



Energy prices and bills - impacts of meeting carbon budgets

Committee on Climate Change | December 2014



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Preface

The Committee on Climate Change (the Committee) is an independent statutory body which was established under the Climate Change Act (2008) to advise UK and devolved administration governments on setting and meeting carbon budgets, and preparing for climate change.

Setting carbon budgets

In December 2008 we published our first report, 'Building a low-carbon economy – the UK's contribution to tackling climate change', containing our advice on the level of the first three carbon budgets and the 2050 target. This advice was accepted by the Government and legislated by Parliament in May 2009. In December 2010, we set out our advice on the fourth carbon budget, covering the period 2023-27, as required under Section 4 of the Climate Change Act. The fourth carbon budget was legislated in June 2011 at the level that we recommended. In April 2013 we published advice on reducing the UK's carbon footprint and managing competitiveness risks. In November and December 2013 we published, in two parts, our review of the fourth carbon budget, as required under Section 22 of the Climate Change Act, as an input to the Government's decision in 2014 not to amend that budget.

Progress meeting carbon budgets

The Climate Change Act requires that we report annually to Parliament on progress meeting carbon budgets. We have published six progress reports in October 2009, June 2010, June 2011, June 2012, June 2013 and July 2014.

Advice requested by Government

We provide ad-hoc advice in response to requests by the Government and the devolved administrations. Under a process set out in the Climate Change Act, we have advised on reducing UK aviation emissions, Scottish emissions reduction targets, UK support for low-carbon technology innovation, design of the Carbon Reduction Commitment, renewable energy ambition, bioenergy, and the role of local authorities. In September 2010, July 2011, July 2012, July 2013 and July 2014, we published advice on adaptation, assessing how well prepared the UK is to deal with the impacts of climate change.

The Committee

The members of the Committee are the Rt. Hon John Gummer, Lord Deben (Chairman), Professor Samuel Fankhauser, Sir Brian Hoskins, Paul Johnson, Professor Dame Julia King, Lord Krebs, Lord May and Professor Jim Skea. The Chief Executive is Matthew Bell.

The Committee would like to thank the core team involved in preparing the analysis for this report:

Ute Collier, Adrian Gault, Taro Hallworth, Mike Hemsley, Jenny Hill, Alex Kazaglis, Clare Pinder, Indra Thillainathan, and Mike Thompson. The Committee would also like to thank other members of the team who provided support: Owen Bellamy, Kathryn Humphrey, Nisha Pawar, David Thompson, Steve Smith and Jack Snape.

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Executive summary and key messages

The Climate Change Act 2008 requires us, when advising the Government and Parliament on how to achieve UK emission reductions, to consider economic and social circumstances. This includes the impact on fuel poverty and competitiveness. For that reason, we previously published, in 2011 and 2012, analysis about the impact of low-carbon policies on energy prices and bills. Since then, there has been considerable debate and new developments to take into account. In 2015, we are due to publish our advice to Government on the fifth carbon budget (2027-2032). Ahead of that, this report sets out the facts about the links between climate policy and energy prices and bills.

Energy bills for households and businesses have risen in the last ten years. Household bills increased from £650 in 2004 to £1,140 in 2013: that is a 75% increase over a period when there was general price inflation of 23%. We find that most (80%) of this increase has been due to factors unrelated to low-carbon policies. During the same period, there was a reduction in energy consumption, without which bills would have increased a further £165 to £1,305.

For a typical dual-fuel household (see Box 1), the 2013 bill was composed of:

- £1,025 associated with costs of wholesale energy and system costs unrelated to low-carbon policy.
- £45 associated with support for low-carbon power generation and the carbon price.
- £60 due to support for energy efficiency schemes and smart meter roll-out, as well as £10 to support low-income households through the Warm Home Discount.

Meeting the UK's statutory carbon targets will add to energy bills in the future, though with potential to offset much of this through energy efficiency. Electricity generation will need to shift from fossil fuels to low-carbon alternatives such as renewables and nuclear, which are currently more expensive. Their deployment is at present being supported through government policies that pass costs through to energy consumers and therefore increase energy bills, in particular electricity bills. We estimate an increase in the typical household bill due to these policies of £55 between 2013 and 2020, and a further £75 by 2030.

Estimates of future energy prices are inherently uncertain. Policy costs for supporting low-carbon generation will depend on future gas and carbon prices, amongst other factors. Investment in low-carbon generation provides a form of insurance against future gas and carbon prices. The costs of financial support for low-carbon generation will be at their highest when overall bills are lowest and at their lowest when overall bills are highest.

Energy efficiency opportunities, if fully implemented, would result in cost savings that would offset most of the additional costs when averaged across all households, and partially offset them in the commercial and industrial sectors. However, for individual households or businesses the potential for savings will differ from the average and their realisation will depend on effective design and implementation of energy efficiency policies.

For some energy consumers, especially the fuel poor and energy-intensive industries, government support may be needed to compensate for some of the price impacts. For fuel poor households, support is likely to be needed beyond existing energy efficiency schemes, including specific targeting of low-carbon heat measures. For industry, the Government has already put a compensation package in place which is likely to be sufficient through to 2020.

Box 1: Our approach to estimating energy prices and bills

Typical dual-fuel household: We focus on the 87% of UK households that use gas for heating and electricity for lighting and appliances. To estimate the consumption of a typical dual-fuel household, we use 2013 energy consumption figures from statistics published by the Department for Energy and Climate Change (DECC). We provide separate analysis for the 7% of households who use electricity for heating.

Commercial sector: We distinguish between those firms covered by different low-carbon policies (i.e. the Climate Change Levy and the CRC Energy Efficiency Scheme) and with different shares of spend on gas and electricity.

Industry: We estimate energy cost impacts for the sector average, as well as energy-intensive and non-intensive users. We also look at the impact that compensation and exemption from the cost of supporting low-carbon investment will have for at risk energy-intensive sectors.

Central estimates: There is considerable uncertainty over future gas and carbon prices. We use DECC projections. In a central case, these have gas prices increasing from 54p/therm in 2013 to 75p/therm in 2030. We also assume the total carbon price (EU ETS and carbon price support) rises from £7 to £76/tCO₂, consistent with DECC assumptions. We separately consider the range around these central assumptions.

Price base: For our backward-looking assessment from 2004 to 2013, we express energy prices and bills in nominal terms. Changes over that period can then be compared with the GDP deflator, a measure of price inflation across the economy as a whole, which increased 23%. For households, the consumer price index rose by 29% over the same period. For our estimates to 2020 and 2030, prices and bills are expressed in constant terms, at 2013 prices.

Our key findings for households and businesses are set out below.

Households

The annual bill for a typical dual-fuel household was £1,140 in 2013. On central estimates, the bill will fall to £1,100 in 2020 and then rise to £1,305 in 2030. While low-carbon policy costs (made up of support for low-carbon electricity generation and the carbon price) rise to 2020 and 2030, wholesale costs decrease to 2020 but then rise again during the 2020s (Table 1).

- Our central estimate is that low-carbon policy costs increase by £55 between 2013 and 2020, and a further £75 by 2030. The total cost of low-carbon policies in 2030 would be about £175 out of a total annual household energy bill of £1,305.
- To 2020, the main driver of the increase is direct support for low-carbon generation. The increase from 2020 to 2030 is driven by the assumed rise in the carbon price.
- Depending on assumptions about gas and carbon prices, we estimate that low-carbon policy costs could range between £70 and £120 in 2020 and from £115 to £235 in 2030.
- There is scope for the additional impacts of low-carbon generation policy costs to be offset by savings through energy efficiency opportunities, up to £210 per year in 2030. This will rely on take-up by households.

By 2030, we expect most electricity generation to come from low-carbon sources. Energy prices and bills should then fall, as support payments for existing low-carbon generation begin to expire. Furthermore, new capacity can be added at lower cost following commercialisation of emerging technologies during the 2020s. By contrast, if the sector does not decarbonise in the 2020s, bills would continue to rise beyond 2030 with increases in the carbon price consistent with international action to avoid dangerous climate change.

Table 1: Central estimate for typical dual-fuel household energy bills (in £2013)

	2013	2020	2030
Wholesale, transmission, distribution	£1,025	£940	£1,090
Direct low-carbon support ¹	£35	£75	£90
Carbon price ²	£10	£25	£85
Energy Company Obligation ³ , Warm Home Discount and smart meter support	£70	£60	£40
Total energy bill for typical dual-fuel household	£1,140	£1,100	£1,305
Potential for energy efficiency savings		-£80	-£210

Notes: Numbers are rounded. All numbers include VAT. We assume constant consumption of 3,000 kWh for electricity, 14,100 kWh for gas. ¹ Includes the Renewables Obligation, Feed In Tariffs, Contracts for Difference, and balancing costs associated with renewables. ² Carbon price including EU ETS and carbon price support, rising from £7 in 2013 to £76 tCO₂e in 2030. ³ Funding for the ECO is assumed to stay constant between 2013 and 2030. Smart meters are expected to provide a reduction in network costs by 2030.

Around 7% of households use electricity as the main source for heating. These are mostly smaller properties, in particular flats, with a large proportion in the rental sector and relatively high numbers in fuel poverty. As the costs of support for low-carbon investment is currently passed through the electricity bill, these households pay a higher proportion of their energy bill towards low-carbon policy costs than dual-fuel households. In 2013, the bill for a typical electrically-heated household¹ was £925, £90 of which was for support for low-carbon generation. We estimate, using central assumptions, that this element of low-carbon support will increase to £210 in 2020 and £360 in 2030, out of a total bill of £1,255. Electrically-heated households able to switch to low-carbon heat systems, such as heat pumps, can reduce their energy bills.

Energy prices are a key driver of fuel poverty. In principle, energy efficiency and low-carbon heat measures included in our carbon budgets scenarios can more than compensate for increases in energy prices due to support for low-carbon generation. However, this will require additional policies and a focus on effective targeting of measures to fuel poor households.

There is also some geographical variation in levels of fuel poverty across the UK. Some households in the devolved administrations (for example, in the North of Scotland) already face higher bills than the UK average due to higher electricity prices, higher heating demand and a high prevalence of electric heating. This is reflected in higher than average levels of fuel poverty. The devolved governments already have policies in place to address fuel poverty but further support may be required.

¹ As these are smaller properties, typical energy consumption is lower than in dual-fuel households. We use electricity consumption of 7,800 kWh, compared to 3,000 kWh for electricity and 14,100 kWh for gas in dual-fuel households, based on analysis by Ofgem.

Commercial and industrial users

Currently, low-carbon policies account for an average of 26% of commercial energy sector bills and 13% of industry sector bills, with higher costs for energy-intensive users. These costs will also rise but it is harder to quantify the impact on bills given the diversity within these sectors. We project low-carbon policies to increase average commercial sector energy bills between 2013 and 2030 between 15% and 48%, with a central estimate of 31%. For industry, we estimate an average increase by 2030 of between 14% and 38%, with a central estimate of 26% (Table 2). There are opportunities for energy efficiency improvement to offset part of these impacts.

Energy costs are likely to remain a small component of total costs: under 1% of costs in the commercial sector and under 3% of costs for industry on average. The impact on total costs and final prices of goods and services will therefore be small on average.

For some sectors, where energy costs are a higher proportion of total costs, the impact, in the absence of compensating measures, would be more significant. Increasing electricity prices imply potential competitiveness risks for electro-intensive industries which are subject to international competition and face higher energy costs relative to competitor countries. To offset these impacts, the Government has put in place an initial compensation package and has plans for further measures for sectors at risk. Our analysis suggests this package is likely to be sufficient through to 2020. Beyond 2020, continuing support may be required depending on the scale of measures taken in other countries.

Table 2: Central estimate for changes in energy bills due to low-carbon policy costs for businesses and industry (2013 to 2020 and 2030)

	2013-2020	2013-2030
Industry (sector average, without compensation and exemptions)	11%	26%
Commercial sector (sector average CRC)	14%	31%

Note: For fixed level of consumption based on 2013. Industry sector average assumes no compensation or exemption, and it does not include cost of EU ETS allowances purchases. Electro-intensive industry eligible for compensation will not experience these levels of increase.

Report outline

We set out the analysis that underpins these messages in four sections:

1. Estimating the impact of carbon budgets on energy prices
2. Household energy bills
3. Commercial sector energy bills
4. Industrial energy bills

1 Estimating the impact of carbon budgets on energy prices



The Climate Change Act sets a long-term target of at least an 80% reduction in greenhouse gas emissions by 2050 on 1990 levels. To date, four carbon budgets up to 2027 have been legislated on a pathway to that target. Emissions in 2013 were 28% below 1990 and the first carbon budget (2008-2012) was met.

This report sets out our best estimate of how policies to reduce emissions¹ affect current energy bills, and how they can be expected to affect future bills as legislated carbon budgets are met. It updates our previous analysis (published in December 2011, updated in December 2012). Since then, there have been a number of changes that have implications for both current and future bills (Box 1.1).

Box 1.1: Changes since our 2012 assessment of carbon budget impacts

We have previously published analysis of the impact of carbon budgets on energy prices and bills (December 2011 and updated in December 2012). In this report, we have taken account of new fossil fuel and carbon price projections, updated estimates of grid costs and supplier operating costs and margins. We also have used a lower estimate of household energy demand, based on recent DECC energy statistics.

- DECC's central projections for wholesale gas prices and carbon prices are lower than they were in 2012 (in £2013).
 - The wholesale gas price projection for 2020 has fallen from 73 p/therm to 59 p/therm.
 - The carbon price projection has fallen from £31 to £23 per tonne of CO₂ in 2020, reflecting the Government's decision to freeze the carbon price support², and a lower projection of the price of carbon allowances in the Emissions Trading System (ETS).
- Ofgem's estimates of the costs of maintaining the grid have increased by 23% for electricity and decreased by 16% for gas between 2011 and 2013,
- Supplier margins have increased in the residential sector from 1% in 2011 to 3% in 2013 for electricity and remained at around 4% for gas over the same period (after increasing to 6% in 2012).
- Household electricity and gas demand (allowing for differences in temperatures between years) fell by around 4% between 2011 and 2013, due to improvements in household energy efficiency, higher energy prices and the impact of the recession (see Chapter 2).

