcher, 2013). The table below illustrates the current rate of VED (DVLA, 2013b), against the rates specified in 2005 (Great Britain. *Finance Act 2005*).

**Table 4 - Vehicle Excise Duty rates**

Band	CO2 Emissions (g/km)	2005/06 Rate	2013/14 Rate	2013/14 First Year Rate
A	Up to 100	£65	£0	£0
B	101-110	£75	£20	£0
C	111-120	£75	£30	£0
D	121-130	£105	£105	£0
E	131-140	£105	£125	£125
F	141-150	£105	£140	£140
G	151-165	£125	£175	£175
H	166-175	£150	£200	£285
I	176-185	£150	£220	£335
J	186-200	£165	£260	£475
K	201-225	£165	£280	£620
L	226-255	£165	£475	£840
M	Over 255	£165	£490	£1,065

A 'first year' tax rate, as also shown in the table above, was also introduced in 2009 with the objective of further strengthening the low-carbon price signal. A slightly reduced rate in each band (£10 reduction) exists for vehicles propelled by alternative fuel (LPG, biofuels, etc.).

The tax therefore covers direct emissions from personal and commercial petrol or diesel driven cars. There is no opt-out available. The Driver and Vehicle Licencing Agency (DVLA), an executive agency of the Department for Transport, administers the scheme and is responsible for collecting and enforcing VED, and setting VED rates. At present, VED provides nearly £6 billion in annual revenue for the government. DVLA are also tasked with ensuring evasion does not rise above 1%. In 2001, across all modes of transport, evasion was estimated to be 0.7%, leading to £40 million in lost revenue (DfT, 2011). Failure to tax a vehicle that has not

been declared 'off road' (not used on public networks) using a 'Statutory Off Road Notice' (SORN) carries a fine of up to £1,000. A fine of £80 is automatically liable for late payment of a renewed tax disc of up to one month.

Annual rate increases are linked to the Retail Price Index (RPI). In Budget 2012, the government announced it would consider medium-term reform of the VED system, to ensure all motorists make a fair contribution to public finances and to reflect vehicle efficiency improvements. Following this, in December 2012 a motoring services strategy consultation stated that it is 'considering the continuing need for the tax disc'. However, there are currently no firm proposals for reform. (Butcher, 2013).

The cost-efficiency of this instrument initially appears high, with high revenue and relatively low cost of administration and enforcement (2.5p per £1.00 collected) (DfT, 2011b). Whilst the UK average new car CO<sub>2</sub> emissions have decreased from 181gCO<sub>2</sub>/km in 2000 to 133.1gCO<sub>2</sub>/km in 2012 (SMMT, 2013), but there is little evidence to suggest VED was key to this (rather than fuel duties and a slow switch from petrol to diesel). This is supported by the government's own projections of attributed carbon savings of just 0.16MtCO<sub>2</sub>/year by 2020. A large proportion of the public are apparently unaware of the reasons behind tax banding, but this is likely a minor issue considering the most important factor in vehicle choice is capital cost (House of Commons Environmental Audit Committee, 2008). Vehicles in the lowest tax bands, such as hybrid or electric vehicles (the latter of which are exempt entirely), exhibit much higher upfront costs than those in the mid-level bands. In addition, owners of vehicles at the higher end of the spectrum are likely to have a higher disposable income and are less sensitive to price signals in this manner. Therefore, the static and dynamic efficiency appears low. Feasibility of the policy however, appears relatively high. Implementation is simple, bands and duty values are easily changed in response to new information and political feasibility is high, considering that vehicle capital cost and cost of fuel is, in general, of much higher concern and visibility to the public.

### Carbon Trust Standard

The Carbon Trust Standard was developed by the Carbon Trust (a government funded organisation – now a private entity), in 2007 and launched in June 2008, to encourage good practice in carbon measurement, management and reduction by public and private sector organisations of any size and sector, through reputational means. Participation is voluntary, and award of the standard is subject to meeting specific requirements following standardised methodologies (currently on version 1.3, active since June 2010). This builds on other international carbon management standards such as the Greenhouse Gas Protocol Corporate Standard from the World Resources Institute (WRI) and ISO14001 standards, along with aspects of a predecessor scheme - the Energy Efficiency Accreditation Scheme (Carbon Trust, 2013). The Standard is recognised by the Environment Agency. To receive the Standard, organisations must comply with the following (Carbon Trust, 2010):

- **Carbon footprint measurement.** Organisations must measure their Scope 1 & 2 emissions, including electricity and gas consumption, onsite fuel consumption (e.g. heating oil, diesel), and transport fuel consumption, in line with the standardised methodology. All six GHGs should be included, with small emission sources (under 1% of total footprint)

able to be excluded if data is lacking. No more than 5% of total emissions may be excluded.

- **Carbon management approach.** Organisations must provide evidence of acting to reduce emissions through effective governance, carbon accounting and reduction targets, investment and training. An assessor will ask a sample of standardised, weighted questions to ascertain the level of management applied. A score of 60% is required to pass this criterion. Compliance with other certified schemes, such as ISO14001, is often enough to demonstrate compliance with this requirement.
- **Carbon reduction target.** Compared to a footprint year, an emissions reduction of 2.5% CO<sub>2</sub>e, either absolute or relative to an intensity metric (e.g. turnover), must be demonstrated over a set timeframe. For organisations with energy bills exceeding £500k, or that qualify for the CRC (discussed previously), this must be shown over a period of three years. For organisations with an energy bill between £50k and £500k, the timeframe is two years, with organisations below this threshold also required to show savings over two years, but with the option to demonstrate this over a single year along with evidence of quantified reductions equivalent to at least 2% of the organisation's total footprint.

Accredited independent assessors undertake assessments, and recipient organisations must be assessed every two years to retain the Standard. For the first renewal assessment the emissions scope is expanded to cover process, fugitive emissions and emissions from transport not directly owned by the organisation (e.g. public transport and private car use for business purposes).

Over 600 organisations are in receipt of the Standard, and it is claimed that over 3.6MtCO<sub>2</sub>e of emissions have been certified as mitigated, equivalent to £165m in cost savings per year (Carbon Trust, 2013). No explicit future changes are expected, however, the Standard is subject to regular review by an independent advisory board.

As the Standard requires on-going emissions reductions, but does not impose direct financial burden (compliance costs will vary dramatically depending on the individual organisation, and what other instruments it is subjected to), or prescriptive measures upon an organisation and rather allows it to reduce emissions in the cheapest manner appropriate, it may be argued that the instrument is efficient in both static and dynamic dimensions. However, the voluntary nature of the Standard and the fact that only reputational drivers are relied upon, which are subject to change in their impact, reducing the incentive to achieve the standard, means its efficacy in reducing emissions is questionable. As the uptake of the Standard has been relatively small, any side effects such as job creation and technology dissemination attributable to the Standard are likely to have been minimal (especially since the introduction of the larger, mandatory CRC scheme). This instrument, however, has proved highly feasible in its implementation, in likelihood due to its voluntary nature, standardised manner of reporting and lack of severe penalty for non-compliance. Its significant overlap with the CRC scheme (to be discussed), also means that many organisations may achieve the requirements of the Standard as a by-product of other efforts. Whilst this also questions the level of emissions savings attributable to this instrument, and therefore its efficacy, it increases its feasibility.



## LSE Mandatory Carbon Reporting

In May 2011 the government released a consultation on options for promoting consistent corporate reporting of greenhouse gas emissions. The consultation considered whether regulations should be introduced requiring companies to report on their GHG emissions, as possible through Section 85 of the 2008 Climate Change Act, or whether enhanced voluntary reporting would prove the best approach. A mandatory approach was decided upon, justified by the feeling that voluntary approaches have not led to significant levels of reporting or methodological consistency. In addition, creating consistency of disclosure provides shareholders and investors information on climate change risks with which to inform future investment decisions, and raises managerial attention to the issue (Defra, 2011).

As such, at the Rio +20 summit in June 2012, Deputy Prime Minister Nick Clegg announced that all companies listed on the main market of the London Stock Exchange (and registered within the UK) would be legally required to report their GHG emissions from April 2013 (over 1,100 organisations). In fact, the regulation is expected to come into effect from late 2013.

The draft regulations state that the annual quantity of all six GHGs defined in the Kyoto Protocol emitted (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride), must be reported in tonnes of CO<sub>2</sub> equivalent in an annual directors' report. The draft regulations appear to allow flexibility for when the first report, and therefore what time of the year subsequent reports, are published. This allows companies to align reporting with other annual reports (Carbon Trust, 2012). A 'carbon intensity ratio' must also be reported, which expresses company emissions against any quantifiable activity of the company (e.g. turnover, units of output, etc.). All 'Scope 1' and 'Scope 2' emissions must be reported, including direct combustion of fuel by any activities controlled by the company, electricity use and transport (*The Greenhouse Gas Emissions (Directors' Reports) Regulations 2013 (Draft)*).

A company within any commercial sector may theoretically be eligible, as eligibility is not determined by sector but by individual membership of the London Stock Exchange. It is not yet clear whether any 'opt-out' options will be available. It is also likely that Defra will be responsible for most aspects of the requirements, but this is yet to be confirmed. It is also not yet clear what the penalties for non-compliance will be. The government has stated that a review of the first two implementation years will be undertaken in 2015 and a further decision will be taken in 2016 on whether reporting requirements will extend to all large companies (with definitions to be determined, if necessary).

As the instrument has not yet been introduced, determining its optimality is a speculative exercise. Defra projects savings of up to 4MtCO<sub>2</sub> by 2021 from the legislation, with annual administrative costs to organisations of around £2.6 million in total outweighed by annual fuel and energy savings estimated up to £89 million, largely from savings in diesel consumption (Defra, 2011), driven by this public reporting mechanism and the desire to show improvements. This is in addition to the stated primary benefit of protecting future investments in relation to climate change risk. If such projections come to pass, the instrument may be considered both statically and dynamically efficient, as the incentive to improve continues,

along with innovation and dissemination of knowledge and technology in emissions abatement. However, since this is largely a reputational driver, investments in improvements are unlikely to surpass the level in which payback periods are relatively short and direct. Owing to the relatively low costs imposed on obligated organisations, the simple structure of the policy and low risk of unintended side effects, this is likely to be a highly feasible instrument. This may change in future if the scope of reporting is extended to other organisations.

**I.2.3 Promotion of Renewable Sources of Energy**

The EU-ETS, CCL, and VED also fall under this landscape, but have been discussed previously. The Landfill Tax also falls into this landscape, but will be discussed under the ‘Non-CO<sub>2</sub> GHG’ landscape.

**The Renewables Obligation (RO)**

The RO was introduced in April 2002 to encourage the development of large-scale renewable electricity in the UK by requiring licenced UK electricity suppliers to source a minimum proportion of their supply from renewable sources, enacted through powers introduced through the Utilities Act 2000. It replaced the Non-Fossil Fuel Obligation, which came into effect in 1990. The RO is managed separately in Scotland and Northern Ireland (the latter of which introduced the instrument in April 2005).

The ‘level’ of the RO for each obligation period (annually April-March, beginning April 2002), is set for each year by the 1<sup>st</sup> October the preceding year. An annual Renewables Obligation Order then sets the target in legislation. The table below illustrates the level of the obligation from inception to the current year (DECC, 2012b)

**Table 5 - Renewables Obligation rates and buy-out price**

Obligation Period	Obligated Proportion	Buy-Out Price
2002/2003	3%	£30
2003/2004	4.3%	£30.51
2004/2005	4.9%	£31.39
2005/2006	5.5%	£32.33
2006/2007	6.7%	£33.24
2007/2008	7.9%	£34.30
2008/2009	9.1%	£35.76
2009/2010	9.7%	£37.19
2010/2011	10.1%	£36.99
2011/2012	12.4%	£38.69
2012/2013	15.8%	£40.71
2013/2014	20.6%	£42.02

Renewable electricity generators report their renewable generation on a monthly basis to Ofgem, who issue Renewables Obligation Certificates (ROCs) equal to their renewable

generation. Initially, a ROC was issued for each MWh of renewable electricity generation for installations over 5MW, and registered with Ofgem's Renewables and CHP Register. Since 2009 the number of ROCs issued per MWh depends on the generating technology, allowing for varied support incentives. At present there are 32 ROC 'bands', with two ROCs per MWh issued to several technologies including wave, solar PV, geothermal and microgeneration, down to 0.1 ROCs issued to landfill gas (nuclear energy is not included). Banding levels are reviewed every 4 years (DECC, 2013e). Each installation is guaranteed to receive ROCs, in line with their banding each year, for 20 years post-installation.

Once ROCs have been issued, generators may sell their ROCs to electricity suppliers, which therefore allow the generators to receive a premium payment in addition to the wholesale electricity price. Electricity suppliers must then submit the number of ROCs required to meet the obligated proportion of their total supply for that obligation period, by 30<sup>th</sup> September the following year. ROCs may not be banked for the following obligation period, and are retired when submitted.

Suppliers who do not submit the required number of ROCs are subject to a penalty known as the 'buy out price', in which the supplier pays a set price for each absent ROC. This price is also set and fixed by government each obligation period, as seen in Table 5. Any revenue raised from suppliers paying into the buy-out fund is recycled on a pro-rata basis to suppliers who presented ROCs within a given obligation period (minus withdrawals from the RO administrator to cover costs of administration). The level of the obligation for each year is determined by a 'headroom' calculation, in which a set margin (10%) is added to the projected renewable generation, to create additional demand to ensure the value of ROCs remains high enough to form an incentive for investment in renewable installations.

DECC is responsible for setting policy objectives and mechanisms for the RO, including setting the annual obligation level. Ofgem are responsible for administering the RO, including issuing ROCs, monitoring and compliance, and receiving and re-distributing buy-out fund payments. The RO initially expired in 2007, but was extended in 2010 to 2037, with the intention of providing certainty to investors to encourage new generation capacity up to 2020 (*The Renewables Obligation (Amendment) Order 2010*).

Around 9GW of renewable generation has been installed in the UK since the introduction of the RO. In July 2011, the government released a white paper on electricity market reform, which proposed several new measures to encourage renewable generation to largely replace the RO. These proposals are included in the 2013 Energy Bill. Arrangements for the transition between policy instruments include the following proposals (DECC, 2011b):

- New renewable installations will have a choice of whether to claim ROCs or Contracts for Difference (CfDs) with Feed-in Tariffs (FITs) between April 2014 and March 2017.
- From 31<sup>st</sup> March 2017, the RO is closed to new generation. Generation accredited until this date will continue to receive full lifetime support (20 years), until the RO closes fully in 2037
- RO will continue to be calculated by 'headroom' until 2027, after which DECC will buy ROCs directly from the generators at a long-term fixed price, until the RO expires.

The RO is not statically efficient, as it mandates the investment in high-cost renewable energy, adding around £20 to the average annual household energy cost (DECC, 2011e). It is relatively dynamically efficient, as it provides a long-term incentive for innovation, reducing long-term cost of abatement and extent of fossil fuel lock-in. This is limited however by the incentive 'ceiling' – if renewable generation exceeds the obligated proportion, the value of the excess ROCs is zero, placing downward pressure on the overall ROC price. This inherently reduces the efficacy of the instrument, as the value of ROCs reduces as deployment increases towards the target (as potential buy-out payments reduce), preventing investment to actually reach it. As such, the obligation levels have never been met (i.e. 9.4% in 2011 against a 12.4% target (RESTATS, 2013)). This may also suggest the buy-out price may not be high enough, and allows for an 'optimal' balance between compliance and non-compliance (paying into the buy-out fund). However, this is purposeful, to allow ROCs to retain their value over time. Ofgem (2013) estimated an implicit price of £96.61/tCO<sub>2</sub> avoided in 2010 from the RO. However, other factors, such as planning laws, may also have hampered efficacy (Woodman & Mitchell, 2011), along with NIMBY-ism, despite widespread support for renewable generation. These aspects join to reduce the feasibility of the instrument. Issues impacting feasibility of the instrument have been tackled on a nearly annual basis through amendments to the instrument's design, such as differentiated ROCs for different technologies to allow investment in more costly technologies and avoid 'picking winners'.

### Renewable Energy Feed-In Tariff (FITs)

Feed-in tariffs for small-scale electricity generation were introduced as part of the Energy Act 2008, and came into effect on 1<sup>st</sup> April 2010. The objective of the instrument is to encourage the uptake of a range of small-scale renewable and low-carbon electricity generation technologies through long-term financial incentives, leading to 1.6% of the UK's electricity by 2020 (Walker, 2012). Eligible technologies are Solar PV, wind, micro-CHP, hydro and anaerobic digestion (AD). The maximum total installed capacity for an individual installation is 5MW, or 2kW for micro-CHP.