We have also updated our scenarios for the delivery of low-carbon generation in 2020 to include, for example, lower deployment of Carbon Capture and Storage (we now assume two demonstration projects instead of four), as set out in our 2014 progress report to Parliament.

Our new estimates of impacts in 2020 allow for these changes. We also extend the period considered to 2030, in preparation for our advice on the 5th carbon budget (2028-2032) to be delivered in December 2015.

1 Although there are multiple ways of meeting carbon budgets, the policy costs assumed in this analysis are consistent with meeting carbon budgets in the way suggested by the CCC's progress report indicators. For example, see CCC (2014) *Meeting Carbon Budgets – 2014 Progress report to Parliament*. Available at: www.theccc.org.uk

2 We assume the carbon price freeze continues until 2020, rising thereafter. While freezing the carbon price support may result in more coal being burnt in the UK in the short term, this will not increase overall EU emissions given that these are capped in the EU ETS



Low-carbon policy costs are currently:

- 16% of electricity prices in the residential sector,
- 26% in the commercial sector,
- 22% in industry.

Energy prices have increased since 2004, predominantly because of increases in the wholesale gas price. As in our 2011 and 2012 reports, we conclude that whilst all energy users have experienced large increases in both electricity and gas prices since 2004, the majority of this change is unrelated to low-carbon policies.

In 2030, based on central estimates, we anticipate that low-carbon policy costs will be 33% of the electricity price for households, and 46% for the commercial sector. For industry, policy costs could be 49% of the electricity price, although for energy-intensive users this does not take into account exemptions and compensation.

We present our analysis in four chapters. In this chapter, we set out the method underpinning our analysis of how energy prices will affect each sector in four sections:

- 1.1 Power sector decarbonisation
- 1.2 Assessing the impact of low-carbon and other policies on current energy prices
- 1.3 Changes in energy prices from 2004 to 2013
- 1.4 Outlook for energy prices to 2030

In Chapters 2-4 we discuss how this can be expected to feed through to energy bills in the residential, commercial and industrial sectors, alongside opportunities to offset these increases through improvements in energy efficiency.

1.1 Power sector decarbonisation

Power sector decarbonisation, that is, shifting electricity generation from unabated fossil fuel combustion to low-carbon alternatives such as renewables, is of key importance for meeting carbon budgets:

- Decarbonisation through investment in a portfolio of low-carbon technologies is a low-regrets strategy with potentially significant benefits in a carbon-constrained world. Low-carbon technologies for the power sector are available which are or are likely to become cost-effective (i.e. cheaper than fossil fuel generation facing a rising carbon price).
- Early decarbonisation of the power sector is central to economy-wide decarbonisation because low-carbon electricity offers a route to decarbonisation of other sectors. Our scenarios for meeting carbon budgets assume that heat pumps and electric vehicles will play an increasingly important role.

As low-carbon generation options are currently more expensive than unabated fossil-fuelled plants (i.e. gas and coal plants without Carbon Capture and Storage – CCS)³, their use will increase the cost of energy.

Offsetting these increased costs, there are opportunities for energy efficiency which can cut energy bills and may provide savings larger than those costs.

Our analysis is based on the current and possible future mix of low-carbon policies, allowing for how policy costs will have to change under scenarios that we have identified as being consistent with the legislated carbon budgets.⁴ Whilst other scenarios could also meet the budgets, the expected costs are likely to be similar, given that all scenarios involve decarbonisation of the power sector by 2030.

The Department of Energy and Climate Change (DECC) has recently published its own assessment of how Government policies affect energy bills. Although there are differences between their approach and ours, the key assumptions underpinning both assessments are comparable (Chapter 2, Box 2.3). We have a statutory duty to take into account economic and social circumstances when considering our advice in relation to carbon budgets, and this includes impacts on competitiveness and fuel poverty. It is important therefore for us to set out our views of these impacts.

1.2 Assessing the impact of low-carbon and other policies on current energy prices

Retail prices faced by customers pay for energy delivered and available at the point of consumption (i.e. in the home or the workplace). Prices reflect the costs of producing, transporting and supplying energy, including supplier margins, as well as policy costs faced by energy generators and suppliers.

We focus on the standard unit of price per kWh⁵. A typical dual-fuel household uses around 3,000 kWh of electricity annually for lighting and appliances, and just over 14,000 kWh of gas for space heating and water heating⁶.

Energy prices in the commercial and industrial sectors are lower than for households (Table 1.1, Figure 1.1), reflecting lower costs of supply (e.g. through higher load factors which allow better utilisation of infrastructure). As large bulk purchasers of energy, some commercial and industrial consumers may also be able to negotiate lower prices.

The historical prices presented in this report are in the 'money of the day' (i.e. nominal); all 2013 and future prices are in 2013 money (i.e. real).

3 Our evidence suggests that the costs of economy-wide decarbonisation are dominated by costs in the power sector. For example, in our 2010 analysis on the Fourth Carbon Budget we identified a total cost of meeting the budget of 0-0.6% of GDP, and a cost of power sector decarbonisation of 0-0.5%.

4 Specifically, we base our analysis on scenarios set out in our 2014 progress report to Parliament and our 2013 review of the Fourth Carbon Budget. ⁴We assume the carbon price freeze continues until 2020, rising thereafter. While freezing the carbon price support may result in more coal being burnt in the UK in the short term, this will not increase overall EU emissions given that these are capped in the EU ETS.

5 One kWh is enough electricity to boil a full kettle around 6 times or run a washing machine cycle.

6 Consumption estimated for a typical, dual fuel customer using estimates of energy consumption from DECC (2014) Energy Consumption in the United Kingdom.



Table 1.1: Gas and electricity prices, by sector, 2013

	Gas p/kWh	Electricity p/kWh
Households	4.9	15.1
Commercial	3.3	10.1
Industry	2.7	8.1

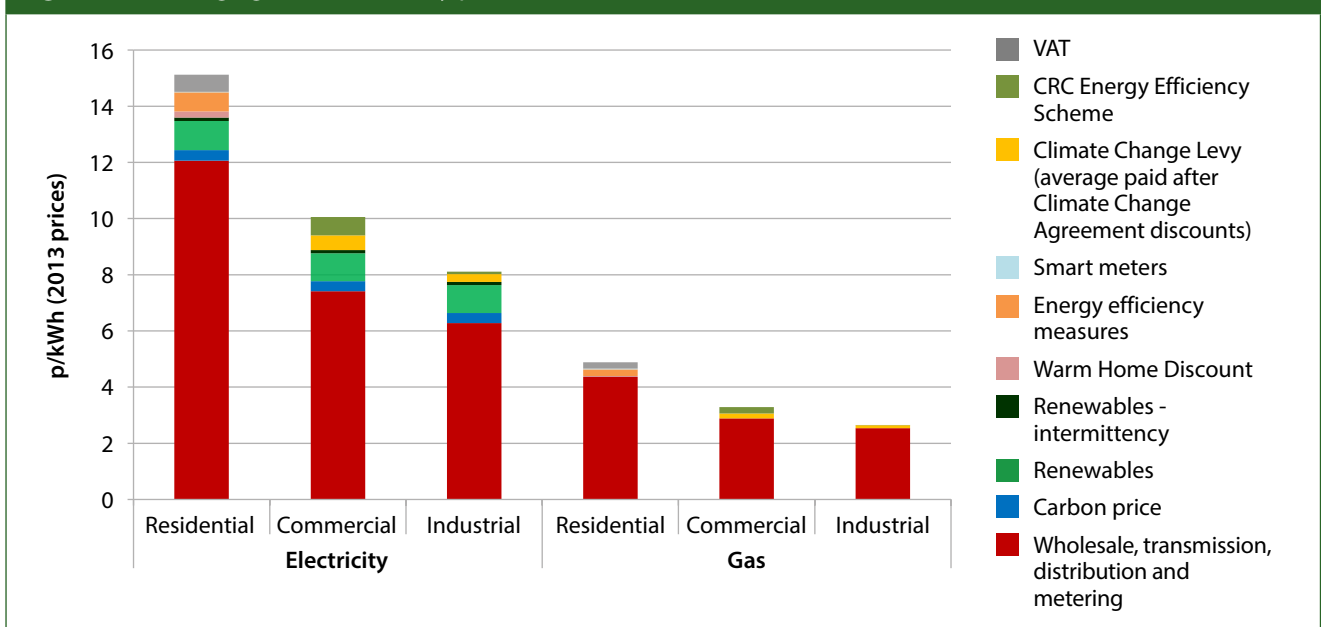
Notes: All costs in £2013.
Source: DECC (2014) *Quarterly Energy Prices – September 2014*. Available at: www.gov.uk.

In the residential sector, the majority of the electricity and gas price (80% and 89% in 2013) reflects wholesale, supplier and network costs (i.e. transmission, distribution and metering – TDM):

- Wholesale costs (i.e. the costs of buying electricity from generators) made up 6.0 p/kWh (39%) of the residential retail electricity price and 2.6 p/kWh (53%) of the gas price.
- Other costs faced by suppliers and their margins made up 2.4 p/kWh (16%) of the retail electricity price and 0.8 p/kWh (17%) of the gas price.
- Transmission and distribution costs (i.e. the costs of installing, refurbishing and upgrading the networks of gas pipes and electricity wires) made up 2.9 p/kWh (19%) of the residential electricity price and 0.9 p/kWh (18%) of the gas price. These costs are regulated by Ofgem.
- Other costs in the electricity price include 0.7 p/kWh for the costs of balancing⁷(5%), and 0.1 p/kWh (1%) for metering.

In addition, final energy prices include the impact of a number of low-carbon, fiscal and social policies (Table 1.2) which we set out in more detail below.

Figure 1.1: Average gas and electricity prices in the residential, commercial and industrial sectors (2013)



Source: CCC Calculations.

⁷ System balancing is required to ensure that the generation of electricity matches the demand for electricity in real time. The responsibility of balancing the electricity grid lies with National Grid, as the System Operator (SO), and incurs additional costs in the form of payments to backup and standby generation plant. In 2013, balancing costs – known as Balancing Use of System Service charges (BSUoS) – are estimated at 0.7p/kWh for residential consumers.

Table 1.2: Key factors affecting electricity prices (2004-2030)

		2004	2013	2020	2030
Base electricity price	Wholesale electricity price	3.4 p/kWh	6.0 p/kWh	5.1 p/kWh	6.1 p/kWh
	Transmission & distribution costs	£6 bn	£8 bn	£8 bn	£8 bn
	Supplier margins: Residential (commercial and industrial sectors)	0%	c. 3% (6%)	c. 3% (5%) (Average 2010-14)	
Low-carbon policy costs	Carbon price	N/A	£7/tCO ₂	£23/tCO ₂	£76/tCO ₂
	Direct low-carbon support	£0.5 bn	£3.3 bn	£7.2 bn	£10 bn
	Energy taxes (commercial and industry only)	Climate Change Levy (CCL)	Carbon Reduction Commitment (CRC), CCL	CRC, CCL	CRC, CCL
Other costs	Energy Company Obligation (households only)	£0.2 bn	£1.4 bn	£1.4 bn	£1.4 bn

Notes: All costs in £2013. See chapters 3 and 4 for assumptions regarding CCL and CRC. The impact of coal prices on the base electricity price is not considered as in recent years gas plant has been the marginal plant in the electricity market, thus setting the price of electricity. In future years our scenarios include a decreasing amount of coal generation on the system. The wholesale electricity price is based on outturn data for 2004 and 2013 (i.e. reflecting a mix of generation plant); projected wholesale electricity price assumes new gas generation and a gas price of 59 p/therm in 2020 and 75 p/therm in 2030. Scenarios include gas price +/- 30p/therm; carbon price +/- £20/tCO₂ in 2020, +/- £40/tCO₂ in 2030.

Source: DECC (2014) *Fossil Fuel Price Projections*, DECC (2014) *Updated short-term traded sector carbon values for policy appraisal*, Ofgem (2014) *Supply Market Indicators*.

The impact of low-carbon policies and other policy costs

The cost of supporting low-carbon electricity generation is paid through electricity bills, and currently adds around 1.5 p/kWh to electricity prices for all users (Table 1.3). This currently accounts for 16% of electricity prices in the residential sector, which compares to 26% and 22% in the commercial and industrial sectors.

- **Carbon price.** Generators face a carbon price of £7 per tonne of CO₂ emitted in 2013 under the EU Emissions Trading System and the UK's carbon price support. The carbon price raised around £0.9 billion in revenue for the Exchequer in 2013.
- **Direct support for renewable generation.** Further support is paid to renewable generators through the Renewable Obligation (RO) and Feed-In-Tariffs (FITs) for small-scale generators. Higher levels of intermittency associated with an increased proportion of renewables on the grid also impose costs, which we include:
 - Renewable generators currently provide 16% of UK generation (51TWh), around 90% of which is supported by the RO and FITs,
 - The total spending for this support is capped under the Levy Control Framework (LCF)⁸, for which the limit was £3.3 billion in 2013/14,
 - The costs are recovered from all electricity consumers.

⁸ The Levy Control Framework put a limit on the total spending to cover the following policies: the Renewables Obligation (RO), Feed-in Tariffs (FITs), Warm Home Discount, and Contracts for Difference (CfDs).



Businesses and households also face other policy costs, as well as a range of taxes. Some of these have an element of supporting emission reductions, while others are aimed primarily at meeting social and/or fiscal objectives:

- **Funding for energy efficiency (households only).** Energy suppliers are obligated to fund energy efficiency improvements in households under the Energy Company Obligation (ECO). Some of this funding is aimed specifically at reducing carbon emissions, some primarily at reducing fuel bills for low-income households (for further detail see Chapter 2). Costs are recovered from almost all household gas and electricity bills⁹.
- **Warm Home Discount (households only).** This provides a rebate to low-income households on their energy bills, with costs recovered from all households (see Chapter 2).
- **Smart meters (households only).** The Government has set a target to install smart meters in all homes and 2 million businesses between 2013 and 2020. Suppliers recover this cost from households. 2013 is the first year this cost is being paid.
- **Energy taxes (businesses only).** Businesses and industry pay towards both the Carbon Reduction Commitment (CRC) and the Climate Change Levy (CCL). The CRC and CCL provide around £1.4 billion per annum in fiscal revenue.
- **VAT.** Households pay a reduced rate of VAT of 5%. As businesses pay VAT but can fully reclaim it, we do not include this in our analysis for the industrial and commercial sectors. For the residential sector, we split out the VAT related to low carbon support, which was less than 0.1 p/kWh of the 0.7 p/kWh VAT on the electricity price in 2013.

⁹ The ECO applies to energy companies that have more than 250,000 domestic customers and provide more than 400 gigawatt hours of electricity or more than 2,000 gigawatt hours of gas to these customers.

Table 1.3: Policy costs paid through energy prices in 2013						
p/kWh	Residential		Commercial (medium user covered by CRC)		Industrial (average user)	
	Electricity	Gas	Electricity	Gas	Electricity	Gas
Direct support for low-carbon generation	1.0	-	1.0	-	1.0	-
Carbon price	0.4	-	0.4	-	0.4	-
Assumed costs of integrating and managing low-carbon generation ¹⁰	0.1	-	0.1	-	0.1	-
ECO	0.6	0.2	-	-	-	-
Smart meters	0.02	0.02	-	-	-	-
Warm Home Discount	0.2	0.04	-	-	-	-
CRC	-	-	0.6	0.2	0.1	0.01
CCL	-	-	0.5	0.2	0.3	0.1
VAT	0.1	0.01	-	-	-	-
TOTAL	2.50	0.3	2.6	0.4	1.9	0.1
Source: CCC calculations.						

Information for the year-to-date in 2014 suggests that prices will be slightly higher than in 2013 (by around 5% for gas and 6% for electricity). This reflects higher supplier margins, metering and grid costs, partially offset by lower wholesale costs and the ECO. It also reflects the package of measures announced in December 2013 to reduce bills for households by £50 on average from 2014, including a reduction in funding for the ECO and a £12 electricity rebate.

Chapters 2-4 set out how prices are reflected in energy bills in each sector.

1.3 Changes in energy prices from 2004 to 2013

The average retail electricity price faced by households increased from 7.5 p/kWh in 2004 to 15.1 p/kWh in 2013 (i.e. a 102% increase compared to general price inflation of 23% over this period).

- **Wholesale, supplier and TDM:** The wholesale price (which includes supplier costs and margins, as well as the wholesale cost of fuels used in generation) increased by 3.7 p/kWh between 2004 and 2013. A further 0.9 p/kWh increase reflects TDM and balancing costs.
- **Carbon price.** The introduction of carbon pricing from 2005, which reached a level of £7 per tonne of CO₂ in 2013, increased electricity prices by 0.4 p/kWh.

¹⁰ We assume costs of managing intermittent generation in line with Pöyry's work for our 2011 *Renewable Energy Review*, of 1p/kWh per additional unit of renewable generation. See Pöyry (2011) *Analysing technical constraints on renewable generation to 2050*. Available at www.theccc.org.uk.



- **Support for low-carbon investment:** Support for low-carbon generation through the Renewables Obligation (RO) and Feed-In-Tariffs (FITs) added 1.0 p/kWh to the electricity price. This support has helped incentivise an increase in the share of renewable electricity generation from 4% in 2004 to 16% in 2013.
- **Energy efficiency funding:** The UK has operated energy supplier obligations to fund energy efficiency schemes since 1994, with the costs passed through to household gas and electricity bills. In 2004, under the Energy Efficiency Commitment, costs were an estimated 0.02 p/kWh on gas and 0.07 p/kWh on electricity. In 2008 and 2009, more ambitious energy efficiency targets were introduced under the Carbon Emissions Reduction Target (CERT) and the Community Energy Saving Programme (CESP), increasing the costs to 0.22 p/kWh on gas and 0.65 p/kWh on electricity. This level of support was maintained under the ECO, which was introduced in 2013. Recent changes to reduce the ambition of the ECO and associated costs only came into effect in 2014, so do not affect our 2013 prices.
- **Smart Meters:** The rollout of smart meters to residential electricity and gas consumers, and two million small businesses in the UK is estimated to have added 0.02 p/kWh to residential electricity and gas prices between 2004 and 2013.
- **Other policies:** The introduction of the Warm Home Discount in 2011, which provides a fuel rebate for eligible low-income and vulnerable householders of around £120 a year, increased the 2013 electricity price by 0.2 p/kWh and the gas price by 0.04 p/kWh. VAT is 5% of the electricity price; in 2013 this was 0.7 p/kWh.

Commercial sector electricity prices increased from 3.9 p/kWh in 2004 to 10.1 p/kWh in 2013 and industrial electricity prices rose from 3.3 p/kWh to 8.1 p/kWh in 2013 (Figure 1.2):

- **Wholesale, supplier and TDM:** The wholesale electricity price (including supplier operating costs and margins, and network costs) for commercial consumers increased by 4.1 p/kWh, from 3.3 p/kWh to 7.4 p/kWh, and increased by 3.3 p/kWh for industrial consumers, from 3.0 p/kWh to 6.3 p/kWh.
- **Support for low-carbon investment and carbon price:** As set out above, the p/kWh impact of low carbon policies are the same for households and businesses (notwithstanding that households pay VAT).
- **Energy taxes:** The CRC added 0.6 p/kWh in the commercial sector and 0.1 p/kWh in the industrial sector in 2013. The CCL increased from 0.4 p/kWh to 0.5 p/kWh for the commercial sector between 2004 and 2013. It fell from 0.2 p/kWh to 0.1 p/kWh in industry on average, given increased discounts for sectors that have a Climate Change Agreement (see Chapter 4).

Figure 1.2: Retail electricity prices from 2004 to 2013 (residential, commercial and industrial sectors)



Note: Inflation over this period was 23%

Source: CCC Calculations.

Retail gas prices have more than doubled from 2004 to 2013, almost entirely due to factors unrelated to policies for meeting carbon budgets:

- Residential gas prices have increased from 1.9 p/kWh in 2004 to 4.9 p/kWh in 2013 (i.e. by 161%). 1.3 p/kWh of the increase was the result of the rising international wholesale price of gas, alongside a 0.4p/kWh increase in network costs, and 0.9p/kWh of the increase was the result of an increase in supplier costs and margins. Increased funding for energy efficiency (i.e. CERT and ECO) added 0.2 p/kWh, while the early roll-out of smart meters added less than 0.1 p/kWh. VAT is 5% of the gas price; in 2013 this was 0.2 p/kWh.
- Commercial gas prices have increased from 1.3 p/kWh to 3.3 p/kWh. Most of this is unrelated to low-carbon policy. The wholesale price of gas increased by 1.3 p/kWh over this period, alongside an increase of approximately 0.4 p/kWh in transmission and distribution costs. A 0.2 p/kWh increase reflects the introduction of the CRC.
- Gas prices in the industrial sector have increased from 1.0 p/kWh to 2.7 p/kWh, the majority of which was due to an increase in the wholesale price of gas of 1.3 p/kWh, with the remainder from increased supplier costs and margins, network costs and policy costs under the CRC and CCL.

Offsetting these price increases, there have been considerable improvements in the energy efficiency of boilers, lights and appliances since 2004. As a result, the cost of energy services has not increased as much as energy *prices* and in some cases has actually fallen (see Chapter 2).

As in our 2011 and 2012 reports, we conclude that whilst all energy users have experienced large increases in both electricity and gas prices since 2004, the majority of this change is unrelated to low-carbon policies.

We now turn to the outlook for energy prices and the potential impact of low-carbon policies out to 2030.



1.4 Outlook for energy prices to 2030

(a) The impact of power sector decarbonisation on future electricity prices

Our assessment assumes the balance of policies remains roughly as currently planned (i.e. with the bulk of the costs of decarbonisation falling on electricity bills) and additional funding in areas where we have assessed this is necessary to meet carbon budgets.

Given its cost-effectiveness and importance in the economy-wide decarbonisation strategy, we have advised the Government that the UK should aim for early decarbonisation of the power sector. This would involve reducing sector carbon intensity from its current level of around 500 gCO₂/kWh to 50-100 gCO₂/kWh by 2030 through a portfolio of low-carbon options (i.e. renewables, nuclear and carbon capture and storage – CCS).

- UK electricity generation had a carbon intensity of around 500 gCO₂/kWh in 2013, although our analysis has shown that the emissions intensity at which the current UK installed capacity mix is capable of operating has reduced from 460 gCO₂/kWh in 2007 to under 300 gCO₂/kWh in 2013.¹¹
- Actual grid intensity is expected to fall to under 300 gCO₂/kWh by 2020, as the UK deploys renewable generation as required by the EU Renewable Energy Directive. The Government has also agreed to support at least two CCS demonstration plants by 2020; the White Rose project in Yorkshire and at Peterhead in Scotland.
- We have identified that to meet carbon budgets cost-effectively, the UK should deploy a portfolio of low-carbon generation options through the 2020s, including renewables, nuclear, and CCS applied to coal and gas plants.

To achieve this decarbonisation of the power sector, current and planned policies are likely to increase electricity prices in real terms:

- **Carbon price.** While the EU ETS price is likely to remain low to 2020 given the current surplus of allowances (Chapter 4), the Government has announced increases in the UK's carbon price support to 2015/16 after which it will be frozen. In the longer term, higher carbon prices are likely to be needed under international efforts aiming to limit global temperature increases to 2 degrees above pre-industrial levels. We therefore follow the approach based on the Government's estimated carbon values and assume a carbon price that increases from £7 per tonne CO₂ in 2013 to £23 per tonne CO₂ in 2020 and £76 CO₂ in 2030. This would increase the impact on electricity prices from 0.4 p/kWh¹² in 2013 to 0.8 p/kWh in 2020 and 2.7 p/kWh in 2030.

¹¹ CCC (2014) *Meeting Carbon Budgets — 2014 Progress Report to Parliament*. Available at: www.theccc.org.uk. The emissions intensity of the grid at any point in time depends upon the relative economics of coal and gas. However, if in 2013 the grid had been operated to minimise emissions (i.e. running gas before coal), the emissions intensity could have fallen to around 300 g/kWh.

¹² We assume new gas generation to be the marginal plant in the electricity system between 2020 and 2030, at a carbon intensity of 350 gCO₂/kWh.

- **Direct support for low-carbon generation.** The Government has allocated £7.8 billion of annual funding¹³ for low-carbon generation in 2020 under the Levy Control Framework. This would be sufficient to increase renewable generation from 16% in 2013 to 30-35% in 2020, while funding at least two CCS demonstration projects. After 2020, we assume that funding continues to support the transition to a low-carbon power sector, such that the impact on electricity prices increases from 1.1 p/kWh in 2013 to 2.4 p/kWh in 2020 and 2.9 p/kWh in 2030 (including direct support for low-carbon generation, additional transmission and managing intermittency, see Box 1.2).

We assume that these increased costs affect all electricity used by households and the commercial sector, given they are recouped from suppliers on a per unit basis. Some energy-intensive industrial users are exempted from or compensated for these costs, and will not be exposed to the increases to avoid competitiveness risks (Chapter 4). These exemptions will increase the costs of supporting low-carbon investment for non-exempt consumers, although this impact is expected to be small (up to around £5 on household bills).

Box 1.2: Estimating the cost of supporting low-carbon generation

Our calculations around the level of support required for low-carbon generation are based on reaching a decarbonisation target of 50-100 gCO₂/kWh in 2030. For example, a 50 gCO₂/kWh scenario could include around 6 GW CCS, 24 GW of each of onshore and offshore wind, as well as 17 GW of nuclear. We assume that 100 gCO₂/kWh would be delivered at a similar cost given that higher carbon intensity would ensue either because the costs of low-carbon technologies are higher, or because cheaper low-carbon technologies face deployment constraints.

Direct support for low-carbon generation is provided through Feed-In-Tariffs (FITs) for small-scale low-carbon generation, the Renewables Obligation (RO) up to 2016/17 and Contracts for Difference (CfDs) from 2014/15¹⁴. The cost of this support is recovered through energy bills, limited by the Levy Control Framework (LCF).

In a central case, we estimate the funding required to directly support low-carbon generation to be around £7.2 bn in 2020 and £10 bn in 2030¹⁵ and falling thereafter (peaking at £11 bn in 2027), in order to meet carbon budgets. These costs are spread over consumption, resulting in price impacts of 2.1 p/kWh in 2020 and 2.6 p/kWh in 2030¹⁶:

- **FITs:** We assume projected spend in the 2020s to remain in line with DECC's projected level for 2020 of £1.2 bn¹⁷.
- **RO:** We assume that the RO peaks at £3.1 bn per annum in 2015. In the 2020s and beyond, as older projects that were installed under the RO come to the end of their 20 year lifetime, the total spend under the RO falls.
- **CfDs:** We assume all projects beyond 2015 opt for the CfD (rather than the RO) at costs in line with DECC's published strike prices¹⁸. Beyond 2020, we assume strike prices in line with Pöyry's 2013 assessment¹⁹ for our 2013 report *Next steps on Electricity Market Reform*.

Further costs are also incurred for integrating and managing low-carbon generation in the grid, for example from higher transmission costs arising from connecting geographically-remote renewable generation, as well as additional costs for backup capacity for intermittent renewables²⁰.

13 £7.6 bn in 2011/12 prices.

14 The cost determined by the difference between the agreed 'strike price' and the cost of gas generation facing a carbon price. In practice, developers will see a return under Electricity Market Reform (EMR) equal to the difference between the strike price and the market wholesale price (with a specific price index, e.g. day-ahead for renewables).

15 As set out in CCC (2013) *Next Steps on Electricity Market Reform*, using the long-run marginal cost of gas generation as the price index is a better reflection of the costs to consumers than the projected wholesale price. We estimate the cost of gas generation facing a carbon price to be around £60/MWh in 2020 and £90/MWh in 2030.

16 In CCC (2013) *Fourth Carbon Budget Review*, our scenarios project rising electricity consumption, from 316TWh in 2013 to 435TWh by 2030. This is in part due to low-carbon electric technologies such as heat pumps and electric vehicles.

17 DECC (2014) *Annual Energy Statement 2014*. Available at: www.gov.uk. This is an increase of £450m since our previous report.