Any organisation, business, community or individual is eligible to purchase and install qualifying technology. Installations must be accredited before they are able to receive FIT payments. For solar PV, wind and micro-CHP installations under 50kW, this must be through the Microgeneration Certification Scheme (MCS) (installed on or after 15<sup>th</sup> July 2009). Any installation over 50kW (and up to 5MW), along with hydro and AD of any size, must be accredited through Ofgem's Renewables and CHP Register (installed on or after 1<sup>st</sup> April 2010). Once MCS accreditation is received for <50kW installations, it may be registered with a 'FiT Supplier'. The date this registration occurs is known as the 'eligibility date', and for 5kW-5MW installations, this is set at the date an Ofgem accreditation is requested. If accepted, FIT payments are approved from the eligibility date.

'FiT suppliers' are all Licenced Electricity Suppliers with a customer base exceeding 50,000, who are legally required to take part (currently 26 suppliers). Suppliers must pay, on a quarterly basis, certified installations both a generation tariff and, where relevant, an export tariff - the costs of which are recovered through general electricity billing. Generation tariff rates for non-PV technologies with eligibility dates on or after the 1<sup>st</sup> December 2012 until 31<sup>st</sup> March 2014 payable from 1<sup>st</sup> April 2013 are (Ofgem, 2012d):

**Table 6 - Feed-in Tariff rates**

Technology	Sub-Category	Generation Rate (p/kWh)
AD	< 250kW	15.16*
	250kW – 500kW	14.02*
	>500kW	9.24
Hydro	<15kW	21.65
	15Kw – 100kW	20.21**
	100kW – 500kW	15.98
	500kW – 2MW	12.48**
	>2MW	3.23***
Wind	<1.5kW	21.65
	1.5kW – 15kW	21.65
	15kW – 100kW	21.65
	100kW – 500kW	18.4
	500kW – 1.5MW	9.79
	>1.5MW	4.15***
CHP (<2MW)	Only available for 30,000 units	12.89

\*From 30<sup>th</sup> September 2011

\*\*From 1<sup>st</sup> April 2010

\*\*\* From 1<sup>st</sup> April 2013

Support for the above technologies is guaranteed for 20 years, with changes in the generation tariff rate linked to the Retail Price Index (RPI) changes of the previous calendar year. However, as a result of the government-wide spending review, a comprehensive review of the FiT instrument took place between October 2011 and April 2012, with the resulting changes aimed at saving £40 million. Generation rates were reduced for all the above technologies (although not for all bands) to the rates seen above, with wind experiencing cuts of over 40% for the smallest installations. Changes to solar PV were the most extensive, with several changes entering into force in 2012, including (DECC, 2012):

- To receive the standard PV generation tariff (now 'higher' rate), the building to which PV installations of 250kW or less is attached or wired to provide electricity must have achieved an Energy Performance Certificate rating of 'D' or above. Otherwise, the new 'lower' rate applies (eligibility date on or after 3<sup>rd</sup> April 2012)
- A reduction in tariff lifetime from 25 to 20 years (in line with other technologies) (eligibility date on or after 1<sup>st</sup> August 2012)
- A new 'middle' tariff rate will now apply to multi-installation systems of more than 25 individual installations, rather than more than one (eligibility date on or after 3<sup>rd</sup> April 2012)
- A degression mechanism that allows PV tariffs to be reviewed and set on a quarterly basis, in response to deployment rates in the previous quarter (from 1<sup>st</sup> October 2012).

The table below illustrates generation tariff rates for solar PV effective for installations with eligible dates between 1<sup>st</sup> February 2013 and 1<sup>st</sup> May 2013 (Ofgem, 2013e).

**Table 7 - FiT rates for solar PV**

Category	Tariff Rate Band	Generation Rate (p/kWh)
<4kW	Higher Rate	15.44
	Middle Rate	13.90
	Lower Rate	7.10
4kW – 10kW	Higher Rate	13.99
	Middle Rate	12.59
	Lower Rate	7.10
10kW – 50kW	Higher Rate	13.03
	Middle Rate	11.73
	Lower Rate	7.10
50kW – 100kW	Higher Rate	11.50
	Middle Rate	10.35
	Lower Rate	7.10
100kW – 150kW	Higher Rate	11.50
	Middle Rate	10.35
	Lower Rate	7.10
150kW – 250kW	Higher Rate	11.00
	Middle Rate	9.90
	Lower Rate	7.10
>250kW	-	7.10
Stand-alone	-	7.10

As part of this review, the ‘export tariff’ paid to generators for each unit of electricity sold to an electricity supplier was increased from 4.5p/kWh to 4.64p/kWh on 1<sup>st</sup> April 2013. This rate is also linked with the RPI (Ofgem, 2013d).

Solar PV rates were subject to extensive change in 2011, in response to extremely high uptake (5,000 to 100,000 installations between April 2010 and November 2011), stemming from rapidly reducing technology costs in response to PV costs dropping dramatically quicker than projected by DECC; 26% between 2010 and 2011, compared to a 9% projection. Prior to this the rate was flat at 36.1p/kWh for new build units, and 41.3p/kWh for retrofitted units. This change altered rates to 19p/kWh for 50kW-150kW installations, 15p/kWh for 150kW-250kW installations and 8.5p for >250kW and stand-alone units with effect from 1<sup>st</sup> August 2011 (Ares, Hawkins & Bolton, 2012).

DECC are responsible for policy aspects of the scheme, and Ofgem are responsible for its administration. This includes setting the tariff rates, accreditation of installations over 50kW and maintaining the Central FiTs database of all installations. Energy suppliers themselves operate a large proportion of the scheme, and are responsible for registering generators with Ofgem and receiving and processing generation data and payments. All licenced electricity suppliers, regardless of customer numbers, must pay into Ofgem’s ‘levelisation fund’ on a quarterly basis, based on their market share of the UK’s electricity supply and FiT payments made to eligible installations. These funds are then redistributed to suppliers based on the difference between their ‘fair’ level of payments to installations based on their market share,

and their actual payments. The total cost is covered through general electricity billing (estimated at around £6 per household/year (Ofgem, 2013)).

As of 31<sup>st</sup> December 2012, 1.66 GW of installed capacity is receiving feed-in tariff support, across 358,337 installations (Ofgem, 2013). Under the current Energy Bill, a proposal is present to introduce FiTs to installations above 5MW, as a vehicle to implement Contracts for Difference (CfDs). This would replace the RO, as discussed previously, and would also include nuclear energy. The arrangements for <5MW installations would remain unchanged.

As with the RO, the promotion of renewable energy in this manner is not statically efficient, as it imposes additional investment cost to encourage renewable deployment at the expense of fossil fuels, but in encouraging deployment and subsequent innovation and cost reduction, it is dynamically efficient in emissions abatement. The general cost-effectiveness of the instrument depends on the capital costs of the supported technologies, and the attached FiT rates. Differentiated rates attempt to produce a level incentive for investment in both mature and developing technologies, however evidence suggests that lack of information and uncertainty lead to unnecessarily high rates, producing windfall profits. This is reflected by the significant reduction in solar PV rates experienced since the instrument's introduction. The implicit CO<sub>2</sub> price imposed by this instrument varies by technology. Kesicki (2011) estimated implicit carbon prices in 2010 of around £118/tCO<sub>2</sub> for biomass, £151/tCO<sub>2</sub> for hydro, £577/tCO<sub>2</sub> for PV (although will now have changed), and £287/tCO<sub>2</sub> for wind (these are central values within ranges). Despite the number of installations currently installed, modelling by Walker (2012) suggests that FiTs may only achieve an optimistic maximum of 1.64% of electricity production in the UK by 2020, and only under high FiT rate scenario. As such, whilst it is clear that FiTs have encouraged the growth of microgeneration, it is unlikely to meet its stated target (1.6% by 2020), reducing confidence in the efficacy of the instrument. The feasibility of the instrument in achieving its goals depends on the FiT rates and the cost of installation of microgeneration technologies, which it has no direct control over. Uncertainty of these costs means that FiT rates must be flexible, however too much alteration leads to uncertainty for installers, leading to strategic behaviour and delay of installations in the hope of increased rate, or rush for installations before rates drop – as already seen. The creation of an estimated 25,000 jobs through FiTs provides additional argument for feasibility (despite heavy regional and organisational size differences – accreditation is too expensive for many small installers), although this may see a decline as a result of reduced rates (Cherrington *et al*, 2013).

### Renewable Heat Incentive (RHI)

The RHI was also introduced as part of the Energy Act 2008, and came into effect on 28<sup>th</sup> November 2011 under the Renewable Heat Incentive Regulations 2011. Similarly to the feed-in tariff for electricity, it seeks to encourage the uptake of renewable heating technologies through financial incentives, and is the first long-term support mechanism for renewable heat in the world. The RHI is the cornerstone of the government's 'heat strategy', and aims to deliver 12% of total heating requirements from renewable sources, with emissions savings of 44mtCO<sub>2</sub> by 2020 (DECC, 2011c).

The scheme has two phases. Phase 1, in effect from the instrument's initiation, is aimed at the non-domestic sector, with industry, commercial and public sector organisations eligible for the

scheme. The scheme is not available in Northern Ireland. The technologies selected for support are those defined as ‘renewable’ by the Renewable Energy Directive (RED) – biomass boilers (including CHP biomass), ground, water and geothermal source heat pumps, all solar thermal collectors and biomethane and biogas (both direct combustion and injection into the natural gas grid). Tariffs are then paid, on a quarterly basis, related to the output of the installation (determined by meter readings), as follows (DECC, 2012d):

**Table 8 - Renewable Heat Incentive rates**

Tariff Name	Eligible Technology	Eligible Sizes	Tariff Level (p/kWh)
Small Biomass	Solid biomass, Inc. contained in municipal solid waste	<200 kWth	8.3 (tier 1)
			2.1 (tier 2)
Medium Biomass		200kWth – 1,000kWth	5.1 (tier 1)
			2.1 (tier 2)
Large Biomass		>1,000kWth	1.0
Small Heat Pumps		Ground-source heat pumps; water source heat pumps; deep geothermal (100kWth and above)	<100kWth
Heat Pumps	>100kWth		3.4
Solar Thermal Collectors	Solar Thermal Collectors	<200kWth	8.9
Biomethane and Biogas Combustion	Biomethane injection and biogas consumption, except from landfill gas	Biomethane all scales, biogas combustion, except from landfill gas	7.1

For biomass, a ‘tiered’ approach is used. Each year, for the initial generation of the installation (equivalent to 15% of annual load capacity), the ‘tier 1’ rate will apply. If this level of output is exceeded, the ‘tier 2’ price comes into effect. All tariffs are payable for 20 years from the date of installation (all installations must be new and installed from 15<sup>th</sup> July 2009 onwards), with static tariff rates linked to the RPI. The rates are set as the marginal cost between renewable heating technologies and conventional fossil fuel systems. Any installed system must be used for space, water or process heating within a building, must not be in receipt of other assistance from public funds, and installations must be certified under the Microgeneration Certification Scheme.

In September 2012, the government released a consultation on proposals to extend the scheme to air source heat pumps, biomass direct air heating (currently systems must heat through steam or liquid), and biomass over 200kW. The consultation closed in December 2012 and responses are currently being considered. At the same time the government published proposals to introduce Phase 2 of the scheme – the extension of the RHI to the domestic sector in Spring 2014 (initially planned for 2012). The policy framework for the domestic scheme was published in July 2013. Eligibility will cover households who plan to replace their current heating system with air source heat pumps (for water), biomass boilers, ground or air source heat pumps and solar thermal systems, on or after 15<sup>th</sup> July 2009. Other points include (EST, 2012):



- Proposed rates for air source heat pumps (7.3/kWh), biomass boilers (12.2p/kWh), ground source heat pumps (18.8p/kWh) and solar thermal (at least 19.2p/kWh)
- All installations must be MCS certified
- Certain energy efficiency measures (excluding solid wall insulation) will be a pre-requisite. This links with measures under the Green Deal (DECC, 2012d).

Partly due to this delay in introduction of this phase, the short-term Renewable Heat Premium Payment (RHPP) was introduced, allowing domestic customers to receive small up-front payments for these technologies. The RHPP will cease once Phase 2 of the RHI comes into effect. DECC is responsible for the policy framework of the RHI, including setting tariff rates and eligibility criteria. Ofgem is responsible for the scheme's administration, including accrediting installations, making payments to generators and compliance. In situations of non-compliance, Ofgem has the power to withhold payments and revoke accreditation or registration with the RHI (*The Renewable Heat Incentive Scheme Regulations 2011*). By the end of the first year of the scheme (to December 2012), 171MW of installed capacity had been created, with £2.53 million of RHI payments made. 90% of these installations are solid biomass boilers (Ofgem, 2013). Funding for the RHI is sourced from general taxation.

Throughout 2012 other consultations and announcements were released proposing alterations to both the financing of the scheme and potential tariff changes. In June 2012, a standby mechanism was introduced to allow suspension of new applications until the following year if 97% of the budget (£67.9 million) is met, to guard against overspend. This will be in place until a new 'long term budget management' plan comes into effect. Consultation responses to this are currently being assessed. A proposed degression system for the non-domestic scheme under this plan would see tariffs paid to new installations reduce if it appears that the rate of installations is higher than needed to achieve the renewable heating proportion of the UK's 2020 renewable energy targets. In January 2013 this was followed by an announcement that the underlying evidence, assumptions and calculations that form the justification for current tariff levels will be reviewed based on evidence accrued since the start of the scheme (DECC, 2012d). Calls for evidence have been issued for potential inclusion of biopropane and landfill gas.

Again, as this scheme encourages the adoption of more costly renewable over non-renewable cheaper alternatives, it is not statically efficient, but as it encourages deployment and cost reduction of these technologies into the future, reducing future cost of emissions abatement, it may be considered dynamically efficient. Similarly, the overall cost-effectiveness depends on the suitability of the support rates, which provides differentiated rates to technologies based on marginal cost of the technologies to provide equal incentive for investment. The support rates for solar thermal, however, depart from this by providing a lower rate of return. This is justified by the fact that if an equal payback period were provided for solar thermal, meaning higher rates, the majority of the RHI budget would likely divert to this technology only. The efficiency of the support rates (i.e. high enough to encourage investment, but low enough to ensure no windfall profits or excessive support or market distortion) depends on the accuracy of the underlying assumptions and calculations of installation cost. This is reflected by the lack of installations in ground source heat pumps against expectations. Discussions between government and industry suggest this may be due to inaccuracies in cost, efficiency and load

factor assumptions, and responses for a call for evidence to confirm or amend these assumptions are currently being assessed. Government estimates for the implicit carbon price for the existing non-domestic scheme are £35/tCO<sub>2</sub> for traded carbon, and £48/tCO<sub>2</sub> for non-traded carbon. The corresponding values for the upcoming domestic scheme are £22/tCO<sub>2</sub> for traded and £94/tCO<sub>2</sub> for non-traded. These values will vary depending on the technology supported.

Such aspects impact the feasibility of the instrument achieving its targets. Other factors, such as incompatibility with pre-existing legislation, have also presented issues. The tariff rate for large biomass was reduced to 1p/kWth from the initially proposed 2.7p/kWth, in order to meet EU State Aid rules. Similarly to FiTs, support rates must remain flexible to ensure appropriate rates into the future, but again, this may cause uncertainty and allow strategic action in installation timings.

### The Renewable Transport Fuel Obligation (RTFO)

The RTFO aims to induce a shift towards renewable road transport fuels by mandating a certain proportion of a fuel supplier's total product is composed of sustainable biofuel. It came into effect on 15<sup>th</sup> April 2008, under provisions made in the Energy Act 2004 (*Renewable Transport Fuel Obligations Order 2007*).

All road transport fuel suppliers with an annual supply of over 450,000 litres in the UK are required to meet increasing proportions of their supply from renewable sources (i.e. biofuels), for each 'obligation period' (annual, beginning 15<sup>th</sup> April 2008). In the initial Order this proportion began at 2.6% in the first period (2008/09), 3.9% in the second (2009/10) and 5.3% for all subsequent periods (2010/11 onwards), in order to meet the Biofuels Directive (2003). This was altered by a subsequent 2009 Order to meet the revised short-term targets in the 2008 amendment to the Biofuels Directive, to the following (DfT, 2012b):

**Table 9 - RTFO targets**

Obligation Period	Original Targets	New Targets (2009)
2008/09	2.6%	2.5%
2009/10	3.9%	3.25%
2010/11	5.3%	3.5%
2011/12	5.3%	4.0%
2012/13	5.3%	4.5%
2013/14 - onwards	5.3%	4.7% (as of April 2013)

This reduction was in exchange for a long-term target of 10% renewable transport fuel (including renewable electricity and hydrogen), by 2020, with a 5% by 2015 interim target in Member States, as voted by the European Parliament in 2008 and codified in the Renewable Energy Directive 2009 (RED). The RTFO is also the primary UK instrument in meeting these targets, and also the Fuel Quality Directive 2009, which requires a reduction in lifecycle GHG intensity by 6% per unit of energy by 2020 (Upham, Dendler & Tomei, 2013). As such, the use of biofuel is promoted as the primary renewable transport fuel in the UK, over electricity, hydrogen and other options.

The RED also places mandatory sustainability requirements on biofuel production (including land use requirements and GHG provisions). In December 2011, an RTFO Order amendment was made to include these criteria, which must be met to be eligible for inclusion as renewable fuel under the RTFO and enable receipt of Renewable Transport Fuel Certificates (RTFCs) - the mechanism through which compliance with the Order may be proven. Claims to meet these criteria must be independently verified. If the fuel does not meet the criteria, they are considered as part of the fossil fuel based supply for that supplier. RTFCs are issued to the owner of the eligible fuel once it passes the 'duty point' (the point at which it becomes liable for UK excise duty), usually at the rate of one RTFC per litre of biofuel, or kilogram of biomethane. The 2011 amendment also allowed 'double counting' for some fuels, including those made from waste products (DECC, 2012e). Under 2012 proposed further amendments, this may increase to 'quadruple' counting for selected feedstock.

At the end of each obligation period eligible suppliers must surrender RTFCs commensurate to the proportionate volume of biofuel supply required (by the 5<sup>th</sup> November following the obligation period in question). This may be achieved through production and import of eligible fuels by the mandated suppliers themselves, or through RTFCs purchased from non-mandated suppliers (with under 450,000 litres of annual fuel supply). This encourages smaller suppliers, not covered by the RTFO, to produce biofuels as part of their supply mix. The price of RTFCs is wholly set by the traded market value.

If the requisite number of RTFCs cannot be provided suppliers must pay a 'buy-out price' per certificate in absence. The buy-out price was £0.35 in the first obligation period, and is £0.30 in each subsequent period. The buy-out fund is then redistributed to each supplier based on the number of excess RTFCs held but not required to fulfil their obligation. Once an excess RTFC has been used to claim part of this fund, it is surrendered. Alternatively, suppliers with an excess of RTFCs are allowed to bank their certificates for use in subsequent obligation periods, provided they meet the sustainability requirements of the period in question, and do not account for more than 25% of the total obligated volume in that period (DECC, 2012e).

The Department for Transport (DfT) is responsible for all aspects of the RTFO (The Office of Renewable Fuels Agency initially undertook administration, and was created by the 2007 Order. This was disbanded in March 2011, and DfT absorbed responsibilities). All mandated participants must register with DfT, along with any other suppliers who wish to receive RTFCs.

Civil penalties are applicable in cases in which obligated suppliers provide inaccurate information, if RTFCs are obtained through means that contravene the requirements of the obligation, and in cases of late payments to the buyout fund. In the first case, a fine of £50,000 is imposed. In the second, a fine is payable equal to double the value of the number of RTFCs obtained (or attempted to obtain) through these means (the value is set by the buy-out price). In the third situation, the outstanding sum is subject to interest at 5% above the Bank of England base rate, charged on a daily basis (*Renewable Transport Fuel Obligations Order 2007*).

As the RTFO operates a tradable certificate scheme it allows the obligation to be met in the most cost-effective manner possible. However, since it mandates a minimum proportion of a

given type of fuel at a higher cost than the cheapest available option, and is narrow in its definition of fuel type required, it cannot be considered statically efficient. A further order came into effect in April 2013, which extended the scope of the RTFO to fuel used in non-road mobile machinery. The Order also reduce the long-term target from 5.0% to 4.7% from the 2013/14 obligation period, in order to prevent an increase in biofuel on the market (*The Renewable Transport Fuel Obligations (Amendment) Order 2013*). It has elements of dynamic efficiency as it encourages innovation in biofuel technologies, but as there is no incentive to go beyond the proportion of biofuel supply required (indeed, with the proposed amendment this is actively discouraged), it cannot be considered fully dynamically efficient.

By the end of the 2011/12 obligation period, over 6 billion litres of renewable road transport fuel had been supplied since the start of the RTFO. 1.6 billion of this was in the 2011/12 period alone, and equalled 3.6% of total road transport fuel against an obligation of 4.2%. 12% of this was sourced from UK feedstock, with the majority of the remainder sourced from cooking oil in the Netherlands, followed by bioethanol from the USA (DfT, 2012). There appears to be an optimal point between compliance and non-compliance (i.e. costs for compliance versus the buy-out price), reducing efficacy of the instrument. Oddly however, due to the environmental concern over the use of biofuels, this may have increased the environmental impact of the RTFO (or rather, decreased the negative impact). For the first 32 months of operation, certificates were earned for biofuel that did not meet the government's environmental social standards, as this was not mandatory. In the first year, 42% was produced on land of 'unknown' previous type, rendering the overall environmental benefit of the RTFO questionable (Upham, Dendler & Tomei, 2013).

Biofuels are a contentious issue. They are often accounted as zero-carbon, but once the energy used to produce feedstock is considered, this is not the case. There is strong opposition to their use by most environmental and development NGOs, and opinion is split between government departments. However, knowledge of the RTFO amongst the general public is very low ((Upham, Dendler & Tomei, 2013). The RTFO is an administratively feasible and flexible instrument, but with unintended environmental and social impacts reducing broad political support and ambition.

#### 1.2.4 Non-Carbon Dioxide GHGs

The EU-ETS also falls under this landscape, but has been discussed previously.

#### Landfill Tax

The Landfill Tax was introduced by The Landfill Tax Regulations 1996, and came into force on 1<sup>st</sup> August of that year. Its primary aim is to encourage waste producers to minimise waste and encourage use of non-landfill options such as recycling, energy recovery and composting (HMRC, 2012). A secondary aim and result of this primary objective is the reduction of methane emissions from biodegradable waste, and the instrument is seen as the primary tool in achieving the targets laid out in the Landfill Directive (1999) for this purpose.

Tax must be paid on all waste disposed into a licensed landfill, and is payable by the landfill operator (with costs passed to waste producers), for any waste deposited on or after 1<sup>st</sup> October 1996. As with the CCL, employer National Insurance contributions were reduced by 0.2% to compensate. Waste from all sectors is eligible, aside from exempt activities such as dredging, quarrying and mining, pet cemeteries and inactive waste used for filling quarries. The tax is levied per tonne, and is divided into a 'standard rate' and 'lower rate', as required by the Finance Act 1996. The lower rate is levied on material considered inactive or inert, such as glass, ceramics and concrete, as defined and listed by the Landfill Tax (Qualifying Material) Order 1996, and subsequently amended in 2011 and 2012. The 2011 amendment also introduces criteria from the revised Waste Framework Directive (2008/98/EC) (non-hazardous waste), and considerations of potential for GHG emissions. The standard rate is levied on all remaining waste considered 'active', such as biodegradable waste and plastics. The table below illustrates the lower and standard rates, with changes over time.

**Table 10 - Landfill Tax rates**

<b>Date of Change</b>	<b>Standard Rate (£/tonne)</b>	<b>Lower Rate (£/tonne)</b>
01/10/96	7	2
01/04/99	10	2
01/04/00	11	2
01/04/01	12	2
01/04/02	13	2
01/04/03	14	2
01/04/04	15	2
01/04/05	18	2
01/04/06	21	2
01/04/07	24	2
01/04/08	32	2.50
01/04/09	40	2.50
01/04/10	48	2.50
01/04/11	56	2.50
01/04/12	64	2.50
01/04/13	72	2.50
01/04/14	80	TBA

The UK Budget 2010 announced that the standard rate would increase at a rate of £8 a year until at least 2014, establishing a floor price of £80/tonne under the standard rate between the compliance years (tax year) 2014/15 and 2019/20 (HMRC, 2012). When a load contains a mix of lower and standard rated material, the full load is charged at the standard rate. Loads with an incidental level of standard rate material in an otherwise lower rated load (i.e. small pieces of wood contained in mainly brick building material that are unfeasible to separate), may be charged at the lower rate.

Landfill operators may claim tax credits of 90% on contributions made to 'approved environmental bodies', under The Landfill Communities Fund. The objective of the fund is to encourage environmental projects in local communities. The maximum percentage of the landfill able to be claimed varies per year, and was 5.6% in 2011/12 (the trend is a generally

decreasing proportion from 6.5% in 2003/04, and from 20% from 1996/97 to 2002/03). The penalty for under-declared tax is equal to 5% of the total value under-claimed, unless a reasonable excuse is put forward. For full tax evasion, the penalty is equal to the full tax evaded or attempted to evade. In both cases, the original tax must be paid alongside the penalty value, along with interest set at 10% above the Bank of England base rate, compounded monthly whilst the debt remains unpaid (HMRC, 2012).

The tax is administered by HMRC, who collect the tax and impose penalties where relevant, with policy decisions, such as tax rates and waste definitions, falling to Defra. In the year 2011/12 a total of £1.09 billion was paid in landfill tax (after £69 million was claimed in Landfill Communities Fund contribution tax credits) (HMRC, 2012b).

There have been few recent reviews of the cost-effectiveness of the landfill tax, however it is clearly a significant source of revenue to government. Although the instrument may have been revenue neutral at introduction, the 0.2% National Insurance reduction does not cover the increase in the tax from £7 in 1996 to £72 in 2013, leading to a net increase in government revenue. Budget 2005 found that the landfill tax has been effective in reducing landfill disposal, with a reduction of around 20% between 1997 and 2004. However, other studies suggest that the instrument has had a relatively low impact on the production of waste. This is especially the case for domestic waste, as householders pay the tax through the general council tax, with no direct link to the waste produced. This reduces the environmental effectiveness of the instrument dramatically, due to the high organic composition of household waste. Waste to landfill from construction industry however, decreased dramatically upon the instrument's introduction (from 51.2% in 1996 to 24% in 2000) (Martin & Scott, 2003), with material re-use and recycling increasing (48.8% in 1996 to 58% in 2000) in response to this price signal. Since these reviews took place, the rate levied has more than doubled. Little evidence exists regarding the impact this has had. The instrument is flexible, and allows for rate changes in response to new information. It is highly administratively feasible.

### **Agriculture Sector Greenhouse Gas Action Plan (GHGAP)**

The GHGAP is a voluntary, industry-led strategy by the agriculture sector with the primary aim of reducing emissions from the agriculture sector by 3MtCO<sub>2</sub>e by the third UK Carbon Budget Period (2018-2022), in line with government estimates of what is feasible over this timeframe. It was published in 2009 in response to the government's Low Carbon Transition Plan (LCTP). To achieve this overarching objective, the GHGAP aims to (GHGAP, 2011):

- Establish an industry-wide partnership to stimulate and deliver a voluntary approach in identifying and adopting practices to improve production efficiency, reducing the need for regulation
- Improve awareness of GHG emissions and practices to improve efficiency and business performance
- Drive implementation of on-farm practices to promote environmental protection through effective scientific communication and decision making, developing effective means of technical dissemination and enhanced partnerships and networks.
- Work with government programmes to share information and data to enable effective measurement of emissions over time

A phased approach is being taken, as follows:

**Phase 1 (2010 - 2012)** – Establishment and consolidation of key activities to underpin implementation, including a communications strategy, identification of key actors for delivery, implementation of sector roadmaps and development of monitoring actions in consultation with Defra.

**Phase 2 (2013 – 2015)** – Actively promote improvements in practices in target sectors. As experience develops, level of practice and technology penetration will be stepped up. By 2015 the partnership will have achieved a high level of awareness in all farming and growing sectors, with evidence of a clear trend towards increased uptake of priority actions.

**Phase 3 (2016 – 2020)** – GHG monitoring process will be in place and reporting results, and focus will move to improving the evidence base. By 2018, the majority of the sector will be implementing best-practice actions.

The strategy aims primarily to reduce emissions of methane and nitrous oxide, but also carbon dioxide, through 15 key actions including improved soil, grassland and fertiliser management, livestock management systems and energy and fuel efficiency, and renewable energy generation. The focus is to encourage emissions reduction per unit of production, using, initially, cost-negative or cost-neutral approaches. Efforts are made not to duplicate efforts, such as road-mapping or advice channels, with other actors (especially government).

By the end of 2012, £12.6 million over four and a half years (in conjunction with the devolved administrations) was pledged to improve the national agriculture GHG inventory, improve the evidence base and develop a monitoring and indicator framework to transparently track progress made (Defra, 2012).

Governance of the GHGAP is entirely industry-led (14 industry-representative organisations), with a Steering Group co-ordinating and overseeing progress. Defra, whilst having no official regulatory oversight, has a senior member of the climate mitigation team on the steering group to reflect government views and to assist with synergies. The National Farmer's Union (NFU), and the Country Land and Business Association (CLA) hold the chairmanship of the steering group jointly. The Chair is responsible for reporting on progress to Defra, Natural England and other interested governmental parties, and where relevant, presenting cases for governmental assistance. The costs of the chairmanship are covered by the two chair organisations and the Agriculture Industries Confederation (AIC).

As the scheme imposes no additional cost on obligated organisations, and actively seeks to promote cost-neutral or cost-negative technologies and activities (and administration cost is arguably negligible), it may be considered statically efficient. As there is a relatively long-term strategy in place (to 2020), and since the likely alternative to the voluntary GHGAP is a series of complex regulation, there is long-term incentive for progress and thus some dynamic efficiency. However, it is not clear whether or not the GHGAP is, or will be environmentally effective, especially as current activities focus on building frameworks for delivery, rather than

delivery itself. As this is industry managed and designed, it is highly feasible at the sector level. Feasibility down to the individual farm level remains to be seen.

### **I.3 Identification of interactions of instruments within each policy landscape**

#### **I.3.1 Carbon Pricing**

##### **Objectives**

The overarching objective of both the EU-ETS and the CRC, stated as both the 'outcome' and final impact in both instruments, is the reduction of CO<sub>2</sub> emissions (with provision for selected other GHGs in EU-ETS). Both instruments have generally aligned secondary objectives, such as encouraging energy efficiency and energy consumption reduction, with the EU-ETS also promoting the deployment of large-scale renewable energy.

##### **Scope and Coverage**

Under the 2013 CRC simplification, EU-ETS organisations are excluded from the CRC, removing target group overlap entirely. Whilst the EU-ETS targets the direct production of CO<sub>2</sub>, plus NO<sub>2</sub> and PFCs from certain sources, the CRC targets direct and indirect CO<sub>2</sub> from electricity and natural gas consumption only (reduced from 28 energy previously).

##### **Functioning and Influencing Mechanisms**

The EU-ETS and CRC have a largely neutral relationship, but some aspects of their respective operation are conflicting. Whilst there is no direct target group overlap, organisations obligated by CRC absorb the pass-through cost of the EU-ETS in their electricity consumption, on which they will also have to pay the CRC rate. This increases the cost burden, reducing energy demand and therefore demand for EUAs, reducing the incentive to decarbonise electricity production. In reverse, the success of the EU-ETS in decarbonising electricity production reduces the carbon intensity of the grid, reducing the levy on CRC electricity consumption, reducing the incentive for efficiency. The success of one instrument undermines the success of the other, however the extent to which this is likely to have a significant effect is low, due to myriad other factors (basic energy prices, size of the target groups, other regulatory pressures). However, in a situation in which the EUA price is low, the CRC still incentivises demand reduction across its narrower, but relatively significant target group.

##### **Implementation Network/Administrative Infrastructure**

The implementation and administration of the EU-ETS in the UK and CRC are highly aligned, with DECC, in conjunction with the Devolved Administrations, holding overall responsibility for implementation and policy aspects. The Environment Agency holds administrative responsibility for both instruments (devolved agencies for the CRC), including maintaining the registries for both instruments, issuing guidance, data collection and analysis and enforcement.



### 1.3.2 Energy Efficiency and Energy Consumption

The Climate Change Levy, due to the broad nature of its application, the prominence amongst UK emission abatement instruments and the importance of recent changes in strengthening this position, has been selected as the key instrument in this landscape against which other instruments shall be assessed for interactions.

#### **Objectives**

The reduction of energy consumption and improvement of energy efficiency is the primary aim of only three instruments within this landscape. The primary objective of the CCL is to encourage energy efficiency in the commercial, industrial and public sectors. The Green Deal and ECO were designed in tandem, and aim to improve energy efficiency (specifically in buildings, principally domestic) as their primary objectives, with reducing fuel poverty as an equal, or at least prominent secondary goal of the latter instrument. However, many instruments aim directly at reducing GHG emissions as their primary objective, and either state energy efficiency as an explicitly secondary goal to achieve this objective, or allow the obligated parties to achieve this goal through any appropriate means – a prominent component of which is inevitably energy efficiency and conservation. The main objective of the CCA is to reduce the cost burden of the CCL from the most energy-intensive industries, to prevent reduced international competitiveness, whilst only the secondary objective aligns with emission reductions (usually emissions intensity, which may be achieved through any suitable means, not just energy efficiency). The VED and Carbon Trust Standard also aim to reduce emissions intensity. The former attempts to achieve this through graded taxation of vehicles, encouraging a shift to cleaner vehicles. The latter encourages continued, proportional emissions reductions.