18 DECC (2013) *Final Delivery Plan for EMR*. Available at: www.gov.uk.

19 Pöyry (2013) *Technology Supply Curves for Low Carbon Generation*. Available at: www.theccc.org.uk.

20 Pöyry (2011) *Analysing technical constraints on renewable generation*. Available at: www.theccc.org.uk.



Box 1.2: Estimating the cost of supporting low-carbon generation

- **Additional transmission:** 0.2 p/kWh to cover additional transmission assets as identified by the Electricity Networks Strategy Group²¹, equivalent to a total cost of £9 bn annualised over the lifetime of the asset.
- **Managing intermittency:** 0.1 p/kWh for the cost of managing intermittency in 2013, based on analysis by Pöyry (2011) for our 2011 *Renewable Energy Review*. This cost increases over time with penetration of intermittent renewables. These increases are included in our estimates of strike prices, which assume generators effectively face these costs.

(b) Funding for energy efficiency and other policy costs

Our scenarios for meeting carbon budgets imply continuing improvements in energy efficiency in all sectors to 2030 and beyond. For example, in homes we assume the insulation of all lofts and cavity walls by 2022 and 3.5 million solid walls by 2030, alongside a number of lower-cost measures such as draught-proofing.

Some of these improvements will save more money over their life than the upfront costs involved and are likely to be financed by homeowners themselves, potentially using the Green Deal. Others will require additional funding, and some will require full funding of the capital costs (e.g. to support action addressing fuel poverty), which may be levied on bills for residential consumers.

We assume that most policy costs would stay constant to 2030, with the exception of smart meter costs which only run to 2020, and by 2030 would deliver saving in network costs.

- **Energy efficiency funding.** Funding under the ECO in 2013 was £1.4 bn. We estimate this to be enough to incentivise the annual uptake of insulation measures in our carbon budget scenarios. We therefore assume no change in the price impact of ECO funding from 2013 to 2020 or 2030. This assumption implies an increase in funding from the reduced level of ambition for the ECO that the Government has introduced in 2014, but no increase relative to 2013.
- **Warm Home Discount.** We have not applied a cost for the Warm Home Discount in 2020 and 2030, as currently the policy is only committed to until 2017.
- **Funding for fuel poverty.** Further funding may be required to address fuel poverty but we assume this would be paid through general taxation rather than energy bills (see Chapter 2).
- **Smart meters.** DECC estimates that the net costs, not accounting for energy savings, of the programme will add 0.01 p/kWh to household electricity prices and 0.02 p/kWh to household gas prices from 2013 to 2020. By 2030, by which time the installation programme will be complete, smart meters will reduce costs due to savings in network and metering costs (by 0.07 p/kWh on electricity and 0.10 p/kWh on gas).
- We assume that **VAT** continues at 5% and the CCL is maintained at its current level in real terms.

21 ENSG (2012) *Our Electricity Transmission Network: A Vision for 2020*. Available at: www.gov.uk

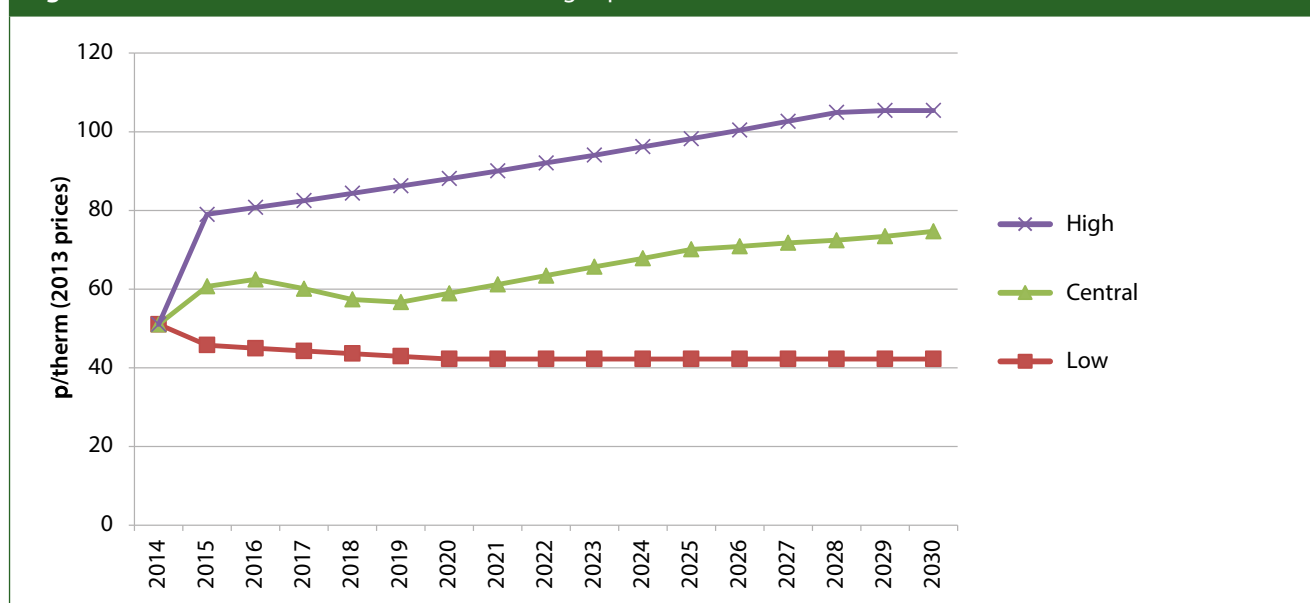
(c) Outlook for other costs

Based on DECC's scenarios for future gas prices (Figure 1.3) and Ofgem's agreed funding for network reinforcement and improvements, prices will also rise as a result of factors unrelated to decarbonisation.

- Wholesale costs.** DECC's central scenario for future gas prices involves a decrease from 2013 to 2020 before increasing from 2020 to 2030. This would result in a decrease in wholesale electricity prices to 2020 (by 0.8 p/kWh for households), and an increase in 2030 (by 0.2 p/kWh, compared to 2013). Household gas prices are projected to fall by 0.4 p/kWh to 2020 (compared to 2013), before increasing by 0.2 p/kWh in 2030. Future wholesale costs are highly uncertain – we discuss the implications of alternative gas price scenarios below, along with other uncertainties.
- Transmission costs** in the power sector are expected to rise, according to the business plans agreed by Ofgem, from £2.2 bn p.a. in 2013 to £3.4 bn p.a. in 2020 and remain constant to 2030, as ageing network assets are replaced; gas transmission costs are also expected to rise from £600m p.a. in 2013 to £1.1 bn p.a. in 2020 and remain constant to 2030. This would add 0.3 p/kWh to household electricity prices and a 0.1 p/kWh to gas prices to 2030.
- Distribution costs** for electricity are projected at £4.9 bn p.a. in 2020, compared to £5.3 bn today. This would reduce distribution costs for electricity by 0.2p/kWh compared to today. Gas distribution costs are projected to remain at today's level of around £3.5 bn p.a. so will not significantly change gas distribution prices.

Overall, on central assumptions we project higher electricity prices resulting from increasing support for low-carbon investment, and from wholesale and network costs (Figure 1.4). Gas prices would fall to 2020 and rise to 2030, due to factors unrelated to low-carbon policy.

Figure 1.3: DECC scenarios for future wholesale gas prices



Source: 2015 Onwards: DECC *Fossil Fuel Price Projections* (September 2014); 2014: *National Grid – Data Explorer*, (Data Retrieved 31/11/2014) (2014 is year to date).



Figure 1.4: Outlook for electricity prices in residential, commercial and industrial sectors (2013, 2020, 2030)



Beyond 2030, electricity prices are projected to fall as a low-carbon power system becomes a cheaper alternative to a gas-based power system facing a rising carbon price.

- Continued investment in gas rather than low-carbon generation would be likely to increase costs given an expected rising carbon price in a carbon-constrained world. For example, assuming no change in gas prices, DECC's carbon price scenarios (e.g. rising to £147 per tonne CO₂ in 2040) would add up to 5.2 p/kWh to electricity prices through the 2030s.
- If the power sector has already been decarbonised by the 2030s, then most generation will not pay the carbon price so will not face these costs. In contrast, some low-carbon generation will reach the end of its contract but still be able to provide power at low marginal cost (e.g. wind has a 15-year contract versus a 20-25 year lifetime).

Where new capacity is required, this should be available at low cost given that our scenarios include a portfolio of options and steady deployment to commercialise options that are currently less advanced.

(d) Uncertainty in projecting future energy prices

There is considerable uncertainty around these projections, particularly relating to gas and carbon prices, and to the costs and deployability of low-carbon technologies. We therefore show both central estimates and ranges to allow for these uncertainties throughout this report.²²

Uncertainty in either (or both) fossil fuel and carbon price projections impacts the level of subsidy required for low-carbon generation. For example, changes in the gas price could impact our projections of LCF spend in 2030 by +/- £6 bn, whereas changes in the carbon price could change the projections by up to £4 bn in 2030.

²² We use a projection of the carbon price based on DECC's central carbon values, including the Carbon Price Floor, rising to £76 per tonne CO₂ in 2030 and consider uncertainties around this value of +/- £30 per tonne CO₂). We consider the range of DECC's latest fossil fuel price projections, with a central gas price projection of 75 p/therm in 2030 and scenarios ranging from 42 p/therm to 105 p/therm.

The overall volatility in energy bills is reduced in a decarbonisation scenario because the costs of supporting low-carbon generation are lowest when gas prices are high. Investment in low-carbon generation can therefore be seen as a way of insuring against potentially high gas and/or carbon prices.

Actual costs of low-carbon technologies may also turn out to be higher or lower compared to estimates in this report. A scenario in which these costs are higher than central estimates should lead to slightly lower deployment of the more expensive technologies, and a slower rate of decarbonisation of the power sector (e.g. a 100 gCO₂/kWh scenario rather than 50 gCO₂/kWh in 2030). The overall costs to consumers of such a scenario would remain similar.

We now turn to the impact of energy prices on bills in the residential, commercial and industrial sectors (Chapters 2-4).

2 Household energy bills



In this chapter, we discuss how low-carbon policies affect households. We assess the impact of policy support for low-carbon electricity generation and energy efficiency improvement on electricity, gas and combined energy bills, both currently and those estimated to 2020 and 2030.

We focus primarily on the energy bills of the 87% of UK households that are dual-fuel (i.e. households that use gas for heating and some cooking). In addition, we consider the impacts for different household types (e.g. those that use electricity for heating), those that are in fuel poverty, and for households in the devolved administrations.

Key messages:

- **Current bills and changes since 2004:** The annual bill for a typical dual-fuel household in 2013 was about £1,140, of which about £685 was spent on gas and £455 on electricity. Around £45 of this goes to support low-carbon investment, £55 to energy efficiency, including smart meters and £10 for the Warm Home Discount. Bills have increased by 75% (£490) since 2004, a period over which there was general price inflation of 23%. Of this increase, around 8% (£40) was associated with support for low-carbon power generation. Support for energy efficiency schemes (including smart meter roll-out) accounted for another 10% (£50) of the increase.
- **Outlook for future energy bills:** By 2030, our central estimate is that low-carbon policies will cost about £175 per year out of a total annual household energy bill of £1,305. Depending on assumptions about gas and carbon prices, we estimate that low-carbon policy costs could range between £70 and £120 in 2020 and from £115 to £235 in 2030. There is scope for the additional impacts of low-carbon generation policy costs to be offset by savings through energy efficiency opportunities, up to £210 per year in 2030. This will rely on take-up by households.
- **Non-dual-fuel households:** Around 7% of households use electricity as the main source for heating. As the costs of support for low-carbon investment is currently passed through the electricity bill, these households pay a higher proportion of their energy bill towards low-carbon policy costs than dual-fuel households. In 2013, the bill for a typical electrically-heated household (typically flats) was £925, £90 of which was for low-carbon policy costs. We estimate that this element of the bill will increase to £210 in 2020 and £360 in 2030 if these households do not change their heating system. Electrically-heated households able to switch to low-carbon heat systems, such as heat pumps, can reduce their energy bills.
- **Fuel poverty impacts:** Energy prices are a key driver of fuel poverty. In principle, energy efficiency and low-carbon heat measures included in our carbon budgets scenarios can more than compensate for increases in energy prices due to support for low-carbon generation. However, this will require additional policies and a focus on effective targeting of measures to fuel poor households.

-
- **Energy bills in the devolved administrations:** Some households in the devolved administrations (especially in the north of Scotland) already face higher bills than the UK average due to higher electricity prices, higher heating demand and a high prevalence of electric heating. This is reflected in higher than average levels of fuel poverty. The devolved governments already have policies in place to address fuel poverty but further support may be required.

We set out our analysis that underpins these messages in five sections:

- 2.1 Current household energy bills
- 2.2 Changes in household energy bills since 2004
- 2.3 Outlook for household energy bills to 2020 and 2030
- 2.4 Fuel poverty impacts
- 2.5 Energy bills in the devolved administrations

2.1 Current household energy bills

The main uses of energy in the residential sector are for space heating (around two-thirds of demand), hot water use, electrical appliances, cooking and lighting. In terms of fuel type, gas accounts for more than two thirds of consumption, with electricity, oil and other fuels accounting for the rest:

- gas accounts for around 68% of consumption
- electricity 22%
- oil 6%
- solid fuel 2%
- bioenergy and other fuels for the remaining 2%.

The residential sector consumed around 36% of total UK electricity (i.e. 113 TWh) and 62% of gas (345 TWh) used outside the power sector in 2013.

In 2013, the 87% of UK households that are dual-fuel (i.e. gas used for heating) used an average of 14,700 kWh of gas and 3,000 kWh of electricity. This is our 'typical' dual-fuel household (Box 2.1). Gas use was somewhat higher than usual because the winter months of 2013 were colder than average. If winter temperatures had been at average levels, gas consumption would have been around 14,000 kWh. We use this temperature-adjusted level of gas consumption when analysing bill changes over time.

Box 2.1: CCC assumptions on energy consumption for the typical dual-fuel household

We assume a level of consumption of 3,000 kWh for electricity and 14,000 kWh for gas for the typical dual-fuel household in 2013 based on total UK consumption of energy:

Gas: We divide the total level of gas demand in the residential sector (345 TWh)¹ in 2013 by the number of households that are dual-fuel consumers (i.e. 87% of UK households). This consumption level of 14,700 kWh is then temperature-adjusted to remove the impact of higher gas demand from colder than average winter months in 2013.

Electricity: We divide DECC modelled data² on residential electricity consumption for lights, appliances and cooking by all 27 million UK households to derive an average level of consumption which we assume for the dual-fuel household.

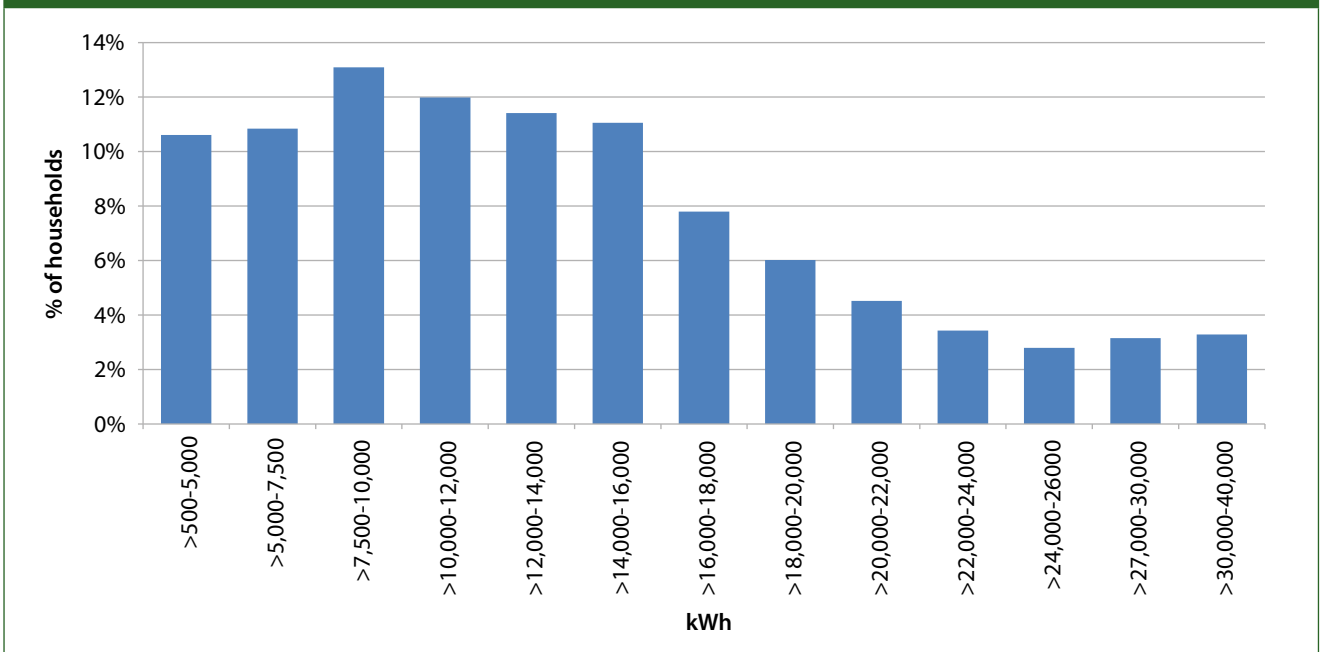
1 DECC (2014) *Digest of UK Energy Statistics 2014*. Available at: www.gov.uk

2 DECC (2014) *Energy Consumption in the UK*. Available at: www.gov.uk



Assuming this level of consumption and residential energy prices as set out in Chapter 1 (i.e. 15.1 p/kWh for electricity and 4.9 p/kWh for gas), the typical annual dual-fuel bill in 2013 was £1,140, of which £685 was spent on gas and £455 on electricity. In reality, there is a wide distribution of bills across households, depending on a range of factors such as size and energy efficiency of the dwelling, age and use of appliances, and occupancy type. These factors impact the level of consumption and there are many households that consume less gas and electricity than the typical level (Figures 2.1 and 2.2).

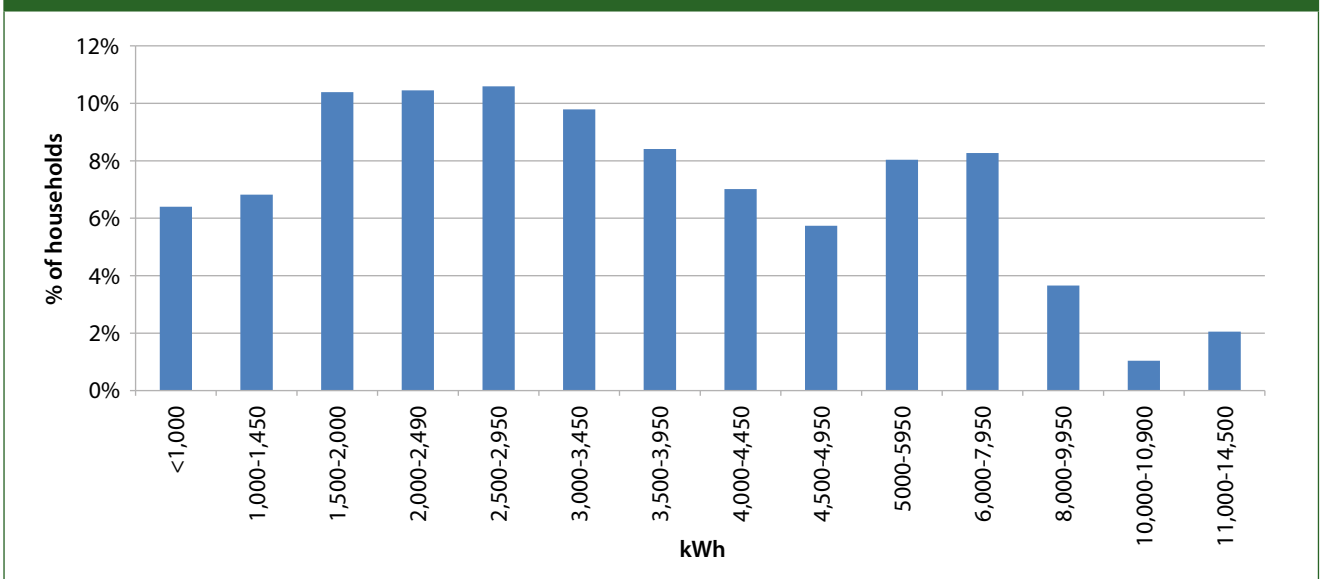
Figure 2.1: Distribution of residential gas consumption, kWh (2012)



Source: DECC (2014) *National Energy Efficiency Data (NEED) Framework* – anonymised data

Note: Based on a sample of 50,000 records selected to be representative of the housing stock (based on region, property age, property type and floor area band).

Figure 2.2: Distribution of residential electricity consumption, kWh (2012)



Source: DECC (2014) *National Energy Efficiency Data (NEED) Framework* – anonymised data

Note: Based on a sample of 50,000 records selected to be representative of the housing stock (based on region, property age, property type and floor area band).

Within the typical annual bill, the cost of supporting low-carbon electricity generation was £45 per household, made up of £10 from the carbon price and £35 from direct support for renewable generation. Funding for energy efficiency added £50 to the typical annual bill, spread across electricity and gas bills; this funding paid towards the installation of insulation and condensing boilers without which energy consumption and bills (particularly for low-income and fuel-poor households who benefit most from this funding) would have been higher. A further £5 was due to smart meter installation costs.

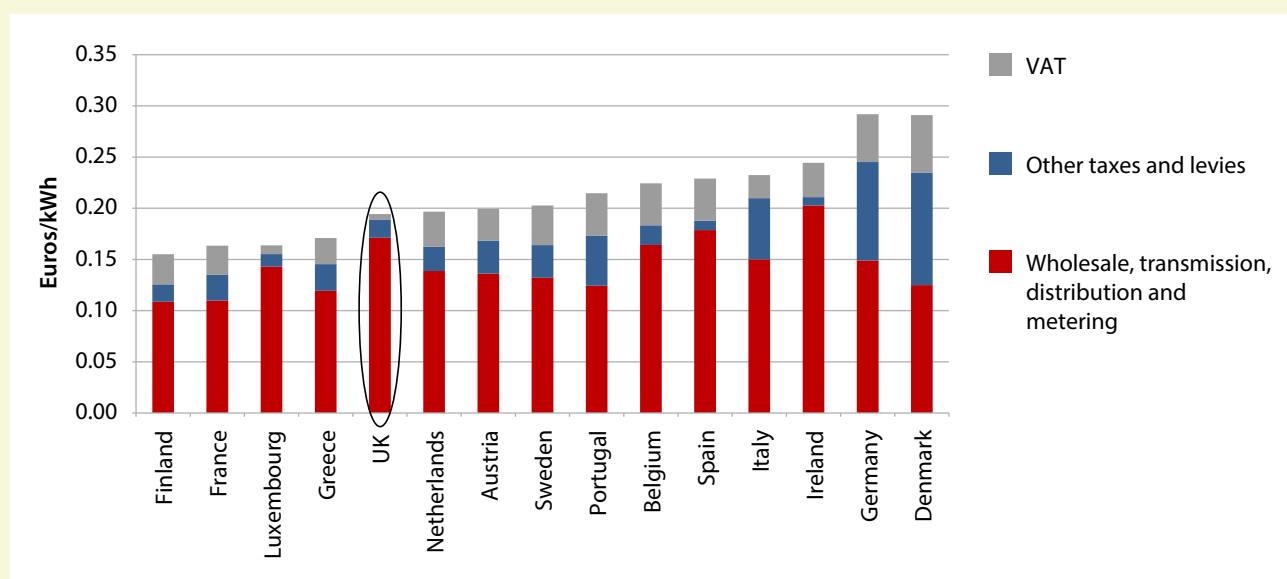
A comparison of 2013 prices with the other countries that make up the EU 15, shows that for both gas and electricity, the UK has some of the lowest energy prices in the region (Box 2.2).

Box 2.2: Comparison of household energy prices for the EU 15

Comparing UK electricity and gas prices in 2013 against other countries that make up the EU 15 shows that the UK had the lowest gas price, as well as relatively low electricity prices.

- The UK has the fifth lowest electricity retail price behind France, Finland, Greece and Luxembourg, with the highest prices paid in Germany and Denmark (Figure B2.1).
- The UK has the lowest gas retail price in the EU15. Sweden and Denmark have the highest gas prices, more than twice the price in the UK, mainly due to ecotaxes and higher VAT.
- UK households pay the lowest rate of VAT on both gas and electricity.

Figure B2.1: EU household electricity price comparisons (including policy costs (2013))



Source: Eurostat (2014) *Gas and electricity prices for domestic consumers*, CCC for UK VAT and other taxes and levies

Note: Consumption band DC: 2,500 kWh-5,000 kWh



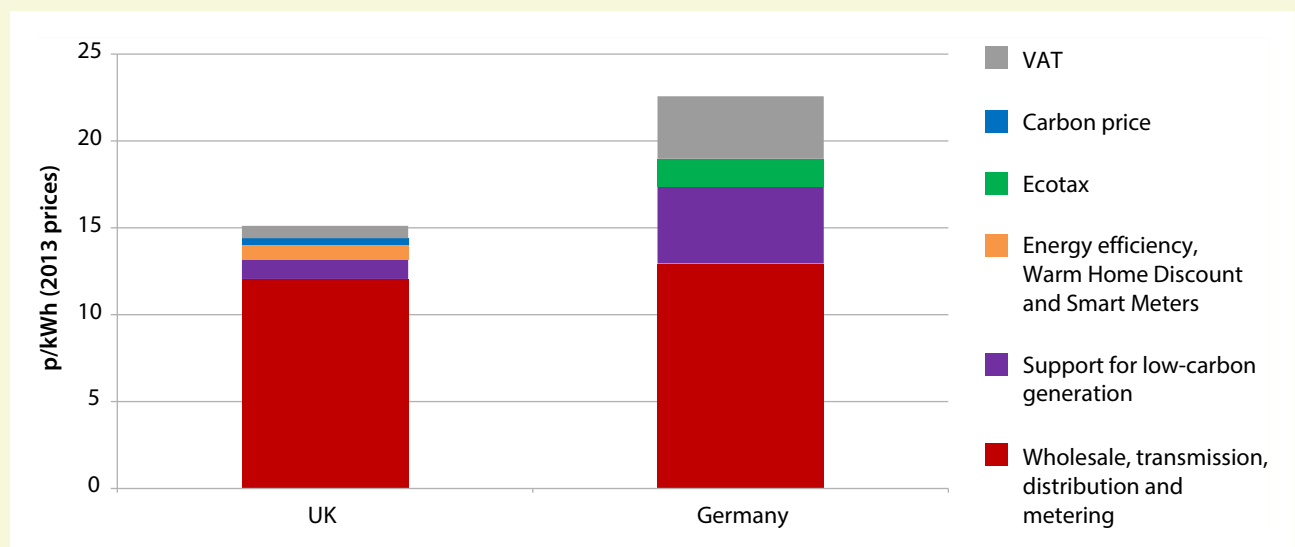
Box 2.2: Comparison of household energy prices for the EU 15

A detailed breakdown for Germany shows that while wholesale, transmission and distribution costs and levies are similar to the UK, overall residential electricity prices are almost 50% higher than in the UK. The differential is primarily due to higher levels of low-carbon generation support, as well as a higher rate of VAT (15.97% versus 5% in the UK) (Figure B2.2).

- Renewable energy in Germany has seen rapid growth in recent years to 147 TWh in 2013 (24.7% of electricity generation). This has been a result of the renewable energy law (Erneuerbare Energien Gesetz – EEG) of 2000 which provides support for renewable electricity generation, the costs of which are recovered through an EEG charge on electricity bills. As many industries are exempt, the costs have mainly been borne by households.
- Charges for renewables support under the EEG have increased from 0.51 Euro cents/kWh in 2004 to 5.28 Euro cents/kWh in 2013 and 6.24 Euro cents/kWh in 2014. Solar PV receives 42% of this support, 20% goes to biomass and 15% to wind.
- Additionally, German households pay an ecotax (similar to the UK climate change levy which is only levied on businesses), as well as a small charge to support combined heat and power plants.