The EU-ETS and CRC aim to reduce absolute, rather than just relative direct and indirect GHG emissions. The EU-ETS places a cap on emissions on obligated sectors and activities, and similarly aims to directly reduce carbon emissions through non-specific measures. This is the primary objective, but the EU-ETS also aims to induce the deployment of renewable energy alongside reducing energy consumption and improving efficiency as secondary stated objectives. The CRC shares this primary goal through taxation of direct and indirect emissions. Mandatory Emissions Reporting aims to reduce both relative and absolute emissions reduction through reputational drivers.

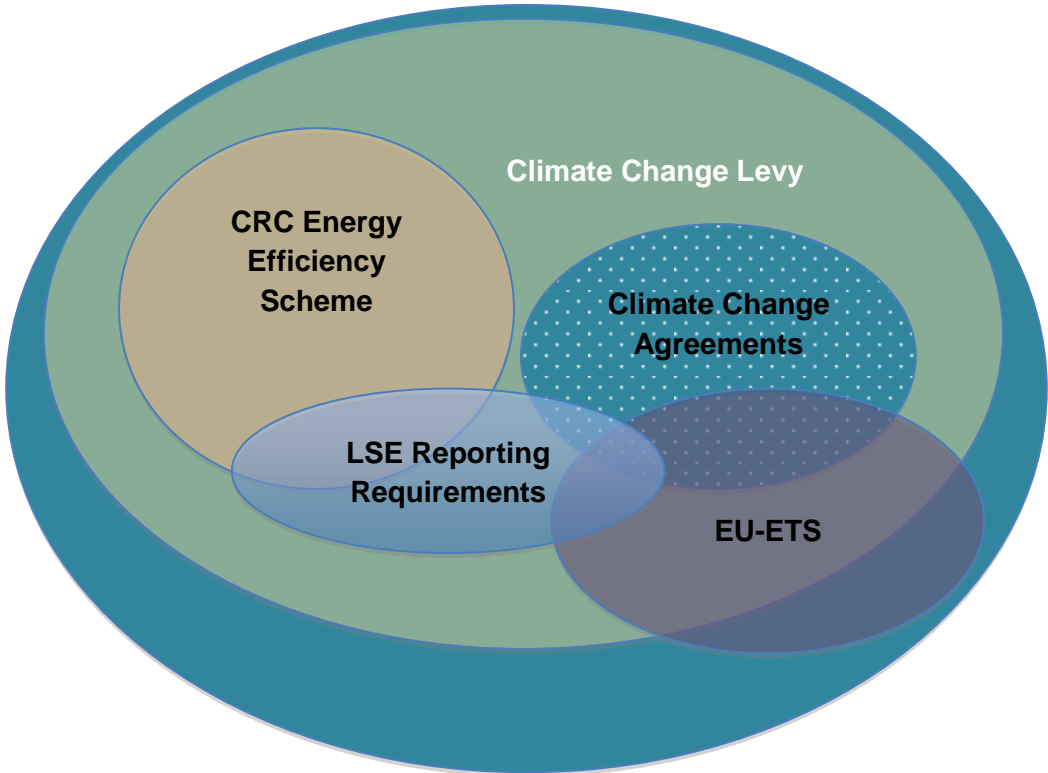
#### **Scope and Coverage**

Figure 2 illustrates instrument overlap in the non-domestic sector in this landscape. As the CCAs and CCL were introduced as a single policy ‘package’, their operation is highly co-ordinated. CCA target groups (e.g. energy intensive industry) are entirely within the larger CCL target group, with CCL discounts granted by CCAs applicable to all fuels on which the Levy is due. There is heavy target group overlap between the CCL/CCA package and the EU-ETS. The CCL supposedly levies a tax on the energy consumption of any industrial, commercial, agricultural and public sector, but in reality the most energy-intensive, and thus most emission-

intensive and most likely to be included under the EU-ETS, receive discounts under CCAs. This is true for cement, pulp and paper, metals, glass, food and drink, chemicals, and many more. However, fuel consumed in an EU-ETS installation which overlaps with a CCA eligible facility, is removed from CCA target setting and reports (despite retaining the CCL discount). Prior to April 2013, the EU-ETS provided an upstream tax on producers of electricity, whereas CCL is a complementary downstream tax on electricity consumed. This introduction of the Carbon Price Floor (CPF) removed this exemption now levies a tax on fuels used to produce electricity based on carbon content, extending the instrument target group overlap. Despite this, there remain significant differences in wider target groups. The CCL, as stated, covers agriculture and numerous smaller industrial, commercial and public sectors outside the remit of the EU-ETS. The EU-ETS now includes aviation, whereas the CCL does not cover transport

The 2013 'simplification' of the CRC scheme removed organisations subject to EU-ETS and/or CCAs from the scope of CRC altogether. The scope of fuels from which CO<sub>2</sub> emissions must be reported reduced to electricity and gas only (from a list of 28 fuels previously), removing overlap between CCL and CRC for direct fuels (except natural gas – although this is subject to a *de minimis* threshold). The UK's Small Emitter and Hospital Opt-out Scheme under the EU-ETS Phase 3, which came into effect in January 2013, also reduces scope overlap between the EU-ETS and CRC by allowing hospitals and other small emitters to opt-out of the EU-ETS in favour of individual emissions reduction targets. These organisations remain in the CRC.

**Figure 2 - EE&EC landscape non-domestic scope (based on Bowen & Rydge (2011))**



The LSE Mandatory Reporting Requirements has a similar target group not directly defined by energy or emission intensity, and will overlap organisations subject to both EU-ETS and CRC.

The Carbon Trust Standard also overlaps with both instruments. The latter is voluntary, and is open to any business or public sector organisation. The former require only those organisations listed on the London Stock Exchange and registered in the UK to report their emissions. Both instruments require measurement of all six GHG gasses identified by the Kyoto Protocol, rather than just CO<sub>2</sub>. The Carbon Trust Standard, by allowing the broadest possible participation group, allow organisations too small to be obligated under EU-ETS, CCAs, CRC or mandatory reporting requirements to voluntarily participate in recognised emissions reductions efforts (although the CCL, in most cases, will remain applicable to these entities).

There is little overlap between the Green Deal, Energy Company Obligation and Vehicle Excise Duty and the instruments discussed above. The Green Deal and ECO, also introduced as a policy 'package', aim to improve energy efficiency primarily in domestic buildings, but also non-domestic properties (Green Deal only). There are no particular criteria for which non-domestic properties are included, and as such the Green Deal may overlap with the target groups of all target sectors above, but only to a limited extent (especially since this instrument is voluntary rather than mandatory). The Green Deal and ECO are designed to work in tandem, the former theoretically open to any household or business property. The latter is specifically designed to target low-income domestic properties and those considered to be in fuel poverty, and would not meet the 'golden rule' required in the Green Deal to secure investment in energy efficiency measures. The CO<sub>2</sub>-graded VED, by targeting the extremely large target group of car users (both private and commercial), indirectly interact with organisations subject to any instrument described here that also hold a car fleet, but only overlap directly with organisations subject to the LSE Mandatory Reporting Requirements and Carbon Trust Standard, with their transport emissions reporting obligations, and indirectly with Green Deal recipients in the domestic sector (private cars are by far the largest group subject to CO<sub>2</sub>-graded VED).

The CCL, CCA, Green Deal and ECO do not directly tackle GHG emissions (aside from the CPF in the CCL, which prices CO<sub>2</sub> only). The CRC, VED and EU-ETS cover CO<sub>2</sub> from all eligible activities and products, with the EU-ETS also directly targeting N<sub>2</sub>O and PFCs, but only for strictly defined activities. The Carbon Trust Standard LSE Mandatory Reporting Requirements hold the broadest GHG scope, and cover all all six GHGs defined in the Kyoto Protocol.

### **Functioning and Influencing Mechanisms**

Arguably the most prominent interaction between the instruments in this landscape is between the CCL and CCAs. There is evidence to support that this relationship is both mutually supporting and conflicting. As the purpose of CCAs is to reduce the impact of the CCL on energy-intensive organisations, it may seem inherently conflicting with CCL's objectives. This is supported by studies that suggest carbon emissions reduction targets, imposed on CCA sectors in lieu of the full CCL, are too low and that participation in CCAs may have in fact increased energy intensity in these sectors. Other studies contradict this and argue that there is a mutually supporting relationship, and that CCAs are effective in attracting managerial attention to energy efficiency ('awareness effect'), allowing for the discovery of cost-effective abatement options that may have otherwise gone undiscovered (Ekins & Etheridge, 2006). It

may also be argued that CCAs contribute to the feasibility of successful implementation of the CCL in broad terms. If CCAs did not exist, energy-intensive industry may lobby for a much-reduced standard rate, impacting organisations without CCAs, reducing the incentive for energy efficiency for all parties. The CCL and EU-ETS have a neutral but complementary relationship. CCL is currently a downstream tax on energy consumption, whereas EU-ETS is in effect an upstream tax levied on electricity production, along with emissions from other emission-intensive sectors. The proposed Carbon Price Floor, discussed above, leans this interaction towards mutually supportive, as there is an additional incentive to decarbonise electricity production.

The CCL has a weak mutually supporting relationship with the CRC, Carbon Trust Standard and Mandatory Reporting requirements. The CRC provides an additional financial incentive to reduce energy consumption (especially emission-intensive), whereas the CT Standard and reporting requirements provide reputational drivers to achieve the energy efficiency and conservation. However, the CCL is likely to provide the largest incentive due to its broad application and broad target group. A mutually supporting relationship also exists between each of these three instruments, but especially between the CRC and CT Standard, with similar measurement and reporting requirements, and the CT Standard a certified Early Action Metric for performance in the CRC Performance League Table. The CCL (through the CPF) and EU-ETS also form a weakly supportive relationship with the Green Deal. Increased domestic electricity prices increase the cost-effectiveness of some Green Deal measures, increasing likelihood of uptake of the instrument. Although, as 85% of the UK's housing stock is gas heated, and most measures relate to the building fabric and space and water heating, most savings would be seen in gas rather than electricity consumption – reducing this interaction.

The Green Deal and ECO might be expected to form a supportive relationship. Once measures have been installed under ECO, it is possible that measures under the Green Deal that previously did not meet the 'golden rule', become cost-effective and therefore eligible for funding. The existence of the ECO arguably makes the Green Deal more politically acceptable, as otherwise the 'golden rule' would mean the Green Deal alone would do little to tackle fuel poverty (an increasingly public issue in the UK). The CCL has an entirely neutral relationship with the ECO and VED.

### **Implementation Network/Administrative Infrastructure**

The Department for Energy and Climate Change (DECC) bears much of the governmental responsibility for policy instruments aimed at climate change mitigation, including energy efficiency and management. DECC holds overall responsibility for policy delivery of the CCAs, EU-ETS and CRC, in partnership with the Devolved Administrations for the latter two. However, the Environment Agency of England and Wales (EA) (and equivalents in Scotland and Northern Ireland), holds administrative functions for all three instruments. For the EU-ETS, this includes issuing guidance, data collection and monitoring. For the CRC the Environment Agency is responsible for maintaining the CRC registry and the recently-scraped Performance League Table. 'Natural Resources Wales' also assumed administrative responsibilities for the EU-ETS from April 2013. A private sector organisation, ICE Futures Europe, is contracted to perform EUA auctions. The Environment Agency and regional

equivalents assumed administrative responsibility for the CCAs from DECC in October 2012, however DECC retains responsibility for negotiating sector targets, via private sector consultancies. Although CCAs are operated by DECC and Environment Agency, the CCL is operated in its entirety by HMRC.

DECC is also responsible for most aspects of the Green Deal and ECO package, however Gemserv, a private sector company also involved in administering the Microgeneration Certification Scheme (MGCS), is contracted as the Green Deal Oversight and Registration Body (GD OSB) with responsibilities for operating the accreditation, registration and Green Deal Central Charge databases. DECC retains responsibility for operating the ECO brokerage platform, but the Office for Gas and Electricity Markets (Ofgem), is responsible for administering the instrument and ensuring trajectories are on track to meet overarching targets. ECO installers must be 'Green Deal Accredited', reducing the administrative burden of this instrument against a case of stand-alone operation.

The CT standard is operated entirely by the now-private Carbon Trust. It is as yet unconfirmed which government department will hold responsibility for the mandatory reporting requirements, but this is likely to be Defra. The Driver and Vehicle Licencing Agency (DVLA), an executive agency of the Department for Transport, operates the VED.

### **1.3.3 Promotion of Renewable Energy**

#### **Objectives**

The promotion of renewables is the explicit and primary objective of four of the seven identified instruments that fall into this landscape. The Renewables Obligation (RO) (considered to be the main instrument within this landscape), the Renewable Energy Feed-in Tariffs (FITs), the Renewable Heat Incentive (RHI) and the Renewable Transport Fuel Obligation (RTFO) all specifically promote or mandate increasing proportions of renewable, low-carbon energy (electricity, heat and transport fuel) often with explicit targets of deployment and capacity, in order to achieve emissions abatement. The Carbon Price Floor under the CCL and the EU-ETS, rather than directly promoting renewables, rather discourages generation from fossil fuels. The former holds the specific objective of encouraging investment in low-carbon energy through a stable carbon price underpinning the EU-ETS price (although the wider CCL instrument is concerned with energy efficiency, electricity from renewable sources is zero-rated), and the EU-ETS – whilst its main objective is direct emissions abatement – holds the deployment of renewable energy as a key component in achieving this (alongside energy efficiency and other methods of emissions reduction). The agriculture sector's GHGAP, similarly to the EU-ETS, holds emissions abatement as both the outcome and impact of the instrument, but states the promotion of renewable energy as a component.

#### **Scope and Coverage**

The EU-ETS, CPF under the CCL, FiTs, RHI and GHGAP all directly target the producers (or prospective producers) of energy (along with other emission-intensive sectors for the EU-ETS), whilst the RO and RTFO are the only instruments within this landscape that directly target energy suppliers (electricity and transport fuel). However, as suppliers must receive their product from producers/generators (if they are different entities), producers are necessarily included within the latter two instruments' mechanisms. The EU-ETS and CPF target large-scale users of fossil fuel energy, whereas the FiTs, RHI encourage microgeneration within both the domestic and non-domestic sectors, and GHGAP in the agriculture sector. The RHI holds no specific maximum capacity for target installations, but is rather limited by demand and technology capacity constraints. The FiTs are applicable to installations up to 5MW, above which the RO provides an incentive through the issuing of ROCs. Any sector of society is able to participate in RHI (including domestic from spring 2014), and FiTs or RO (depending on size of installation).

The costs inherent within these instruments are eventually borne by all electricity consumers in the case of the RO, EU-ETS, CFP and FiTs, as electricity producers and suppliers pass through their costs to the end user. The RTFO is financed by all petrol or diesel driven vehicles (again from cost pass-through), and direct government funding sourced from general taxation finances the RHI.

### **Functioning and Influencing Mechanisms**

There are very few direct interactions within this landscape, although a number of indirect interactions are present - primarily between the RO and EU-ETS. This relationship is mutually supportive. A high EUA price encourages investment in renewable technologies; satisfying the objectives of the RO. Increasing renewable capacity reduces emissions and achieves the objectives of the EU-ETS (through avoided fossil fuel generation). If one of the instruments is not operating properly, for example if the value of a EUA (EU-ETS) or ROC (RO) is too low, the presence of the other should retain some incentive for renewables investment. In the case of a high EUA value, investment in renewables is made with generators receiving ROCs of zero value once the obligation target is met. The EU-ETS may still provide enough incentive to exceed the RO target in the case of high EUA value. Similarly, if the RO target produces high ROC values the incentive to invest in renewables is high, even in the presence of low EUA values. It is unlikely that success in the RO would reduce demand for EUAs enough to significantly impact their value, as the RO only impacts a very small proportion of the overall EU-wide demand for EUAs. However, in the case of low EUA price and lack of stringent compliance mechanism in the RO, as is currently the case, the objectives of both instruments are unfulfilled. An indirect interaction also exists between the RO and CCL, as renewable generation is exempt from the CCL, reducing the cost burden. This is likely to be strengthened by the CPF, increasing the cost of electricity produced from fossil fuel, making renewable generation a more attractive investment. Regarding nuclear energy, none of the instruments presented directly encourage investment. Only the CCL (through the CPF), and the EU-ETS provide financial incentive through increasing the relative cost of fossil generation.

There is little functional overlap between the RO, FiTs, RHI and RTFO, as each targets different technologies across often-different target groups. However, biomass may be used for different purposes under all four instruments, raising the potential for resource competition.

Competition for landfill gas, already promoted under the RO, may increase with expansion of the RHI.

### **Implementation Network/Administrative Infrastructure**

As with the carbon pricing and energy efficiency and energy consumption landscapes, DECC is the lead government department for policy design and implementation of policy instruments for the promotion of renewables. This is the case for EU-ETS, RO, FiTs and RHI. Whilst in other landscapes the Environment Agency is responsible for administration for policy instruments, Ofgem is the primary administrator for the promotion of renewable energy policy landscape, with responsibilities for monitoring, reporting and verification and compliance for the RO, FiTs and RHI. This includes operation of the RO buy-out fund and making RHI payments. Any renewable electricity installation above 50kW capacity, along with AD and Hydro regardless of size, must be registered with the Ofgem-operated Renewables and CHP Register. This covers some installations under FiTs and all RO installations. Ofgem also operates the RHI Register. The Microgeneration Certification Scheme operates alongside these registers, and is an industry-led independent scheme supported by DECC. All renewable electricity installation not covered by the Renewables and CHP register must be accredited under the MCS (<50kW installations, under FiTs), along with all RHI installations.

Administration of the CCL and EU-ETS is discussed previously. The RTFO is operated entirely by the Department for Transport, and the GHGAP is entirely industry-led, with input from government stakeholders.

#### **1.3.4 Non-Carbon Dioxide GHGs**

##### **Objectives**

The primary aim of the GHGAP is the reduction of agricultural sector emissions, whilst the reduction of emissions from biodegradable waste in landfills is only a secondary objective of the Landfill Tax (with general waste reduction cited as the primary aim). The EU-ETS targets non-CO<sub>2</sub> emissions from key industrial sectors. These objectives are aligned.

##### **Scope and Coverage**

The GHGAP covers the agriculture industry only, on a voluntary basis. The Landfill Tax directly impacts landfill operators, but through this influences the reduction of waste across the whole economy. There is no direct interaction between these instruments in terms of target group, and only very indirectly through increased cost of waste disposal from agriculture sent to landfill. Methane is GHG explicitly targeted for reduction in both instruments (along with nitrous oxide, and to a lesser extent CO<sub>2</sub>, in the GHGAP). The EU-ETS covers CO<sub>2</sub> emissions from numerous sectors (although not agriculture), and N<sub>2</sub>O and PFCs from selected industrial sectors.

##### **Functioning and Influencing Mechanisms**

The Landfill Tax, GHGAP and EU-ETS experience an entirely neutral relationship, with very little interaction between the instruments.

### **Implementation Network/Administration Network**

The Landfill Tax is driven by Defra (but administered by HMRC), whilst the GHGAP is an industry-led initiative. Defra, whilst with no regulatory authority on the GHGAP, is represented on the steering group and is reported to by the Chair of the steering group. This allows Defra general oversight of the two primary non-CO<sub>2</sub> mitigation instruments in the UK, and to co-ordinate the approach as far as is required (little, as little interaction is experienced). The EU-ETS is overseen by DECC and administered by the Environment Agency, and there is little interaction.

## **I.4 Description and evaluation of policy landscapes in the light of the concept of optimality developed in task I.1**

### **I.4.1 Carbon Pricing**

The interaction between the EU-ETS and CRC, despite relatively high individual static efficiency, produces low static efficiency overall. Whilst the EU-ETS targets upstream emissions from electricity production and energy-intensive sectors (and is economy-wide in its indirect impact), the CRC targets the non-energy intensive commercial sector. This produces a double emission cost to these organisations, indirectly through the EU-ETS and directly through the CRC. Therefore, the CRC obligated organisations hold the highest incentive to reduce emissions under this landscape, which may not be the sector with the lowest abatement costs within the economy.

In addition, the CRC obligated organisations have little control over the carbon intensity of electricity, which is by far the largest component of their energy consumption profile, and therefore cannot achieve the same level of decarbonisation as a higher EUA price alone might encourage. However, the CRC may be considered a pricing 'backstop' in cases of low EUA prices (as at present), ensuring incentive to increase efficiency remains, even if the ability to decarbonise the remaining demand is lacking. The CRC, with its set price and long-term certainty, also increases dynamic efficiency of the carbon pricing landscape, which EU-ETS with its price uncertainty does not provide. However, each instrument provides different carbon prices, producing unequal abatement incentives to the sectors of the economy covered by either one, but not both of these instruments.

The efficacy of combining both upstream and downstream carbon pricing is questionable, as the success of one instrument may reduce the efficacy of the other, as previously discussed. A high, stable upstream carbon price from the EU-ETS would encourage both decarbonisation and economy-wide efficiency, rendering the CRC relatively redundant. Although, as also discussed, at times of a low EUA price, the CRC retains the efficiency incentive in the obligated organisations.



Feasibility of implementation of these two instruments has been relatively high, although CRC simplification highlights some opposition to the design of the tax from some obligated organisations. Should the EUA price increase significantly, it is likely that opposition to this double taxation would grow. The CRC is relatively flexible however, and may adjust its tax value in response, reducing efficacy but allowing the instrument to remain in place.

#### 1.4.2 Energy Efficiency and Energy Consumption

The majority of the instruments within this landscape are imposed at the UK level, and are not simply impositions of EU law and initiatives – although they contribute to overarching strategies (i.e. Climate Change Act), which are aligned with EU ambitions. They are mostly economic instruments, with a roughly even balance between mandatory and voluntary participation of target groups. Instruments that directly impact the price of energy and/or CO<sub>2</sub> are the most prevalent single approach (e.g. CCL, EU-ETS, CRC and VED).

In general terms, the energy efficiency and energy consumption landscape is both statically and dynamically cost-effective, as it incentivises energy efficiency and GHG reductions across most economic sectors (commercial, industrial, domestic, agricultural, transport, etc.). As this is generally achieved through economic or reputational instruments as opposed to command-and-control or technology standards, it encourages continuous improvement. The broad downstream impact of the CCL and EU-ETS interaction, especially with the introduction of the CPF, encourages efficiency by any electricity-consuming entity (whilst, in the case of CCL at least, remaining revenue neutral or even negative to government, and therefore of net benefit to industry, until at least 2007). The non-energy intensive sector in some cases may be charged several times for their energy use; the full CCL for electricity and other fuel consumption, EU-ETS (passed on through electricity prices) and the carbon floor price under CCL (and until recently, an emissions tax under CRC). Energy-intensive industry, by contrast, may only be subject to partial CCL charges through CCA exemptions (but still receive the full 0.3% national insurance reduction in compensation for the CCL), the CCL, CPF and EU-ETS (direct and indirect). As such, the present configuration does not necessarily incentivise efficiency and emission reduction where the potential is greatest and cost is cheapest. This is supported by the different explicit and implicit carbon prices imposed by these instruments. It may also be argued that the Carbon Trust Standard and mandatory reporting requirements are either superfluous, or reduce the need for several economic instruments by relying on reputational factors to drive change, achieving the same effect at reduced cost in both energy and non-energy intensive commercial and industrial sectors.

The CPF and EU-ETS, through their combined impact on domestic electricity prices, may have a minor positive impact on uptake of the Green Deal, although this is severely limited by the prevalence of gas rather than electric heating. The ECO is aimed at reducing fuel poverty, and by achieving this aim may free financial resources for these households to be used for other purposes. The Green Deal/ECO package is also expected to stimulate growth in the insulation, double-glazing and other related industries, leading to job creation. The Carbon Trust Standard and LSE Reporting Standards demand, and are likely to demand, little cost from organisations. Whilst there is no quantified evidence for the Carbon Trust Standard,

impact assessments for the LSE Reporting Requirements demonstrate potential overall net savings for obligated organisations (through energy cost reductions).

The environmental effectiveness of this landscape, as with other landscapes, is difficult to determine in terms of impact (e.g. GHG emission reduction), as there are myriad confounding factors, and tangible outputs are often lacking (as opposed to, for example, volume of renewable capacity). Whilst the CCL exceeded its 2010 target, there is conflicting evidence for the effectiveness of interaction with the CCAs. Estimates suggest that the CCAs may have been responsible for 1.9MTCO<sub>2</sub> savings in 2010. Some propose this is in excess of potential savings if these sectors were subject to the full CCL, partly due to the managerial attention CCAs raise regarding energy efficiency (Ekins & Etheridge, 2006). CCAs also directly concern CO<sub>2</sub> emissions, rather than energy consumption as a proxy. Other commentators suggest that installations subject to the full CCL reduced CO<sub>2</sub> emissions between 9.6% and 22.6% more than installations in receipt of a CCA (Martin, de Preux and Wagner, 2011). Evidence also suggests that whilst the CCL/CCA package has encouraged low-carbon innovation in the UK, full CCL participants are 16% more likely to innovate than CCA counterparts (UNESCAP, 2012). The broad efficacy of the CCL is likely to increase with the introduction of the Carbon Price Floor (partly due to inclusion of the domestic sector downstream), but this cannot yet be determined.

The CCL, through the CPF, likely experiences a positive interaction with the EU-ETS (as was designed). The EU-ETS appears to have strengthened the shift from coal to gas, but the current low EUA price prevents significant investment in renewables and nuclear. The CPF boosts this price and provides a level of certainty, increasing the rate of low-carbon energy investment. The EU-ETS also partly calms fears of CCA ineffectiveness, as it places a cap on emissions from largely the same energy and emission intensive sectors.

The CRC is a young instrument, and its efficacy is not yet clear. It is designed to tackle CO<sub>2</sub> emissions directly through a carbon tax on non-energy intensive end users. The majority of energy consumed by mandated organisations is electricity, on which they are charged based on average grid carbon intensity. However, these organisations have little influence over the grid energy mix, and are unlikely to be able to switch to microgeneration or other low-carbon energy carriers on a scale that a typical carbon tax might encourage. Therefore, a stronger price signal from the EU-ETS and CPF might render the CRC rather superfluous over time. The Green Deal and ECO are extremely new, and also cannot yet be assessed for efficacy. Little interaction between these instruments and others within this landscape occurs, especially since most savings are likely to be from gas heating reductions rather than electrical under these measures, reducing the incentive for efficiency enabled by rising electricity prices through other instruments. Other aspects such as high loan rates, golden rule uncertainty and simple lack of awareness present other barriers to the efficacy of the Green Deal, in particular. In properties for which initial savings are realised, the rebound effect may hold further concern. Evidence is lacking for the efficacy of the Carbon Trust Standard, and LSE Reporting Requirements have not yet been introduced. Neither is likely to be effective in curbing emissions significantly, as many participants are subject to other instruments in this package for which the incentive for efficiency is far stronger. Similarly the VED, whilst a significant source of government revenue, abates a negligible volume of emissions. It also has virtually no interaction with other instruments in this landscape.

This landscape contains a combination of instruments aimed at both carbon and energy efficiency. These must be closely co-ordinated, as success in one (i.e. energy efficiency) may undermine success in the other (i.e. carbon efficiency). If the CCL, Green Deal, ECO and the CRC (to the extent it encourages energy efficiency rather than direct emissions abatement) are successful, energy demand will reduce, curbing absolute emissions and therefore the EUA price under the EU-ETS, whilst retaining similar carbon intensity of electricity and reducing incentive for further decarbonisation. However, this is theoretical and would be limited in its impact as the EU-ETS cap is now Union wide, and success in these instruments would be relatively insignificant in the context of total EU electricity demand.

The instrument mix in this landscape, and the interactions between them, may be considered highly feasible. The existence of CCAs raises the political acceptability of the CCL, and CRC simplification maintains future acceptance of that instrument. Most instruments are flexible and can adapt to new information, such as CRC, CCL and the VED. The EU-ETS is less flexible at the national level. Most of these instruments are co-ordinated by a single government department (DECC), and operated through a single agency (Environment Agency). Reporting and information requirements are often aligned (EU-ETS, CRC and the two reporting mechanisms), and compliance regimes are clear and stringent.

### 1.4.3 Promotion of Renewable Energy

National-level instruments, rather than simple impositions of EU Directives compose the majority of this landscape. However, many either explicitly aim to satisfy broad Directive targets or align with EU-level strategies. Market-based instruments again hold prevalence, and are again mostly voluntary incentive mechanisms, or obligatory instruments containing flexible market drivers.

The landscape as a whole encourages the deployment of renewables across all installation sizes, in electricity, heat and transport, and by any sector of society. Whilst the landscape as a whole attempts to be neutral in terms of technology choice (through generally equalised rates of return though differentiated FITs and number of ROCs), it places a larger emphasis on high capacity renewables (>5MW) and transport, through obligatory instruments. All instruments seek to encourage deployment of renewables, which exhibit a higher cost than existing non-renewable energy. The RO and RTFO achieve this through legally requiring suppliers to meet a minimum proportion from these technologies and sources, whilst the RHI and FiTs attempt to attract voluntary investment through removing the marginal cost difference between non-renewable and renewable technologies. The CCL (CPF) and EU-ETS also incentivise renewables in this manner, but through increasing the relative price of fossil fuel generation rather than decreasing the direct cost of renewables (although not necessarily by this margin). The RO and FiTs alone are estimated to add an additional £20 and £6 respectively to each annual domestic energy bill (Ofgem, 2013c), with EU-ETS in addition (amongst others, discussed in Section 2.2.). The explicit and implicit price of carbon varies hugely both within and across instruments within this landscape, rendering the abatement incentive across instruments, targets groups and technologies uneven. As such, this landscape cannot be considered statically efficient.

Despite this, as this landscape encourages innovation and cost reduction, it reduces the future cost of emissions abatement and may therefore be broadly considered dynamically efficient. Uneven incentives are often required to ensure a single technology does not dominate, and wide range of technologies is developed. Although, the extent to which this is true depends on instrument flexibility. If the estimated costs of different renewable technologies are overestimated by the RO, FiTs and RHI, installations will quickly rise but recipients will receive windfall profits, increasing the budgetary cost of the instruments overall and heavily skewing technologies installed - in effect 'picking winners' rather than levelling the playing field. As such, they must be flexible to adjust to changes in technology costs. This is somewhat tempered under the RO and RHI, as ROC values fall as the target is exceeded for the former (although the technology mix may be artificially skewed), and recent amendments place a cap on the cost of the latter. Whilst the CCL (CPF) and EU-ETS must also be flexible, there is a degree of separation, reducing their direct influence. The RTFO has a similar mechanism as the RO (reducing RTFC value), and the GHGAP does not attempt to adjust the economics of renewables, and rather makes use of other instruments that do.

Flexibility also impacts environmental effectiveness. Whilst cost-overestimation leads to windfall profits, conversely, cost-*underestimation* removes the incentive to invest. If there is no sufficient return on investment, the RHI and FiTs in particular, become ineffectual. By the end of 2012, 1.66GW of installed capacity (358,337 installations) is receiving FiT support, and 171MW of renewable heating under the RHI. The change in solar PV support based on cost-misestimation under the former has been discussed, and underestimation of the costs of ground source heat pumps under the latter is currently the subject of debate. Although 90% of installations under the RHI are biomass boilers, this is not unexpected, as it is the most mature (in both technology and market), and previously well-supported technology (under the Bioenergy Capital Grant Scheme, for example). Even mandatory instruments such as the RO and RTFO, with their required portfolio standards, are subject to this effect. The RO and RTFO have never met their targets (despite an increase in renewable electricity from around 1.8% in 2002 to 9.4% in 2011 (RESTATS, 2013)). For both instruments, obligated entities appear to have simply found equilibrium between compliance and the costs imposed for non-compliance.

Cost-effectiveness is therefore central to the feasibility of this instrument mix. There is broad support for renewables in the UK amongst the general public, for both emissions mitigation and energy security. However, NIMBY-ism has proven to be a substantial stumbling block (especially regarding onshore wind), as have planning laws. This mainly impacts the RO, but is not negligible for FiTs and the RHI. As with other landscapes, the administrative feasibility is high, with DECC leading design and Ofgem leading implementation for the majority of these instruments.

#### I.4.4 Non-Carbon Dioxide GHGs

The instruments in this landscape are generally cost-efficient. The EU-ETS, as a cap-and-trade mechanism encourages emissions reduction at the least cost, both statically and dynamically. The GHGAP imposes no costs, and rather aims to produce net savings for its

participants. The GHGAP and landfill tax also encourage long-term reduction through either rising prices or the threat of regulation, encouraging dynamic efficiency. However, whilst the instruments cover the key sources of non-CO<sub>2</sub> emissions in the UK, they are not economy-wide, and there is little interaction between them to ensure reductions are realised in the sectors in which abatement is cheapest. Therefore, as a landscape, both static and dynamic efficiency is lacking.