The total electricity price for households in Germany has increased at a lower rate since 2004 than in the UK (60% versus 121%). Recent changes to the EEG are expected to result in a small reduction in the EEG charge in 2015 (to 6.17 Euro cents/kWh) and the Government aims to keep costs under control in the future. However, even by 2020, when we expect low-carbon generation costs to increase substantially in the UK, it is likely that German households will still be paying higher charges for such support than UK households.

Figure B2.2: Household electricity prices – UK versus Germany (2013)



Source: Eurostat, BDEW.

Notes: Exchange rate as of 8 November 2014

Prices so far in 2014 have been higher than in 2013³. The most recent energy price estimates for 2014 indicate that gas and electricity prices are 5% higher in 2014 than the previous year for the typical UK dual-fuel household. While there has been a decline in the wholesale cost of energy, supplier margins have increased from 4% to 8% of a consumer's bill for gas, and from 3% to 6% for electricity⁴. Whilst funding for energy efficiency under the Energy Company Obligation (ECO) has been cut by almost half, it is not clear how this has fed through to household energy bills.

The Department for Energy and Climate Change (DECC) has recently published its own assessment of how Government policies have affected energy bills in 2014. They also assess impacts to 2020 and 2030. There are differences in our approach, though we can reconcile our assumptions and key results are similar (Box 2.3).

Box 2.3: CCC approach on energy bill impacts compared with DECC

The Department of Energy and Climate Change (DECC) has recently published its own assessments of how Government policies affect energy bills⁵. Although there are differences in approach, the key assumptions underpinning both assessments are comparable. The key differences in how we analyse current energy bills include:

- Our starting point is actual 2013 energy bills, whereas DECC compares 2014 bills with what bills would have been without any energy and climate change policies. We use 2013 bills as this is the latest full year for which energy consumption and price statistics are available.
- DECC includes a wider range of policies that do not deal directly with climate change but directly affect energy bills, such as the Government Electricity Rebate.
- DECC measures the impact on the average bill across all household types, with a separate assessment of impacts across the household distribution, including across expenditure, household composition, and main heating fuel. We take as our primary focus a typical "dual-fuel" household (gas heating and electricity for lighting and appliances) and separately report results for non-typical households (e.g. households with electric heating).
- The CCC's approach to energy efficiency is different in that we separately estimate the cost of low-carbon policies and the potential for energy efficiency savings, rather than providing a single calculation for the net impact on bills of all policies. DECC includes the savings from efficiency within their estimate of projected bills.
- Our costs are in line with scenarios set out in our 2014 Progress Report, so they include measures we assume are needed to meet the fourth carbon budget. DECC's estimates include the costs and savings only from those policies that are already in place or planned to a sufficient degree of detail.

There are further minor differences, which we set out in full in the technical annex.

Adjusting for the differences in approach, our estimate of the impact of low-carbon policies on current bills closely matches DECC's assessment.

Notes: All numbers in £2014 and include VAT.

3 DECC (September 2014) *Quarterly Energy Prices*. Available at: www.gov.uk.

4 Ofgem (August 2014), *Supply Market Indicators*. Available at: www.ofgem.gov.uk.

5 DECC (2014) *Estimated impacts of energy and climate change policies on energy prices and bills*. Available at: www.gov.uk.



2.2 Changes in household energy bills since 2004

(a) Changes in household energy demand

Energy bills have changed over the last decade due to changes in both energy prices and levels of consumption. Gas and electricity consumption in the residential sector have declined by 13% and by 9% respectively between 2004 and 2013, despite an 8% increase in the number of UK households to just over 27 million during the period. This implies that average energy consumption per household has fallen by 19% from 2004 to 2013.

Gas consumed for space heating and hot water has declined by around a third since 2004 for the typical dual-fuel household in the UK. This reflects improvements in boiler efficiency and insulation along with a reduction in internal temperatures, while average dwelling size (90m²) and household size (2.4 people) remained broadly the same:

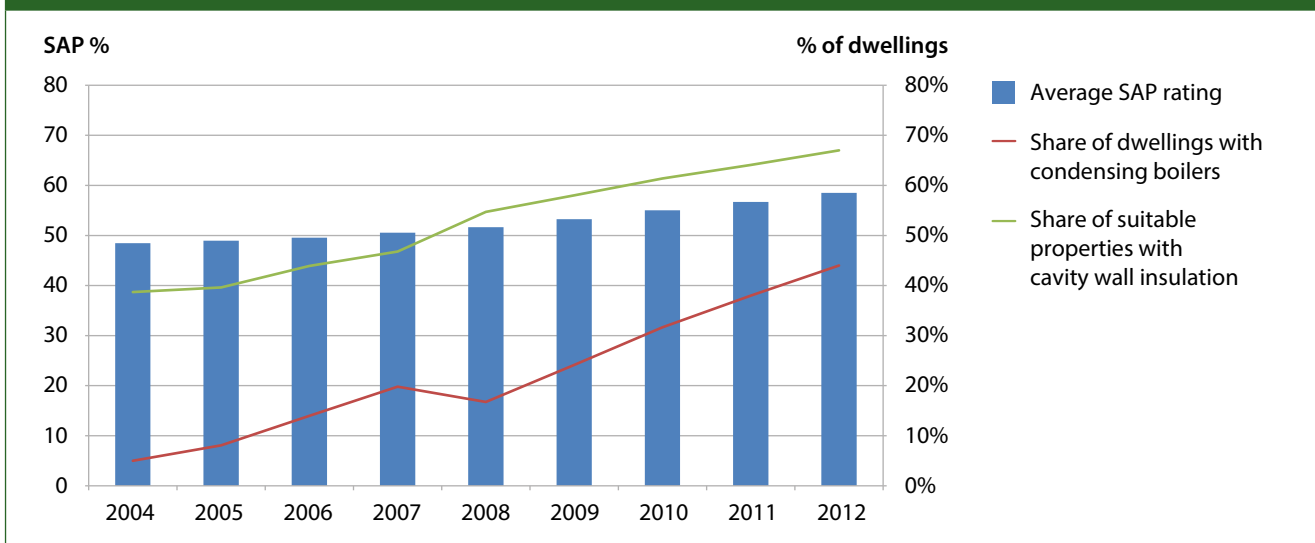
- **Boiler efficiency:** The Building Regulations of 2005 introduced stricter energy efficiency standards for boilers. As a result, the share of efficient gas and oil condensing boilers has increased to around 40% of the stock and the average boiler efficiency has increased from 72% to around 82%.
- **Hot water efficiency:** Since 2004, energy use for hot water has declined by 8%. This reflects more efficient heating systems (e.g. condensing boilers), and improved insulation of tanks and pipes reducing heat loss from stored hot water.
- **Fabric insulation:** There has been an increase in the number of homes that have loft and cavity wall insulation from 27% and 39% in 2004 to 68% and 67% in 2013 respectively. Cavity wall insulation alone can reduce gas consumption for a three bedroom semi-detached house by around 1,900 kWh (14%). The combination of efficiency improvements in boilers and from insulation has led to an increase in the average SAP⁶ rating of the existing housing stock from 48 in 2004 to 59 by 2012. Meanwhile, tighter energy efficiency standards in the Building Regulations now deliver a typical SAP rating of 80 for new-build homes (Figure 2.3).
- **Indoor temperatures:** The long-term increase in the average indoor temperature appears to have peaked⁷ at 18.5°C in 2005 and has since declined by around 1°C. This seems to reflect a reduction in the duration and number of rooms heated rather than lower thermostat settings⁸. This is likely to have been a response to rising energy prices during this period, and more recently the economic recession.

6 The Standard Assessment Procedure (SAP) is the Government's method for assessing the energy performance of homes (space heating, hot water and lighting). SAP ratings are expressed on a scale of 1 to 100 – the higher the number, the more efficient the home.

7 Average internal temperatures increased by 54% between 1970 and 2005. DECC (2014) *Energy Consumption in the UK*. Available at: www.gov.uk.

8 DECC (2013) *United Kingdom housing energy fact file 2013*. Available at: www.gov.uk

Figure 2.3: Improvement in average SAP rating, 2004 to 2013



Source: CLG (2013) *English Household Condition Survey*, DECC (2014) *Energy Consumption in the UK*

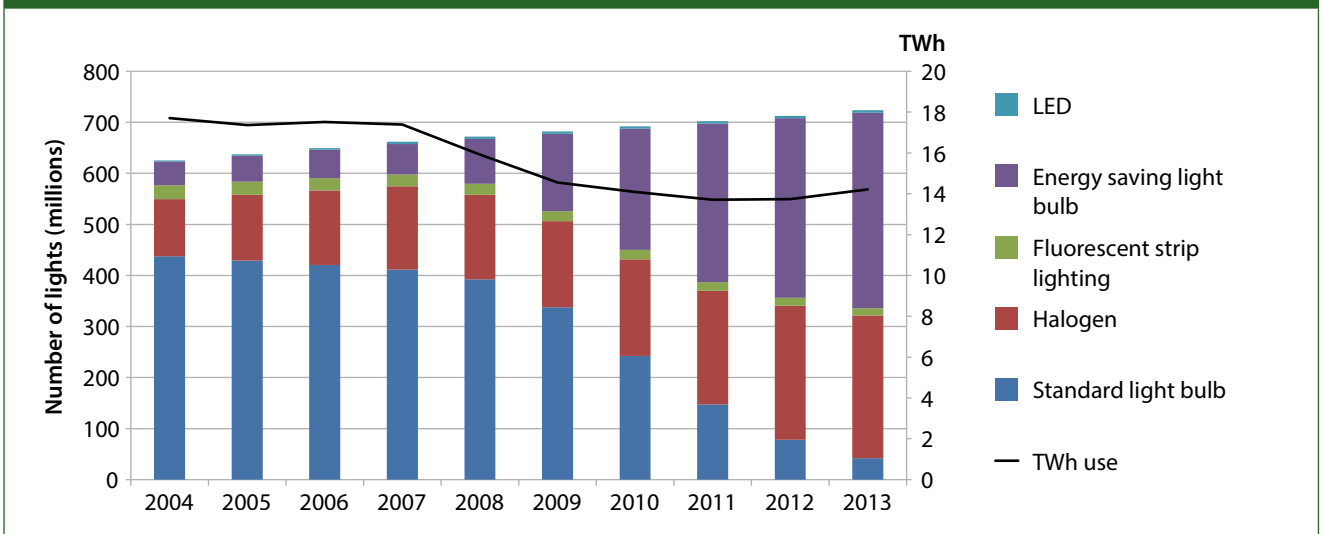
Note: Using energy efficiency rating band SAP 2009

Electricity use by the typical dual-fuel household has fallen by around 16% between 2004 and 2013. Improvements in energy efficiency have more than offset an increase in appliance ownership and use.

- **Lighting:** The number of light bulbs in households increased by 16% between 2004 and 2013 but a large switch to efficient lighting such as energy saving light bulbs and light emitting diodes (LEDs) has improved the overall efficiency of the stock. DECC estimates that by 2013 inefficient incandescent bulbs accounted for only 6% of the stock (compared to 70% in 2004), while the share of efficient light bulbs increased from 7% to 53%. As a consequence, electricity use for lighting has declined by around a fifth despite the increase in the number of light fittings (Figure 2.4).
- **Appliances:** There has been a general trend of rising numbers of electrical appliances, with cold and wet appliances in the stock increasing by 10% and 20% respectively during the period. However, this has been more than offset by a rise in the energy efficiency of these products driven by EU minimum standards. For example, only 11% of the stock of fridge-freezers in 2004 had an energy efficiency rating of A or above. By 2013, this share had increased to 65%. The annual electricity use of the most efficient A++ fridge-freezer of 165 kWh compares to 430 kWh for the average appliance (Figure 2.5).

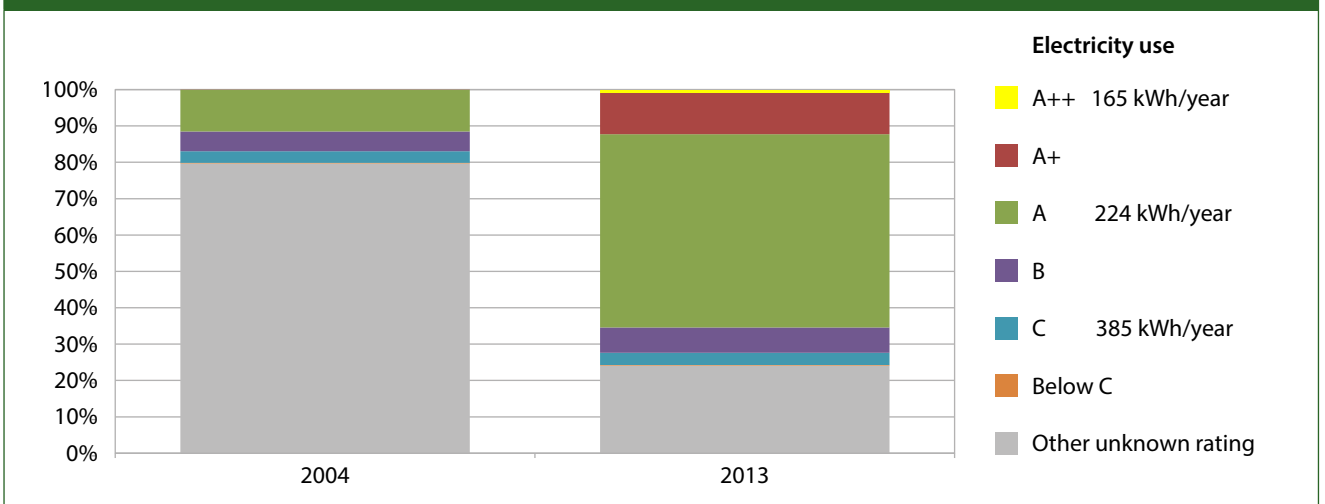


Figure 2.4: Increased efficiency of lighting, 2004 to 2013



Source: DECC (2014) *Energy Consumption in the UK*

Figure 2.5: Stock of fridge freezers by energy rating, 2004 to 2013



Source: DECC (2014) *Energy Consumption in the UK*, Energy Saving Trust.