The environmental efficacy of both the instruments themselves and landscape of a whole is also questionable. Whilst there is some evidence to suggest that the landfill tax has reduced landfill waste overall, there is little impact on the production of household waste, from which most active waste and therefore methane emissions, are sourced (although, recycling and centralised composting of this waste has increased). The GHGAP is a young instrument and is currently in the framework 'planning' stages, rather than active emissions reduction activities. It is also a voluntary mechanism, which is unlikely to go further than reducing emissions from activities that are cost-neutral at best. Similarly, the introduction of N<sub>2</sub>O and PFCs in the EU-ETS began only recently under Phase 3, and it is unclear what impact this will have.

However, this policy landscape is highly feasible in its implementation. The EU-ETS mechanism is well established, and requires little adjustment for the scope expansion. The Landfill tax is also well established and incorporated into the general tax mechanism within HMRC, and the GHGAP is industry designed and implemented. Defra has official oversight over the landfill tax, and unofficial involvement with the GHGAP. Although, as there is little interaction, this joint oversight brings little additional benefit.

## **2 Description and initial evaluation of the overall instrument mix**

### **2.1 Identification and description of the main interactions between policy landscapes**

These four landscapes cannot be separated entirely, and have some intrinsic links. Many instruments fall into more than one of the defined policy landscapes, and the EU-ETS falls into them all. Interactions are therefore inevitable.

#### **Objectives**

The objectives of the policy landscapes, and the instruments therein, are highly aligned. Both instruments in the carbon pricing landscape aim directly at reducing emissions as a primary objective (rather than simply an eventual impact), through increasing the cost of producing carbon emissions (mainly from energy production – either directly (EU-ETS) or indirectly (CRC)), with secondary objectives to achieve this goal. One such objective is energy efficiency, aligning with the energy efficiency and energy consumption landscape (of which the EU-ETS and CRC are part). Only three instruments out of nine in this landscape aim directly at improving energy efficiency as an outcome (CCL, Green Deal and ECO), with the remaining four (after EU-ETS and CRC), also holding the reduction of CO<sub>2</sub> emissions as the primary

objective and using energy efficiency as a method of achieving this (CCAs, VED, Carbon Trust Standard and LSE Mandatory Reporting Requirements).

Placing a price on carbon emissions also encourages promotion of renewable energy, aligning with this landscape. The EU-ETS and CCL also fall into this landscape through having secondary objectives of renewables promotion, whilst four of the remaining six instruments in this landscape hold this as a primary objective (RO, FiTs, RHI and RTFO). The GHGAP, the remaining instrument in this landscape, also holds the reduction of (mainly non-CO<sub>2</sub>) emissions as a primary objective, and the promotion of renewables as a stated secondary objective to achieve this. Aside from the GHGAP, the 'non-carbon dioxide GHG' landscape has little interaction with the other landscapes, although the landfill tax (the other instrument within this landscape) aims specifically at reducing methane emissions, it attempts to reduce physical waste economy-wide, along with the associated energy and emissions.

### **Scope and Coverage**

Each policy landscape has broad and significantly overlapping direct target groups. As such, for ease of discussion, interactions shall be described by target group. This is not necessarily the group upon which the direct cost or burden of an instrument falls, but which sector is the target of the instrument's impact. Subsequent secondary interactions between target groups shall be discussed in the following sub-section.

The large-scale electricity-producing sector is subject to the EU-ETS, the CCL under the Carbon Price Floor, and the RO. The first places a cap and a price on CO<sub>2</sub> emissions from generation, the second increases the price of fossil fuels for electricity generation and the third requires electricity suppliers (generators by proxy) to produce an average minimum proportion of electricity from renewable, low carbon sources (>5MW). Small-scale renewable electricity (<5MW) by any sector of society is encouraged through the FiTs, as is renewable heat through the non-domestic RHI.

Energy-intensive industry is within the scope of the EU-ETS, CCL and CCAs. However, the CCA acts to (mostly) remove this sector from the scope of the CCL. The non energy-intensive sector (including public sector) falls under the CCL and CRC, the first of which is mandatory for almost all organisations within this sector. The CRC only applies to non-energy intensive organisations but with over 6,000MWh annual electricity consumption. The LSE Mandatory Reporting, Carbon Trust Standard and Green Deal may apply to both of these sectors. The first is only applicable to organisations listed on the main market of the London Stock Exchange. The second and third are voluntary instruments, with the Green Deal expected to be applicable to non-domestic buildings in late 2013. The agriculture sector is also subject to the CCL, along with the voluntary, industry-led GHGAP.

The Domestic sector is only subject (directly) to one mandatory instrument – the ECO. This generally only impacts the poorest households. The rest of the sector may be voluntarily subject to the Green Deal, and RHI (along with FiTs, as mentioned above). The Domestic RHI scheme is expected to come into being in Spring 2014.

The transport sector is subject to the EU-ETS, RTFO and VED. At present, only domestic (national and intra-EU) aviation is subject to the EU-ETS, with coverage suspended for international aviation until at least late 2013. The RTFO covers, by proxy, all petrol or diesel road transport, and soon non-road mobile machinery. The VED (within the scope of the VED relevant to this discussion) covers all cars in both the domestic and commercial sector. The landfill tax, in effect, applies economy wide.

As discussed, many of the instruments do not relate to GHGs directly, including the RO, FiTs, RHI, Green Deal, ECO and RTO. The CCL in general also only concerns energy, but will directly relate to CO<sub>2</sub> through the CPF, along with CCAs, CRC and VED. The EU-ETS, whilst primarily a CO<sub>2</sub> instrument, also covers N<sub>2</sub>O and PFCs from specific sources and over half of all UK direct emissions. The landfill tax and GHGAP cover methane, whilst the Carbon Trust Standard and LSE Reporting Requirements are the only instruments to specify coverage of all six GHGs as specified in the Kyoto Protocol.

Therefore, the UK climate policy mix in some manner, and to different extents, covers all sectors of the economy (either directly or indirectly). The focus is split between direct emissions reductions as an instrument outcome and reductions as an impact of another primary outcome. In the former, whilst CO<sub>2</sub> is the primary focus, all GHGs are represented to some extent or another.

### **Functioning and Influencing Mechanisms**

As both carbon pricing instruments also fall under the energy efficiency and energy consumption landscape, a highly mutually supporting relationship might be expected, and is generally experienced. Broadly speaking, a price on carbon boosts the incentive for carbon and energy efficiency. Key interactions include the introduction of the CPF under the CCL to underpin the EU-ETS price in the UK and the interaction of the CRC with the Carbon Trust Standard (used as evidence of 'early action'). However, success of energy efficiency instruments may undermine carbon pricing (more specifically EUA value), although this effect would be limited at the national scale, and there is no evidence for this having occurred in the UK.

Carbon pricing instruments might also be expected to be strongly supportive of instruments designed to promote renewables. In the UK, these landscapes are only weakly supportive. The EU-ETS price has largely signalled a further shift from electricity from coal to gas, rather than to renewables, and electricity generated by installations supported by the RO or FiTs may not be used for CRC compliance, and is treated as having the same carbon intensity as grid-supplied electricity. Renewable heat produced under the RHI however, is zero-rated (i.e. zero emissions under the CRC).

A significant interaction exists between the energy efficiency and energy consumption, and the promotion of renewables landscapes, and appears highly supportive. The first reduces demand for energy, and the second promotes low-carbon solutions to satisfy the remainder (in addition, the cost premium for renewables increases energy prices, further encouraging efficiency). Aside from the EU-ETS, the CCL is the only other instrument to feature in both landscapes. Renewable electricity is not subject to the CCL, and the CPF further adjusts the

economics of electricity production in renewable technology's favour (also nuclear), alongside promoting efficiency in electricity consumption through higher prices. Loans for the installation of microgeneration technologies through the Green Deal allows participants to claim support for these technologies under FiTs and the RHI (although expected income from these instruments cannot count towards 'golden rule' calculations). In addition, RHI payments may only be made if certain building energy efficiency measures are present in a property, or installed through the Green Deal. Similarly under FiTs, the higher tariff rate for solar PV is only applicable if the property meets an Energy Performance Certificate rating of 'D' or above (under the Energy Performance of Buildings Directive, not discussed in this paper). In the transport sector, the interaction between the RTFO and VED is supportive. The first impacts the cost of fuel; the second impacts the cost of the vehicle, encouraging high-efficiency, low-carbon vehicles (although this effect is only felt in cars, due to the scope of CO<sub>2</sub> graded VED).

The non-CO<sub>2</sub> landscape exhibits limited interaction with the other landscapes. In the agriculture sector, the GHGAP and CCL are weakly supportive, as the latter encourages efficiency, whilst the former encourages renewable generation and the reduction of methane in particular. This support for renewables may be provided by the RO, FiTs and RHI in particular. The landfill tax finds interaction with the RO, as landfill gas for electricity production is eligible for ROCs, and in future possible interaction with the RHI, as inclusion of landfill gas through injection to the gas grid is currently under discussion. Unless key restrictions were put in place this would likely be a negative interaction, as the landfill tax aims to reduce methane emissions, whereas the RHI expansion would incentivise it.

### **Implementation Network/Administration Network**

For the carbon pricing, energy efficiency and energy consumption and renewable energy landscapes, DECC is the lead department for development, implementation and oversight of the majority of instruments. The Environment Agency is the primary administration body for the first two, whilst Ofgem hold this function for the renewables landscape, and each are responsible for the management of registries, developing and issuing guidance, data collection and monitoring of progress and compliance. Defra, a government department with a specific environmental mandate, is also present. This is mainly felt in the non-CO<sub>2</sub> landscape (landfill tax and GHGAP), but also with likely responsibility for the LSE Mandatory Reporting Requirements. The HMRC also hold cross-landscape functions, with significant responsibility for the CCL and landfill tax, whilst the Department for Transport is responsible for the RTFO and VED (through its executive agency, the DVLA). Private sector involvement, in the case of 'Gemserv', is also cross-landscape. This organisation manages the Microgeneration Certification Scheme for the relevant instruments under the renewables landscape, and is also the Green Deal Oversight and Registration Body.

## **2.2 Summary discussion of the combination of policy landscapes (the overall instrument mix) against each one of the elements of the concept of optimality**

### **Economic Efficiency**



Broadly speaking, the energy efficiency and energy consumption and non-CO<sub>2</sub> landscapes appear relatively statically efficient, whereas the carbon pricing and promotion of renewable energy landscapes do not. The energy efficiency landscape relies on both economic and reputational, and both voluntary and mandatory (but flexible) instruments. It generally encourages efficiency economy-wide (through broad measures such as the CCL and CRC, and more sector-specific measures such as the ECO), with no specific prescription for reaching targets (where given). The Non-CO<sub>2</sub> landscape is also economy-wide (through the landfill tax), with the GHGAP a voluntary instrument, encouraging only cost-neutral or cost-negative activities. Although, the breadth of impact of the instruments in this landscape is narrow. The instruments within the carbon pricing landscape may themselves be considered statically efficient (EU-ETS and CRC), but the interaction between them cannot. Entities that fall under one instrument but not the other experience different carbon prices, and organisations subject to both instrument experience a double cost of electricity emissions (direct through CRC and indirect through EU-ETS) All three target groups therefore experience a different level of abatement incentive. The promotion of renewables landscape encourages the dissemination of higher-cost technologies, through both obligatory and voluntary instruments, which is not statically efficient. However for this reason, and as this encourages innovation and cost reduction of these technologies, thereby reducing the cost of future emissions abatement, it may be considered dynamically efficient (although this potential is hampered somewhat by the design of the RO and RTFO, in particular).

The carbon pricing landscape may also be considered relatively dynamically efficient, as it also encourages innovation. It also provides a long-term price signal to continue this innovation and investment, with the CRC acting as a 'backstop' to a low EUA price, as is currently the case (for the CRC obligated organisations, at least). The energy efficiency landscape, into which these instruments also fall, is also relatively dynamically efficient. The long-term price signal from the CCL is also added (although removed from CCA organisations), as are the long-term reputational drivers from the Carbon Trust Standard and LSE reporting requirements. The Green Deal (also the ECO less so) also encourages ongoing energy efficiency under this landscape. The Non-CO<sub>2</sub> landscape, with its small target group, cannot be considered fully dynamically efficient – however it does provide long-term incentive for waste reduction and diversion economy-wide through the landfill tax (the efficacy of this has been discussed). The GHGAP simply uses the threat of regulation to encourage long-term improvement in the agriculture sector.

For the carbon pricing landscape, and most of the instruments within the energy efficiency and renewables landscapes, it is the final energy consumer who ultimately bears the instrument cost (EU-ETS, CRC, CCL, RO, FiTs, Green Deal and ECO through electricity billing, and RTFO through transport fuel costs). Environmental charges comprise around £82 (11%) of the average annual domestic electricity bill, primarily from ECO (£27), RO (£20) and FiTs (£6) (Ofgem, 2013c). However, this is arguably offset almost entirely by the reduced VAT rate on domestic electricity (5% rather than 20%) - roughly equal to a £75 a year reduction. The Green Deal, as the cost only applies to those who opt in to measures, would add to this value (but under the 'golden rule', the increase should be offset by savings in primarily gas bills). The CCL, which is only applicable to the non-domestic sector (but indirectly to the domestic sector through the CPF, and to the wider economy through the cost of goods produced by CCL sectors), was offset by a 0.3% reduction in National Insurance at the instruments introduction

(which until at least 2007, was revenue negative to the government). The Landfill Tax under the non-CO<sub>2</sub> landscape was also offset at introduction by a 0.2% reduction in National Insurance (although Landfill Tax rate has increased from £7 in 1996 to £72 in 2013), whilst the GHGAP is cost-neutral or negative. The cost of N<sub>2</sub>O and PFC emissions under EU-ETS is borne only by very select industries.

As such, the UK climate policy taken as a whole is broadly statically and dynamically inefficient. This may be briefly illustrated by some example explicit and implicit CO<sub>2</sub> prices from instruments discussed in this paper, in Table 11 (these are indicative, as some values are average or from historic years).

**Table 11 - Range of Carbon Prices in the UK Climate Policy Mix**

Instrument	Approximate CO <sub>2</sub> Price
EU-ETS	£4
CRC	£12
CCL	£4 - £8
RO	£97
FiTs	£188 - £577
RHI	£22 - £94
ECO	£77

Therefore, different sections of society experience vastly different burdens and incentives for emissions abatement, both absolutely and the use of different abatement methods (efficiency or renewable generation, for example), rather than an equal, economy-wide incentive to allow emissions abatement where it is cheapest in society, using the most cost-effective methods.

Despite this, the policy mix appears largely cost neutral to target groups. This includes government, as whilst it must bear administrative costs for these instruments, it directly finances very few – only the RHI in the instruments discussed (around £2.5 million year, although this will likely increase). It also raises significant revenue from several instruments, including CRC, VED, and auctioning of EUAs (over £8 billion in total – CCL and landfill taxes too, but neutralised by National insurance reductions). Much of this revenue contributes to the central exchequer.

**Environmental Effectiveness**

Many instruments aim directly at reducing emissions as a primary outcome, whilst many set other policy outcomes to encourage behaviours required to achieve emissions reduction as an eventual impact.

If several instruments seek to encourage the same outcome, it is extremely difficult to distinguish individual impact. For the instruments aimed at directly reducing emissions, the EU-ETS has arguably had the largest impact. It covers over half the UK emissions, and places a guaranteed cap on emissions from these sectors. Evidence suggests that the existing switch from coal to gas electricity generation was strengthened by the EU-ETS. The landfill tax by comparison has had rather limited success in reducing methane emissions, as the incentive to

reduce domestic active waste is rather weak (although methane emissions from landfill have reduced substantially, other instruments have contributed – such as the use of landfill gas under the RO, and others). The other methane-specific instrument, the GHGAP, remains in the early stages and has no confirmed or estimated savings attributed. The effectiveness of the CCAs is the subject of debate, but some estimates suggest an additional 1.9MtCO<sub>2</sub> saving from its application. The impact of the CRC is as yet unclear, and the LSE reporting requirements are not yet in force. The impact of the Carbon Trust Standard is also unclear, as it is a voluntary instrument and overlaps significantly with other mandatory instruments (such as the CRC).

Whilst these instruments target emissions reductions directly, much of their impact is sourced from energy efficiency. In addition, the CCL is estimated to have produced 3.5MtCO<sub>2</sub> savings from reduced energy consumption (against a 2.5MtCO<sub>2</sub> target). The removal of energy-intensive industry may reduce the environmental impact of this instrument, but direct emissions reductions along with increased efficiency are likely to emerge from the new CPF, with the increased cost of fossil fuel electricity generation. The VED, which seeks to encourage more fuel-efficient cars, has had a rather negligible effect. The Green Deal and ECO are prominent new instruments for encouraging efficiency in the UK's building stock, with the former expected to save 4.5MtCO<sub>2</sub>/year by 2020, and the latter over 27MtCO<sub>2</sub> in lifetime savings. However, these instruments are extremely new, and concerns regarding their design produce great uncertainties around their effectiveness.

The final primary element of encouraging emissions reductions is the promotion of renewables. The share of renewables in the UK has increased from around 1.8% at the introduction of the RO in 2002, to around 9.4% in 2011. The majority of this new capacity is likely to be due to the RO, despite it having never met its target (as appears to be inherent to the instrument's design). As stated, the EU-ETS appears to have triggered a move to gas, rather than renewables. FITs encourages electricity microgeneration, and despite a significant number of installations already in place, is unlikely to achieve its target of 1.6% of UK electricity by 2020. It is unclear as yet what additional impact the CPF will have on renewable deployment (and nuclear, in addition). The RHI is estimated to have created an additional 171MW of renewable heat capacity, but as it is also relatively new it is uncertain whether it will meet its aim of 12% of UK heating requirements (with 44MtCO<sub>2</sub> savings by 2020). Similar to the RO, the RTFO has never met its obligated targets, but is largely responsible for the 3.6% share of renewable transport fuel in 2011/12 (although against a 4.2% target).

The UK reduced its direct emissions by 27% in 2011, from 1990. This is nearly double the Kyoto target. Whilst climate policies may influence key changes such as further encouraging a fuel switch from coal to natural gas, other factors such as a declining energy-intensive sector and the global economic crisis play an extremely influential role. The Committee on Climate Change (CCC) estimates that only 0.8% of the total 7% emissions reduction in 2011 was directly due to climate policy, whilst a full 3% was due to mild winter temperatures (CCC, 2012).

### **Instrument Mix Feasibility**

The instrument mix in the UK appears largely feasible in achieving stated objectives. The general public is broadly in favour of instruments for emissions reduction, energy efficiency and renewable energy. This is not just for reasons of emissions abatement but also of economics, through cost reduction, energy security and the potential for 'green growth' and an international competitive advantage in low-carbon technology, although significant focus is placed on the rising cost of energy and incidence of energy poverty, reducing the potential ambition of some instruments that impose a direct cost. The commercial sector is also broadly in favour of these instruments, but as expected does not wish to shoulder significant cost burdens. Instruments such as the CCL and landfill tax, which reduce cost burdens elsewhere to compensate, recognise this, along with CCAs and the recent simplification of the CRC. Ongoing flexibility in operation, and the ability of instruments to adapt to changing information and performance evaluations, is crucial to the cost burden and environmental efficacy, and therefore feasibility. Most instruments across all four policy landscapes are flexible in these aspects, and avoid prescriptive approaches and encourage innovation.

A high level of administrative co-ordination prevents excessive overlap between instruments, and in some cases produces synergies. Whilst there remains some potentially counter-productive overlap between instruments and landscapes, the instrument interactions are generally positive. Where this has not been the case, instruments can be altered to account for this.

### 3 Conclusions

The UK has a broad range of climate policy instruments, with varied objectives and mechanisms to encourage emissions abatement. The key policies and interactions within each 'policy landscape' are:

- **Carbon Pricing** – The EU-ETS provides an upstream price on CO<sub>2</sub>, whilst the CRC provides a downstream price. This provides a relatively sub-optimal scenario for the CRC target group, which is subject to double taxation for the same emissions (electricity).
- **Energy Efficiency & Energy Consumption** – Along with the EU-ETS and CRC, the CCL, CCAs and Green Deal are the primary instruments. The CCAs provide an exemption to energy-intensive sectors (generally EU-ETS sectors) from the CCL. The optimality of this is unclear, although efficiency is reduced. CCA and EU-ETS organisations are now fully exempt from the CRC, reducing the cost burden and potential efficacy of the instrument mix, but increasing long-term acceptability. The Green Deal only indirectly interacts with the CCL (through the upcoming CPF) and the EU-ETS, which appears sub-optimal, as gas rather than electricity savings are expected from this instrument. The design of the Green Deal itself is also subject to heavy criticism, placing doubts on its effectiveness.
- **Promotion of Renewable Energy** – The RO and RTFO, along with the EU-ETS and CCL (CPF) are the key instruments. The RO obligates and creates a market for large-scale renewable electricity generation, and whilst seemingly effective in increasing renewable generation in the UK, its targets are purposely missed. The RTFO holds a similar profile. The EU-ETS exhibits a supporting relationship with the RO, but appears to have had little

influence independently. The CPF under the CCL likely experiences a highly supportive relationship with these instruments in the promotion of renewable electricity,

- **Non-Carbon Dioxide GHGs** – The Landfill Tax and the agriculture industry's GHG Action Plan (GHGAP) are the primary instruments. The former is mandatory, but appears to have had relatively little impact in reducing methane emissions, the latter is a voluntary instrument still in early stages of design. There is no direct interaction between these instruments.

Many instruments fall into more than one landscape, and thus interaction is inevitable. Increasing the relative price of carbon emissions encourages energy efficiency and investment in renewables. Some cross-landscape interactions have already been described. Other instruments, such as FiTs and RHI, recognise that efficiency in using the renewable energy produced increases their own effectiveness, thus linking with the Green Deal in the latter case. The GHGAP in turn will use these instruments in meeting its own objectives, for example.

In general, the UK climate policy mix is inefficient, although generally feasible in its approach and implementation to meet stated objectives. Despite achieving more than double the UK's Kyoto target, the efficacy of the mix in its final impact (emissions mitigation) however, especially in relation to influences stemming from the global financial crisis and underlying cost of fossil fuels, is difficult to determine.

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## Annex I: table for the description of instruments

Areas of Policy interaction in design parameters	<b>European Emissions Trading System</b>	<b>Climate Change Levy</b>	<b>Climate Change Agreements</b>	<b>CRC Energy Efficiency Scheme</b>
<b>Instrument category</b>	ETS	Taxes	Taxes	Taxes
<b>Instrument subcategory</b>	Cap-and-Trade	Taxes on Inputs or Outputs of a Production Process	Negative Taxes for Environmentally Friendly Activities	Taxes directly applied to the pollution source (Carbon Tax)
<b>Level of governance</b>	EU	UK	UK	UK
<b>Degree of bindingness</b>	Legally Binding	Legally Binding	Legally Binding (once opted-in)	Legally Binding
<b>Objectives*</b>				
Goal(s)	Mitigation primarily through reduction in GHG emissions, with secondary goals of encouraging the development and dissemination of energy efficient technologies	Mitigation through reduction in energy demand	Mitigation secondary goal – protection of international competitiveness primary goal	Mitigation primary goal, though effective tax on emissions. Secondary goal to encourage development and dissemination of energy efficient technologies.
Type of target	Cap on total emissions in EU from covered sectors	No specific target	Reduction of carbon intensity for a given sector and facilities contained therein	No specific target
<b>GHG Scope</b>				
GHGs covered	CO <sub>2</sub> , Nitrous Oxide and Perfluorocarbons	CO <sub>2</sub> (indirectly)	CO <sub>2</sub>	CO <sub>2</sub>
Direct/indirect emissions	Direct	Direct	Direct and Indirect	Direct and Indirect
Primary/final energy	Primary	Primary and Final	Primary and Final	Primary and Final

Opt-in/opt-out	Member States can opt-in emissions	Discount Available with CCAs	Opt-in	No opt in/out available
<b>Sectoral scope</b>				
Sectors of economy	Energy supply, several industrial sectors, aviation	Industry, Commerce, Agriculture, Public	Industry, Commerce, Agriculture, Public	Potentially all sectors (except energy supply, domestic and transport)
Covered entities	Installations	Installations	Installations	Organisations
Covered sites	Installations for the production of energy, refining of mineral oil, coke, metal ore, iron and ferrous metals, aluminium, non-ferrous metals, cement, glass, ceramic products, pulp from timber, paper, carbon black, nitric acid, adipic acid, ammonia, bulk organic chemicals, hydrogen, soda ash.	Any Industrial, Commercial, Agricultural or Public energy-consuming site.	Any Industrial, Commercial, Agricultural or Public energy-consuming site.	Any site within a qualifying organisation (once qualification is determined by 6,000MWh annual energy consumption).
Capacity thresholds entities/sites	Combustion installations with rated thermal input above 20MW, specific thresholds for each sector	-	Energy Intensive industries, no minimum threshold for eligible processes at individual sites	Organisations with 6,000MWh annual electricity consumption through HHM.
Opt-in/opt-out for sectors	MS can opt-in entire sectors subject to conditions	Discount available with CCAs	Yes	EU-ETS and CCA sectors
Opt-in/opt-out for entities	MS can exclude small installations (emissions below 25000 tonnes CO <sub>2</sub> eq and/or rated thermal input below 35 MW) subject to conditions	Discount available with CCAs	Yes	As above
Opt-in/opt-out for sites	Opt-out for hospitals and small emitters	Discount available with CCAs	Yes	As above

<b>Implementation network</b>				
Competent bodies for adopting instrument	DECC	HMRC	DECC	DECC
Competent body for setting-up instrument	DECC	HMRC	DECC	DECC
Competent body to administer instrument	Environment Agency	HMRC	Environment Agency	Environment Agency
Competent body for registration of participating entities	Environment Agency	HMRC	Environment Agency	Environment Agency
Competent body for Monitoring & verifying compliance	Environment Agency	HMRC	Environment Agency	Environment Agency
Competent body for enforcement of compliance	Environment Agency	HMRC	Environment Agency	Environment Agency
<b>Rules &amp; influencing mechanisms</b>				
<i>Market arrangements</i>				
Non-obligatory for eligible parties	-	-	-	-
Number of participants	~1,100 (in UK)	-	52 sectors, >9,000 facilities	2,757
<i>Market flexibility</i>				
Trading Participants	Not Limited	N/A	N/A	N/A
Unit type and name	Emission Unit Allowance (EUA)	N/A	N/A	N/A
Nature of unit	1tCO <sub>2</sub> e	N/A	N/A	N/A
Lifetime of unit	Up to 8 years	N/A	N/A	N/A
Banking provisions	Allowed between years and	N/A	N/A	N/A



	Phases			
Borrowing provisions		N/A	N/A	N/A
<i>Financing</i>			N/A	N/A
Cost-recovery	Possible through cost-pass through		N/A	Cost-pass through in products
Revenues raised	£1.3 billion in Phase 2	Revenues are recycled back through reduction in business National Insurance contributions. Some revenue is earmarked for environmental purposes, such as historic funding of the Carbon Trust.	N/A	~£1 Billion/year
<i>Technological parameters</i>				
Eligible technologies	-	N/A	Set per Sector	N/A
Opt-in/opt-out	-	No	Opt-in for sectors and facilities	No
Treatment of additionally	-	N/A	N/A	N/A
<i>Timing</i>				
Operational?	Yes	Yes (2001 – present)	Yes (between schemes)	Yes
Operational changes foreseen?	Possible reduction in cap and widening of sectors and GHGs	Yes – removal of exemption for electricity generation	No	Yes – ‘simplification’, reduction of eligibility and fuel coverage

Compliance period(s)	2005-2007, 2008-2012, 2013-2020, probably 2020-2028	2001 onwards	2001 to 2010 (target period), then 2013 to 2023 (2016 milestone period)	Annual
Future continuation	Yes	Yes	Until 2023	Yes
<i>Compliance</i>				
Monetary penalties	£100 per EUA in absence (rather than standard €100)	£250 for various administrative errors	Equal to discount received	£40/tCO <sub>2</sub> for reported shortfall
Naming and shaming	Yes	No	Yes	Yes (but scrapping league table)
Administrative liability	Yes	Yes - £250 for various administrative errors	Yes	Yes
Civil liability	-	-	-	

Areas of Policy interaction in design parameters	<b>Green Deal</b>	<b>Energy Company Obligation</b>	<b>Vehicle Excise Duty</b>	<b>Carbon Trust Standard</b>
<b>Instrument category</b>	Technology Support	Technology Support	Taxes	Information
<b>Instrument subcategory</b>	Policies to remove financial barriers to acquiring green technology	Policies to remove financial barriers to acquiring green technology	Taxes on inputs or outputs of a production process	Award Scheme
<b>Level of governance</b>	UK	UK	UK	UK
<b>Degree of bindingness</b>	Voluntary	Legally Binding	Legally Binding	Voluntary
<b>Objectives*</b>				
Goal(s)	Mitigation through reduction in energy demand	Mitigation through reduction in energy demand	Mitigation through promotion of low carbon vehicles	Mitigation primary objective through organisational carbon management

Type of target	Volume of measures installed	Volume of measures installed	Additional purchase of low-carbon cars against baseline	Direct and indirect emissions reductions (>=2.5%) over given timeframes for certified organisations
<b>GHG Scope</b>				
GHGs covered	CO <sub>2</sub> (Indirectly)	CO <sub>2</sub> (Indirectly)	CO <sub>2</sub>	All 6 Kyoto GHGs
Direct/indirect emissions	Direct and Indirect	Direct and Indirect	Direct	Direct and Indirect
Primary/final energy	Primary and Final	Primary and Final	Primary	Primary and Final
Opt-in/opt-out	Opt-in	No	No	Opt-in
<b>Sectoral scope</b>				
Sectors of economy	Buildings (primarily domestic)	Energy Generation	Transport	Any non-domestic
Covered entities	Buildings	Energy Suppliers	Passenger cars	Any non-domestic
Covered sites	Any domestic and eventually all buildings (public and private)	Domestic Property	N/A	Any non-domestic
Capacity thresholds entities/sites	N/A	3 different obligations – bottom 15% of IMD for CSCo	N/A	None
Opt-in/opt-out for sectors	N/A	No	N/A	N/A
Opt-in/opt-out for entities	N/A	No	N/A	Opt-in
Opt-in/opt-out for sites	Opt-in	Opt-in	N/A	Opt-in
<b>Implementation network</b>				
Competent bodies for adopting instrument	DECC	DECC	DVLA	Carbon Trust
Competent body for	DECC	DECC	DVLA	Carbon Trust

setting-up instrument				
Competent body to administer instrument	Gemserv	Ofgem	DVLA	Carbon Trust
Competent body for registration of participating entities	Gemserv	Ofgem	DVLA	Carbon Trust
Competent body for Monitoring & verifying compliance	Gemserv	Ofgem	DVLA	Carbon Trust
Competent body for enforcement of compliance	Gemserv	Ofgem	DVLA	Carbon Trust
<b>Rules &amp; influencing mechanisms</b>				
<i>Market arrangements</i>				
Non-obligatory for eligible parties	N/A	N/A	N/A	N/A
Number of participants	New instrument	Unsure	N/A	~600
<i>Market flexibility</i>	N/A			
Trading	N/A	N/A	N/A	N/A
Unit type and name	N/A	N/A	N/A	Carbon Trust Standard
Nature of unit	N/A	N/A	N/A	N/A
Lifetime of unit	N/A	N/A	1 Year	1-3 years
Banking provisions	N/A	N/A	N/A	N/A
Borrowing provisions	N/A	N/A	N/A	N/A
<i>Financing</i>				
Cost-recovery	'Golden rule' – energy savings equal or outweigh costs	General energy billing	No	N/A
Revenues raised	Planned to be revenue neutral	None	£6 Billion annually	N/A
<i>Technological</i>				

<i>parameters</i>				
Eligible technologies	45 energy efficiency and microgeneration measures	Limited Green Deal measures	Passenger cars	N/A
Opt-in/opt-out		No	No	N/A
Treatment of additionally	N/A	N/A	N/A	N/A
<i>Timing</i>				
Operational?	Yes	Yes	Yes	Yes
Operational changes foreseen?	No	No	Yes – possible reform in near future	No
Compliance period(s)	N/A	2013-2015	Annual	1-3 years
Future continuation	Yes	TBC	Yes	Yes
<i>Compliance</i>				
Monetary penalties	N/A	Up to 10% global turnover	£80 (late), up to £1,000 for lack of SORN	No
Naming and shaming	No	Yes	No	No
Administrative liability	N/A	Up to 10% global turnover	N/A	No
Civil liability	N/A	N/A	N/A	No

Areas of Policy interaction in design parameters	<b>LSE Reporting Requirements</b>	<b>Renewables Obligation</b>	<b>Renewable Energy Feed-in Tariffs</b>	<b>Renewable Heat Incentive</b>
<b>Instrument category</b>	Reporting	Technology Support	Technology Support	Technology Support
<b>Instrument subcategory</b>	All Stand-alone Reporting Requirements	Renewable Portfolio Standard	Feed-in Tariffs	Feed-in Tariffs
<b>Level of governance</b>	UK	UK	UK	UK
<b>Degree of bindingness</b>	Legally Binding	Legally Binding	Voluntary	Voluntary