Notes: Electricity consumption based on an average size of 253 litres with frost-free fridge.

Although consumers are using energy in more applications now compared to ten years ago, actual energy consumption has fallen as the efficiency of energy use has improved. However, this has only partly offset larger increases in energy prices, resulting in higher overall energy bills, which we consider in the next section.

(b) Changes in household energy prices and bills (2004 – 2013)

Changes in electricity bills

As set out in Chapter 1, the average electricity retail price doubled from 7.5 p/kWh in 2004 to 15.1p/kWh by 2013⁹ in nominal terms, compared to the general rate of inflation of 23%¹⁰:

- Costs due to supporting low-carbon electricity investment (including the carbon price) accounted for 18% (1.4 p/kWh) of the increase while the costs of funding energy efficiency measures increased by 0.6 p/kWh to 0.7 p/kWh (Box 2.4).
- Half of the increase in the bill can be attributed to the rise in the cost of wholesale electricity, while other costs associated with running the network such as transmission, distribution and balancing account for a further fifth of the overall increase.

Box 2.4: The Energy Company Obligation and Warm Home Discount

There are two policy instruments which aim to improve energy efficiency in the residential sector and energy affordability for low income and vulnerable households, the costs of which are recovered through the energy bill:

The Energy Company Obligation (ECO)

The ECO is a legal obligation on energy suppliers introduced in 2013 to improve the energy efficiency of households and achieve carbon emissions reductions. It consists of three separate obligations and is expected to run until at least 2017:

- Carbon Emissions Reduction Obligation (CERO): obliges energy suppliers to reduce CO₂ emissions in the residential sector by encouraging the uptake of energy efficiency measures. It was initially focused on the more expensive measures such as hard-to-treat cavity wall insulation and solid wall insulation, but has now been extended to cover cavity wall and loft insulation.
- Carbon Saving Community Obligation (CSCO): A target to deliver CO₂ savings in low-income and rural areas.
- Home Heating Cost Reduction Obligation (HHCRO): The 'Affordable warmth' programme obliges energy suppliers to deliver energy bill reductions (£4.2 billion of lifetime cost savings) in fuel poor and low-income households.

Annual ECO spending by energy suppliers was around £1.4 billion in 2013, adding around £50 to household energy bills. The Government reduced the carbon target from April 2014 under the CERO. It expects to bring down the costs to £0.8 billion (£35 per household), with around two-thirds of this spent to deliver CSCO and HHCRO, which focus on the fuel-poor and other low-income homes.

Warm Home Discount Scheme (WHD)

The WHD was introduced in 2011 and is an obligation on energy suppliers to assist low-income households:

- It provides a rebate on electricity and gas bills, equivalent to an average of around £120 in 2013/14.
- Around 2 million households are eligible. Initial funding of £250m in 2011/12 will rise to £310m by 2014/15, the final year of the scheme.

The cost of the WHD is recovered through the energy bill and is equivalent to around £12 a year per household.

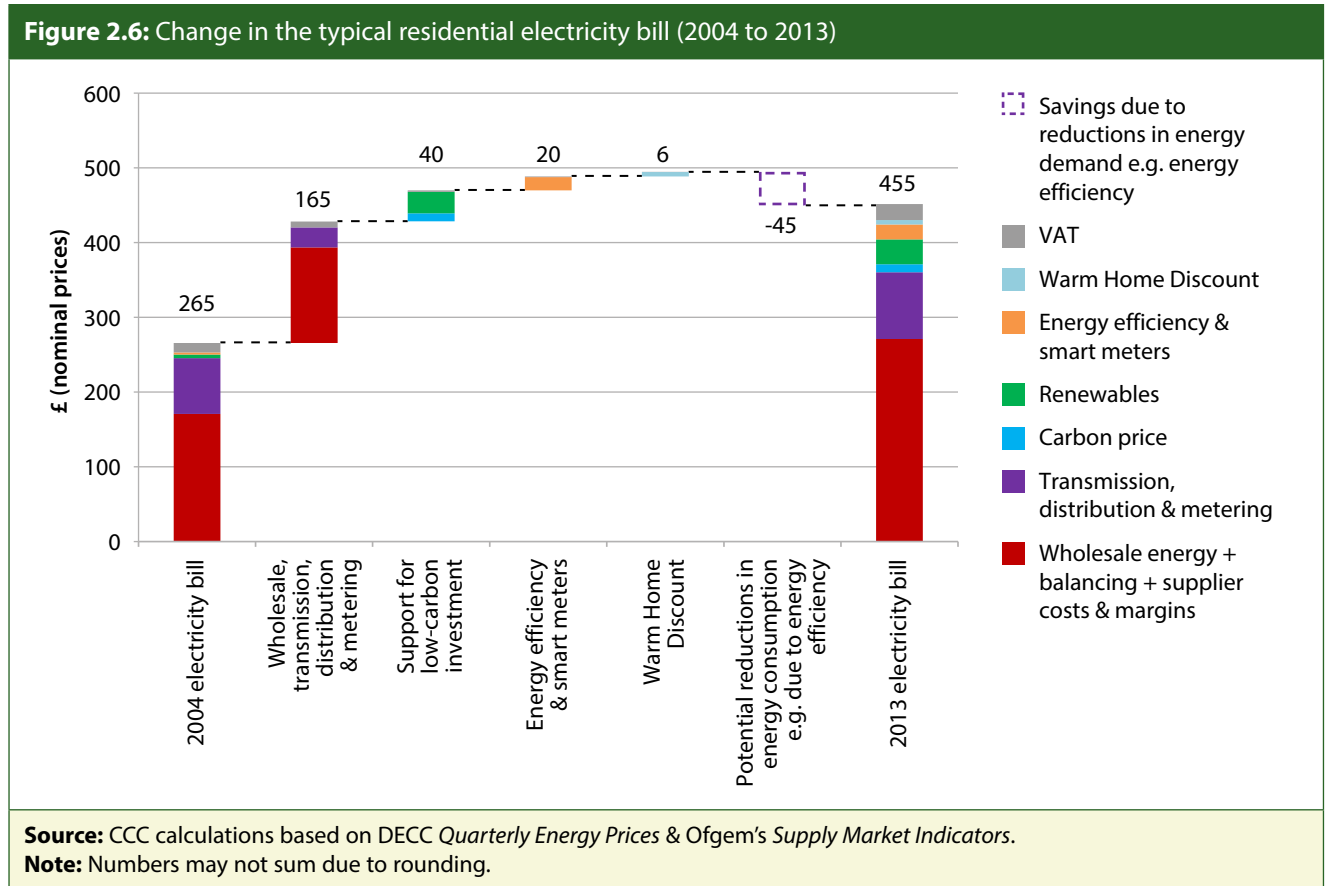
As part of the package to reduce energy bills, all householders will be given a £12 rebate off their electricity bill from October this year, with a further rebate due in autumn 2015. This effectively offsets the costs of the WHD.

9 All prices are nominal for 2004, and 2013 values are in real prices. All prices quoted include VAT.

10 We use an inflation rate based on the GDP deflator to allow comparisons across sector. The consumer price index increased by 29% during the same period.



The doubling in the electricity price has more than offset the 16% reduction in electricity consumption of the average dual-fuel household. As a result, the average annual electricity bill for dual-fuel households increased from £265 to £455 between 2004 and 2013. Without the reduction in electricity consumption, due in part to improvements in energy efficiency, the 2013 bill would have been a further £45 higher (Figure 2.6).



Changes in gas bills

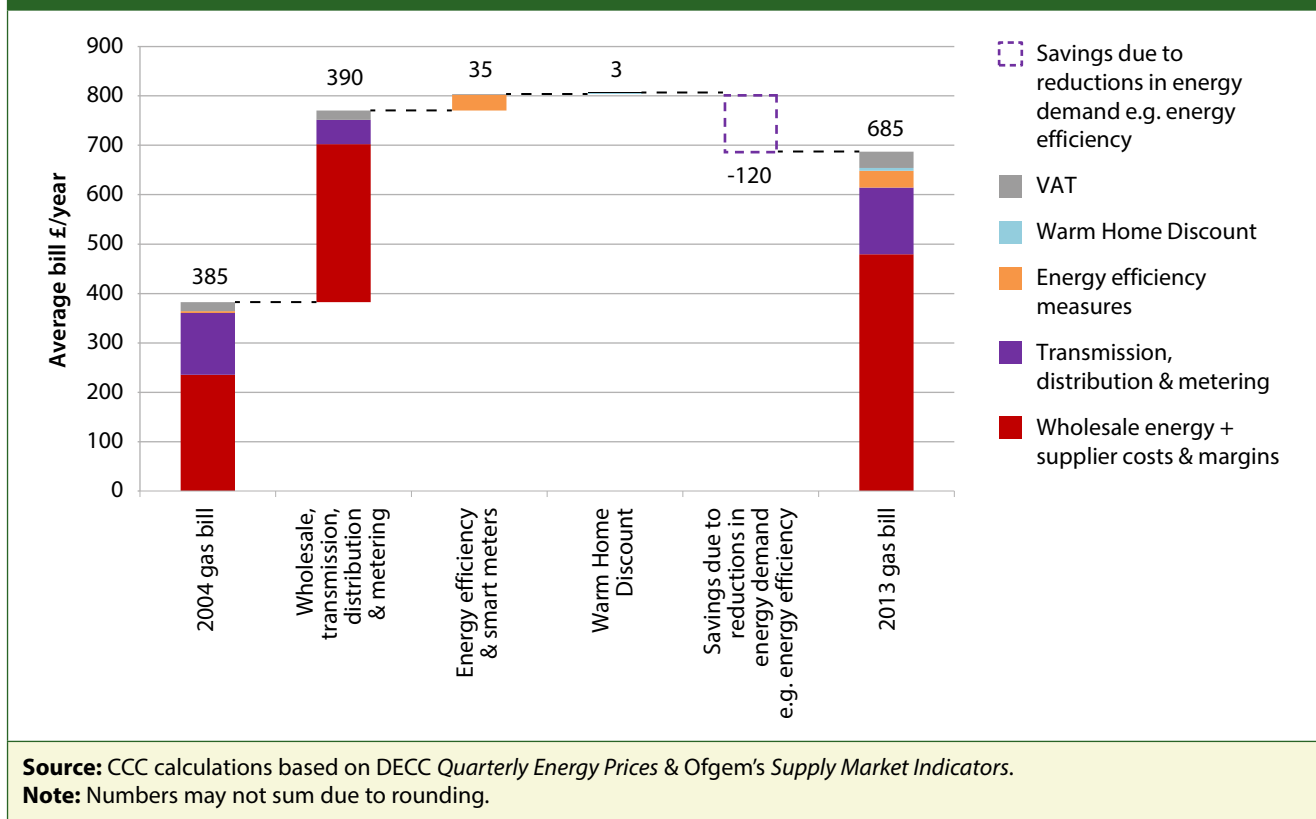
The average retail gas price for the residential sector increased by 158% in nominal terms from 1.9 p/kWh to 4.9 p/kWh between 2004 and 2013:

- The rising cost of wholesale gas to 3.6 p/kWh accounted for most (79%) of the overall increase, while the cost of transmission, distribution and metering accounted for 11% of the increase.
- Funding of energy efficiency measures (up 0.2 p/kWh), and the combined cost of the Warm Homes Discount and early stages of smart metering (up 0.2 p/kWh) accounted for 10% of the rise.

The increase in the gas price outweighed the decline in gas consumption over the period, which fell by a third¹¹. Therefore, the average gas bill for a dual-fuel household increased by £300 to £685 in 2013. Without reduced gas consumption largely resulting from energy efficiency improvements the bill would have been £120 higher (Figure 2.7).

¹¹ Gas consumption based on an adjustment for temperature.

Figure 2.7: Change in the typical residential gas bill (2004 to 2013)



Combined dual-fuel energy bill in the residential sector

We now consider the combined impact of changes to gas and electricity bills on the total dual-fuel bill for UK households between 2004 and 2013.

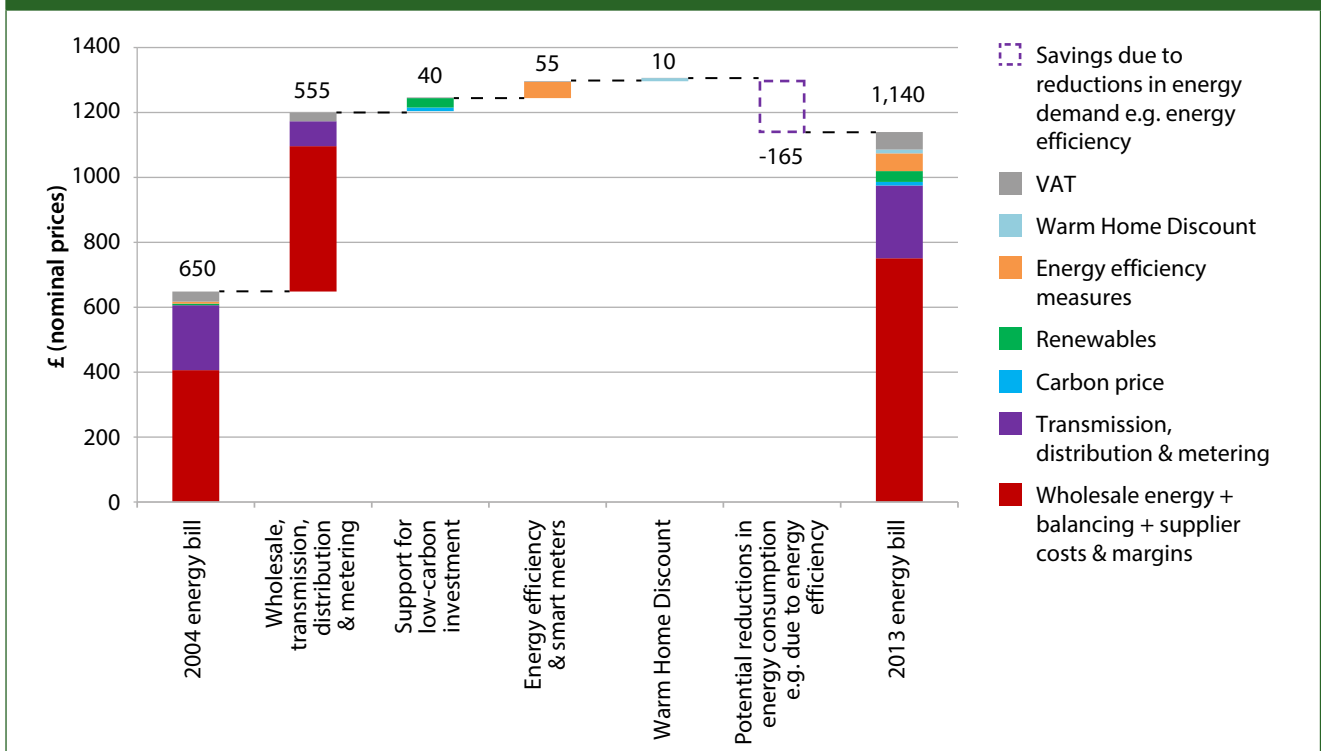
The annual energy bill increased by 75% in nominal terms from £650 in 2004 to £1,140 in 2013 for the typical dual-fuel household. Of the £490 increase, around 80% was associated with rising costs of wholesale energy and system costs and therefore unrelated to low-carbon policy.