<b>Objectives*</b>				
Goal(s)	Mitigation primary, publication of information for investment purposes secondary	Mitigation secondary, with development and deployment of renewable technologies primary	Mitigation secondary, with development and deployment of renewable technologies primary	Mitigation secondary, with development and deployment of renewable technologies primary
Type of target	Reporting of direct and indirect emissions	Minimum obligated proportion of electricity from renewables	Number of installations/additional capacity	Number of installations/additional capacity
<b>GHG Scope</b>				
GHGs covered	All 6 Kyoto GHGs	CO <sub>2</sub> (indirectly)	CO <sub>2</sub> (indirectly)	CO <sub>2</sub> (indirectly)
Direct/indirect emissions	Direct and Indirect	Direct	Direct	Direct
Primary/final energy	Primary and Final	Primary	Primary	Primary
Opt-in/opt-out	No	No	Opt-in	Opt-in
<b>Sectoral scope</b>				
Sectors of economy	Non-specific – potentially all non-domestic	Electricity Production	Any	Any
Covered entities	On London Stock Exchange main market	Electricity Suppliers	Any	Any
Covered sites	As above	N/A	Any	Any
Capacity thresholds entities/sites	As above	>5MW	Any	Any
Opt-in/opt-out for sectors	N/A	No	N/A	N/A
Opt-in/opt-out for entities	No	No	Opt-in	Opt-in
Opt-in/opt-out for sites	No	Yes	Opt-in	Opt-in

<b>Implementation network</b>				
Competent bodies for adopting instrument	TBC	DECC	DECC	DECC
Competent body for setting-up instrument	TBC	DECC	DECC	DECC
Competent body to administer instrument	TBC	Ofgem	Ofgem	Ofgem
Competent body for registration of participating entities	TBC	Ofgem	Ofgem	Ofgem
Competent body for Monitoring & verifying compliance	TBC	Ofgem	Ofgem	Ofgem
Competent body for enforcement of compliance	TBC	Ofgem	Ofgem	Ofgem
<b>Rules &amp; influencing mechanisms</b>				
<i>Market arrangements</i>				
Non-obligatory for eligible parties	N/A	N/A	N/A	N/A
Number of participants	~1,000	Unsure	358,337 installations	171MW installed
<i>Market flexibility</i>				
Trading	N/A	Renewable generators and electricity suppliers	N/A	N/A
Unit type and name	N/A	Renewable Obligation Certificate (ROC)	N/A	N/A

Nature of unit	N/A	Varied per technology, a certain number of ROCs per MWh	N/A	N/A
Lifetime of unit	N/A	1 Year	N/A	N/A
Banking provisions	N/A	No	N/A	N/A
Borrowing provisions	N/A	No	N/A	N/A
<i>Financing</i>				
Cost-recovery	N/A	Through general electricity billing	General electricity billing	General taxation
Revenues raised	None	None	None	Negative
<i>Technological parameters</i>				
Eligible technologies	N/A	Biogas from AD, biomass, hydro, tidal, wind, solar PV, wave	AD, Hydro, Wind, Biomass, Solar PV	Biomass, biomethane, solar thermal, heat pumps
Opt-in/opt-out	No	Opt-in	Opt-in	Opt-in
Treatment additionally of	N/A	N/A	N/A	N/A
<i>Timing</i>				
Operational?	No	Yes	Yes	Yes
Operational changes foreseen?	Not yet confirmed	Yes – instrument ceasing	No	Yes – possible technology expansion, and full expansion to domestic sector
Compliance period(s)	Annual	Annual	Continuous	Continuous
Future continuation	Yes	Until 2017	Yes	Yes
<i>Compliance</i>				
Monetary penalties	TBC	Buy-out price	N/A	N/A



		(~£40/MWh)		
Naming and shaming	TBC	Yes	N/A	N/A
Administrative liability	TBC	No	N/A	N/A
Civil liability	TBC	No	N/A	N/A

Areas of Policy interaction in design parameters	<b>Renewable Transport Fuel Obligation</b>	<b>Landfill Tax</b>	<b>GHG Action Plan</b>
<b>Instrument category</b>	Technology Support	Taxes	Information
<b>Instrument subcategory</b>	Renewable Portfolio Standard	Taxes directly applied to the pollution source (Carbon Tax)	Voluntary Agreements
<b>Level of governance</b>	UK	UK	UK
<b>Degree of bindingness</b>	Legally Binding	Legally Binding	Voluntary
<b>Objectives*</b>			
Goal(s)	Mitigation secondary, with development and deployment of renewable technologies primary	Mitigation secondary, primary objective is reduction of waste to landfill	Reduction of GHG emissions, especially methane, from agriculture
Type of target	Minimum obligated proportion of electricity from renewables	Reduction of landfill waste volume	Reduction in CH <sub>4</sub> emissions
<b>GHG Scope</b>			
GHGs covered	CO <sub>2</sub> (indirectly)	Methane	Methane (primarily) and CO <sub>2</sub>
Direct/indirect emissions	Direct	Direct	Direct and Indirect
Primary/final energy	Primary	Final	Primary and Final

Opt-in/opt-out	No	No	No
<b>Sectoral scope</b>			
Sectors of economy	Transport	Waste	Agriculture
Covered entities	Transport fuel suppliers	Landfills	Farms
Covered sites		Landfills	Farms
Capacity thresholds entities/sites	Entities with over 450,000 litres of annual supply	No	No
Opt-in/opt-out for sectors	No	No	Voluntary for agriculture sector
Opt-in/opt-out for entities	Opt-in for non-mandatory suppliers	No	Opt-in
Opt-in/opt-out for sites	No	No	Opt-in
<b>Implementation network</b>			
Competent bodies for adopting instrument	Department for Transport (DfT)	Defra	Agriculture Industry
Competent body for setting-up instrument	Department for Transport (DfT)	HMRC	Agriculture Industry
Competent body to administer instrument	Department for Transport (DfT)	HMRC	Agriculture Industry
Competent body for registration of participating entities	Department for Transport (DfT)	HMRC	Agriculture Industry
Competent body for Monitoring & verifying compliance	Department for Transport (DfT)	HMRC	Agriculture Industry
Competent body for enforcement of compliance	Department for Transport (DfT)	HMRC	Agriculture Industry
<b>Rules &amp; influencing</b>			

<b>mechanisms</b>			
<i>Market arrangements</i>			
Non-obligatory for eligible parties	N/A	N/A	N.A
Number of participants	Unsure	>2,000	Unsure
<i>Market flexibility</i>			
Trading	Producers of biofuel and suppliers of transport fuel	N/A	N/A
Unit type and name	Renewable Transport Fuel Certificate (RTFC)	N/A	N/A
Nature of unit	1 litres biofuel/1kg biomethane	N/A	N/A
Lifetime of unit	Potentially unlimited if banked	N/A	N/A
Banking provisions	Yes – up to 25% for following compliance period	N/A	N/A
Borrowing provisions	N/A	N/A	N/A
<i>Financing</i>			
Cost-recovery	Through fuel costs	Pass-through to waste depositors	N/A
Revenues raised	None	>£1 billion	N/A
<i>Technological parameters</i>			
Eligible technologies	N/A	N/A	N/A
Opt-in/opt-out	N/A	N/A	N/A
Treatment of additionally	N/A	N/A	N/A
<i>Timing</i>			
Operational?	Yes	Yes	Yes
Operational changes foreseen?	No	No	No
Compliance period(s)	Annual	Continuous	Continuous

Future continuation	Yes	Yes	Yes
<i>Compliance</i>			
Monetary penalties	Buy-out price (£0.30/RTFC in absence)	N/A	N/A
Naming and shaming	Yes	No	N/A
Administrative liability	N/A	N/A	N/A
Civil liability	£50,000 for misreporting	Value of tax avoided as penalty, plus original tax	N/A

## Annex II: Types of interactions between instruments

### EU-ETS - CRC

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	ETS and Tax
Degree of bindingness	m-m	Both mandatory on target groups
Objectives	p-p	Both aim directly at emissions reductions
Scope	p-pa (soon i-i)	Currently some overlap, but zero after 'simplification'
Implementation network	f-r	DECC and Environment Agency
Rules and influencing mechanisms	Trading and regulatory	EU-ETS is trading, CRC is regulatory

### CCL - CCAs

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	Tax and emission reduction agreement
Degree of bindingness	m-m	Both mandatory on target groups
Objectives	p-s	Energy efficiency (CCL) and emissions reduction (CCA)
Scope	os-pa	CCA group is entirely within CCL target group
Implementation network	d-r	HMRC (CCL) and DECC/Environment Agency (CCA)
Rules and influencing mechanisms	Regulatory	Both regulatory

## CCL – EU-ETS

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	Tax and ETS
Degree of bindingness	m-m	Both mandatory on target groups
Objectives	p-s	Energy efficiency and direct emissions reduction
Scope	p-pa	All EU-ETS sectors (aside from energy generation and aviation) are subject to CCL
Implementation network	d-r	HMRC (CCL) and DECC/EA (EU-ETS)
Rules and influencing mechanisms	Trading and regulatory	CCL is regulatory, EU-ETS is trading

## CCL - CRC

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Identical	Both Tax
Degree of bindingness	m-m	Both mandatory on target groups
Objectives	p-s	Energy efficiency and direct emissions reduction (with heavy EE component).
Scope	os-pa	All CRC participants are subject to CCL
Implementation network	d-r	HMRC and DECC/EA
Rules and influencing mechanisms	Regulatory	Both regulatory

### CCL – Carbon Trust Standard

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	Tax and voluntary certification
Degree of bindingness	m-v	Mandatory (CCL) and voluntary (CTS)
Objectives	p-s	CTS has mitigation as primary objective, CCL has energy efficiency as primary
Scope	os-pa	CT standard may be applied to any commercial or public organisation, whilst some of these organisations will be exempt from CCL.
Implementation network	d-r	HMRC and Carbon Trust Standard
Rules and influencing mechanisms	Regulatory	CCL is regulatory and CTS is voluntary (no trading element)

### CCL – LSE Carbon Reporting Requirements

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	Tax and Reporting Requirements
Degree of bindingness	m-m	Both mandatory on target groups
Objectives	p-p/p-s/s-s	Energy efficiency and emissions reduction
Scope	os-pa	All participants in the LSE requirements will be subject to the CCL
Implementation network	d-r	HMRC and Defra (most likely)
Rules and influencing mechanisms	Regulatory	Both regulatory

### CCL – Green Deal

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Identical	Energy efficiency instruments
Degree of bindingness	m-v	CCL is mandatory, and Green deal is voluntary
Objectives	s-s	Emissions reduction for both instruments is the secondary objective (and overall desired impact)
Scope	p-pa	Green deal is domestic (and will be non-domestic), whilst CCL is non-domestic only
Implementation network	d-r	HMRC and DECC
Rules and influencing mechanisms	Regulatory	Both regulatory

### CCL – ECO

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Identical	Energy efficiency instruments
Degree of bindingness	m-m	Both mandatory
Objectives	s-s	Emissions reduction for both instruments is the secondary objective (and overall desired impact)
Scope	i-i	ECO is domestic only, CCL is non-domestic only
Implementation network	d-r	HMRC and DECC



Rules and influencing mechanisms	regulatory	Both regulatory
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### CCA - CRC

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	Tax and emission reduction agreement
Degree of bindingness	m-m	CRC is mandatory, as is CCA once sectors/facilities have opted-in
Objectives	p-s	For CCA mitigation is primary, for CRC this is the secondary objective (but primary impact objective)
Scope	p-pa	Currently there is some overlap between CCA and CRC target groups (energy and non-energy intensive), but with simplification there will be no direct interaction
Implementation network	p-r	DECC and EA administer CRC, whilst the EA is taking over from DECC for the CCA
Rules and influencing mechanisms	Regulatory	Both regulatory

### RO - CCL

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	Renewable portfolio standard and tax
Degree of bindingness	m-m	Both mandatory

Objectives	s-s	Mitigation is secondary for both. RO has deployment of renewables as primary, with energy efficiency and primary for CCL
Scope	i-i	CCL is not applicable for renewable electricity production
Implementation network	d-r	HMRC for CCL, DECC and Ofgem for RO
Rules and influencing mechanisms	Trading and Regulatory	RO has trading elements

### RO – EU-ETS

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	Renewable portfolio standard and ETS
Degree of bindingness	m-m	Both mandatory
Objectives	p-s	For EU-ETS mitigation is primary, secondary for RO
Scope	i-i	RO applies directly to electricity suppliers, and indirectly to generators. EU-ETS applies to fossil fuel generation (only) and other sectors.
Implementation network	p-r	DECC/EA for EU-ETS and DECC/Ofgem for RO
Rules and influencing mechanisms	Trading	The EU-ETS is fully trading, whilst RO has a strong trading element (ROCs)

### RO - FiTs

Table 2: types of interaction between instruments	Type of policy interaction	Description

Area of policy interaction		
Instrument type	Different	Renewable portfolio standard and Feed-in tariff
Degree of bindingness	m-v	RO is mandatory, FiTs is voluntary to join
Objectives	s-s	Both have mitigation secondary, with deployment of renewables secondary
Scope	i-i	No overlap between RO (>5MW) and FiT technologies (<5MW) supported
Implementation network	f-r	DECC and Ofgem for both instruments
Rules and influencing mechanisms	Trading regulatory and	FiTs provides financial incentive, RO is mandatory with trading aspect

#### RO - RHI

Table 2: types of interaction between instruments	Type of policy interaction	Description
Area of policy interaction		
Instrument type	Different	Renewable portfolio standard and renewable heating feed-in tariff
Degree of bindingness	m-v	RO is mandatory, RHI is voluntary to join
Objectives	s-s	Both have mitigation secondary, with deployment of renewables secondary
Scope	i-i	No overlap between technologies supported
Implementation network	f-r	DECC and Ofgem
Rules and influencing mechanisms	Trading regulatory and	RHI provides financial incentive, RO is mandatory with trading aspect

Note: Legend to interpret table 2<sup>1</sup>

**Degree of bindingness:** m-m/m-v/v-v: mandatory-mandatory/mandatory-voluntary/voluntary-voluntary

**Objectives:** p-p/p-s/s-s: primary-primary/primary-secondary/secondary-secondary.

To ensure consistency between table 1 and table 2, all instruments that promote mitigation as: (1) only objective; (2) as primary objective; (3) together with other equally important objectives; are considered for the purposes of table 2 as having mitigation as primary objective. Those instruments that promote mitigation as a secondary objective or which have impacts on mitigation, are to be considered for the purposes of table 2 as having mitigation as a secondary objective.

**Scope:** os-pa/p-pa/f-pa/i-i: one-set participation/partial participation/full participation/ indirect interaction.

Interactions due to scope occur when instruments are imposed upon the same target groups or when operations of other sectors, linked with the specific target groups of the two examined instruments, are affected. The first form of interaction is called direct target group interaction, and the second indirect. Using TP1 and TP2 to denote the set of target groups in policy instrument 1 and 2, respectively, three possible combinations for direct interaction occur, described by the following relationships.

First, if  $TP1 \subseteq TP2$  then  $(TP1 \cap TP2) = TP1$  or if  $TP2 \subseteq TP1$  then  $(TP1 \cap TP2) = TP2$  (One Set Participation, os-pa). Second, if  $TP1 \cap TP2 = TP3$  and  $TP3 \subseteq TP1$  or  $TP3 \subseteq TP2$  (partial participation, p-pa). Third,  $TP1 = TP2$  (full participation, f-pa). If  $TP1 \cap TP2 = \{\emptyset\}$ , then there is no direct interaction, but there may be indirect interaction.

**Rules and influencing mechanisms:** there are many areas where interactions can occur. The basic distinction made here is between trading and regulatory interactions. The former would apply to interactions between those instruments where trading of units (allowances, certificates) take place. Regulatory interactions would refer to all those elements of an instrument that are of a regulatory nature (administrative permits and licenses, MRV arrangements, compliance, timing). Interactions regarding compliance may be complementary (when two instruments impose two different types of consequences for lack of compliance),

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<sup>1</sup> We follow the terminology and analysis employed by P. Konidari and D. Mavrikis, (2006), 'Multi-Criteria Evaluation of Climate Policy Interactions', Journal of Multi-Criteria Decision Analysis, 14: 35-53, p.39. Most of the content of this note is taken literally from that publication with some small adjustments.

lead to a double burden (when two instruments impose consequences for lack of compliance with the same issue), or leave a gap (when none of the instruments applies any consequences for lack of compliance).