- Wholesale, supplier and balancing costs accounted for a £360 increase in the energy bill, with a further £25 coming from transmission, distribution and metering.
- Support for low-carbon investment added £40, of which £10 was due to the carbon price, and £30 from additional support for low-carbon power generation support. This accounted for 8% of the overall increase.
- Support for energy efficiency measures, including costs of smart meter roll-out, added another £50 accounting for 10% of the increase in the bill. This also has social benefits given that much of the support goes to low-income or fuel poor households.
- The introduction of the Warm Home Discount in 2011 added £10 to the bill.

The reduction in energy use from 2004 to 2013, which was largely due to energy efficiency, more than offset increased appliance use. In the absence of this reduced consumption, the combined energy bill would have been £165 higher in 2013 (Figure 2.8).



Figure 2.8: Changes in the typical dual-fuel bill (2004 to 2013)



Source: CCC calculations based on DECC *Quarterly Energy Prices* & Ofgem's *Supply Market Indicators*.

Note: Numbers may not sum due to rounding.

The increase in energy bills since 2004 is largely a consequence of the rising wholesale price of gas and other factors unrelated to support for low-carbon investment.

2.3 Outlook for household energy bills to 2020 and 2030

We estimate household dual-fuel bills to 2020 and 2030 based on the assumptions about power sector decarbonisation and fuel price developments discussed in detail in Chapter 1.

(a) Outlook for electricity prices and bills

In Chapter 1, we identified that low-carbon measures would increase the electricity price by 1.7 p/kWh from 2013 to 2020 and by a further 2.3 p/kWh to 2030¹². This supports investment required to decarbonise the UK electricity sector from its current level of 500 gCO₂/kWh to 50-100 gCO₂/kWh by 2030, and is based on the Government's central assumption for an increasing carbon price (Figure 2.9).

Assuming that electricity consumption remains unchanged from 2013 levels, and applying DECC's central scenario for future fossil fuel prices, the increase in low-carbon policy costs would be partially offset by a reduction in wholesale and system costs, resulting in an overall electricity bill increase of £10 to £465 between 2013 and 2020:

- The carbon price element is estimated to rise by £15 and the remaining policies supporting low-carbon generation (i.e. renewables support through the Renewables Obligation and Feed-in Tariffs, CCS demonstration) another £40.

¹² 2013 prices.

-
- Wholesale energy costs, TDM and balancing are projected to fall by £25 by 2020 DECC's central scenario for fossil fuel prices.
 - We assume that in 2020, there is no charge on the bill for Warm Home Discount (WHD). In 2014 and 2015, the WHD costs are being offset by the Government Electricity Rebate. We assume this could continue or that the WHD could be paid for through general taxation.
 - We assume the rate of VAT and costs of funding energy efficiency (excluding smart meters) remain constant to 2030. Our assumption on energy efficiency funding reflects that the level in 2013, if continued, would be enough to fund the cost of measures included in our scenarios for meeting carbon budgets (see Chapter 1).

The total impact from low-carbon policies could range between £25 and £75 depending on gas and carbon prices (see Chapter 1). Higher costs from low-carbon policies (£75) would occur in a scenario with low gas prices and a high carbon price but the total electricity bill would be lower in this case.

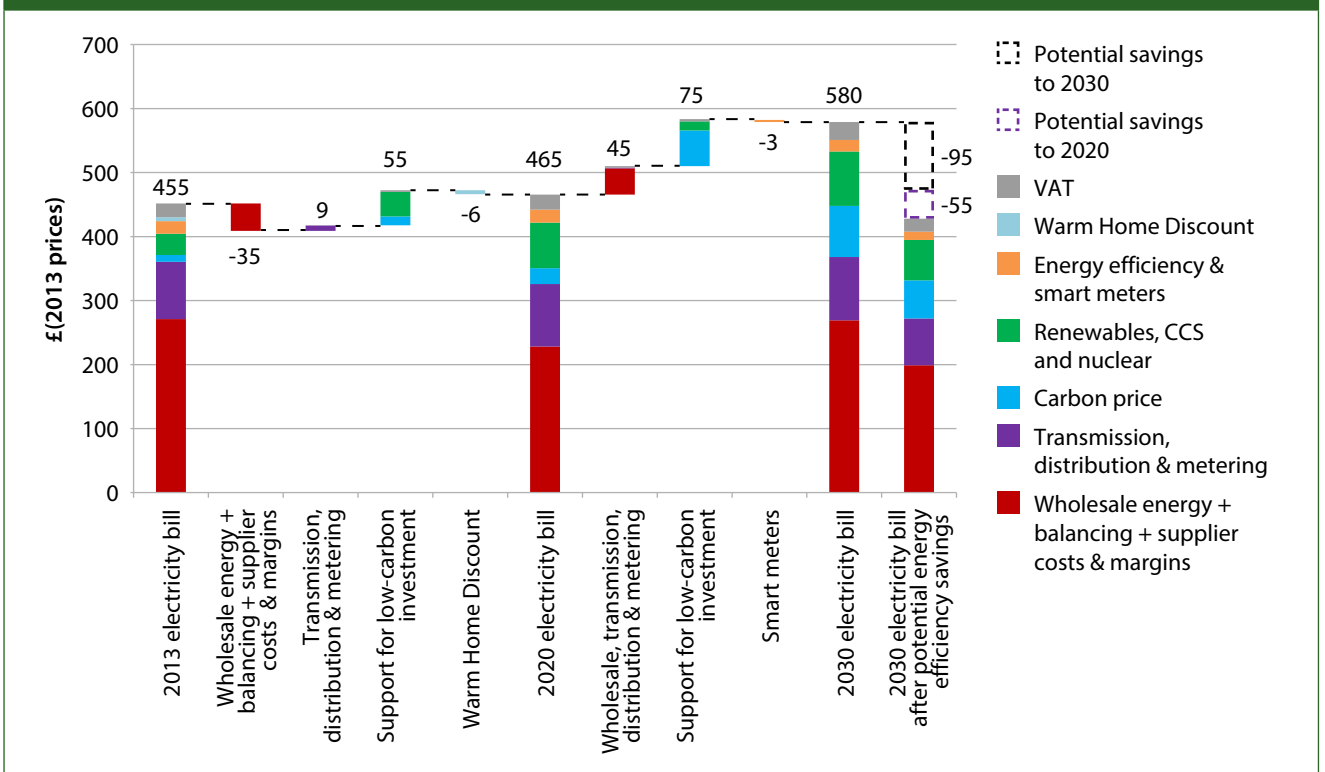
In the 2020s, we estimate that the carbon price and support for low-carbon generation would add a further £75, on central assumptions. Wholesale energy costs would also increase bills, so that the total electricity bill would reach a total of £580 by 2030:

- There is a £60 increase due to the assumed rise in the carbon price to £76/tCO₂.
- Costs of direct support for low-carbon electricity generation are estimated to increase by £15 per household from 2020 to 2030. There will also be a £1 reduction due to the end of legacy costs from the Renewables Obligation. Subsidies under the Renewables Obligation last for 20 years, and will end for capacity commissioned before 2010.
- Increases in wholesale energy and other system costs add a further £45 to electricity bills from 2020 to 2030.

The total impact of low-carbon policies in the 2020s ranges between a £45 and a £115 increase, depending on gas and carbon prices. The impact would be higher under a scenario of low gas prices, but given the savings from a lower gas price, the net impact would be a lower bill than in the central scenario.



Figure 2.9: Changes in the typical electricity bill (2013, 2020 & 2030)



Source: CCC calculations.

Note: Numbers may not sum due to rounding. Potential savings at 2030 prices.

Energy efficiency opportunities

To offset these increases, there are opportunities to reduce the electricity bill. Based on the assumptions that underpin our fourth carbon budget scenario¹³, we estimate that the take-up of energy efficiency measures, together with behaviour change (e.g. turning lights off) can deliver average savings by 2030 of £55 per household from measures installed between 2013 and 2020 and a further £95 from additional measures taken up in the 2020s. If these savings are realised, they would more than offset the increase in support for the low-carbon investment, reducing the estimated electricity bill from £580 to £430 by 2030. Key measures for savings include efficient appliances, lighting, fabric measures and behaviour change (Table 2.1).

¹³ Our fourth carbon budget scenario assumes electricity savings of 8 TWh between 2013 and 2020 and a further 15 TWh between 2020 and 2030 for all households, not just dual-fuel.

Table 2.1: Main measures to reduce electricity consumption by 2030

Energy efficiency measure	Savings averaged across housing stock (kWh/household)	Savings averaged across housing stock (£/household)
Efficient appliances (e.g. fridges and washing machines)	260	£50
Televisions (primary and secondary sets)	225	£45
Efficient lighting	220	£40
Fabric measures (e.g. cavity wall and lofts insulation)	35	£5
Other measures e.g. behaviour change (e.g. turning off lights, reduced flow showers)	40	£10
Total	780	£150

Source: CCC calculations.
Note: Fabric measures excludes solid wall insulation as the capital and installation costs would, in many households, exceed the savings; numbers are rounded.

(b) Outlook for gas prices and bills

Existing and planned policies should not add any further costs to gas bills beyond the £30 already paid towards energy efficiency improvement in the 2013 bill, and a further £5 from smart meters.

- Energy efficiency improvements assumed in our scenarios for meeting carbon budgets, including 1.5 million solid wall installations in the 2020s, could be funded within the 2013 costs on bills.
- The roll-out of smart-metering to the residential sector is estimated to start delivering net cost savings by the mid-2020s.

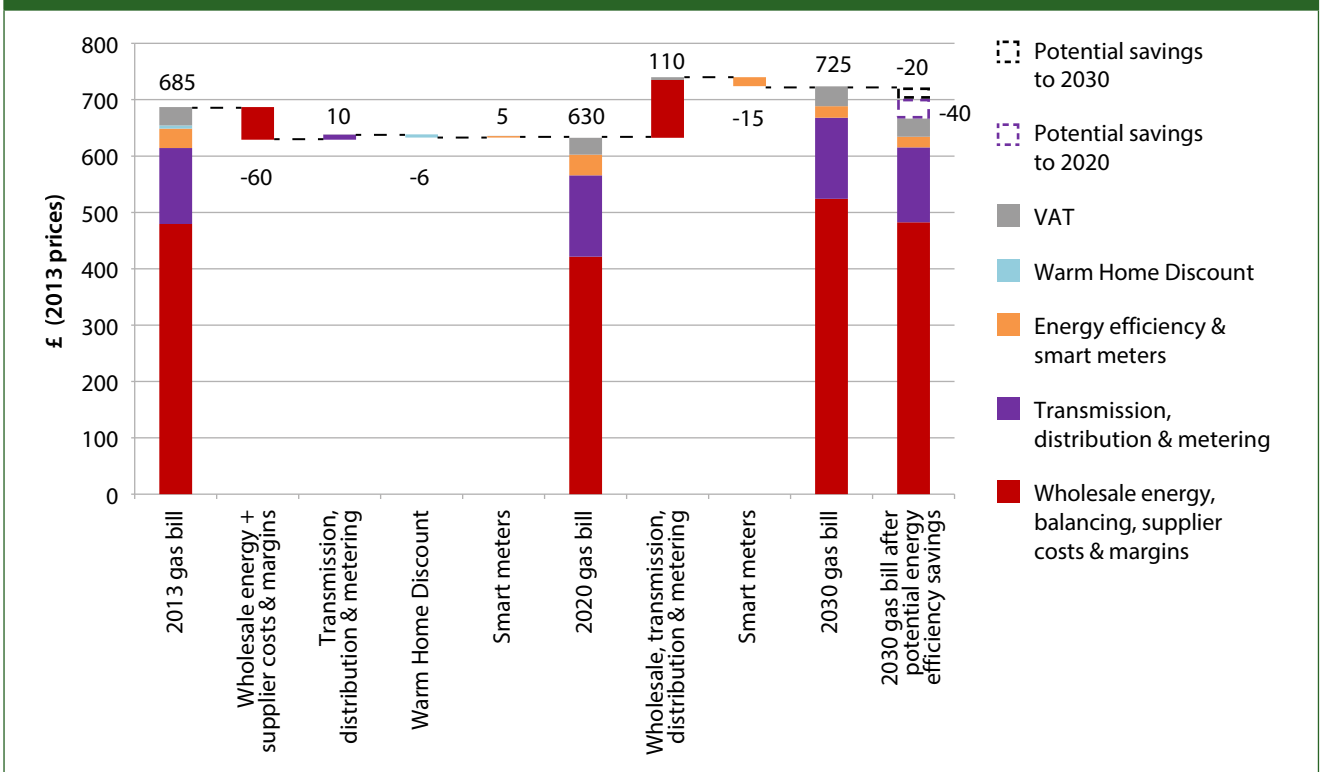
Our fourth carbon budget scenarios assume that 4 million heat pumps are deployed in homes by 2030. However, costs associated with the shift to low-carbon heat are not currently recovered from energy bills, with the Renewable Heat Incentive being paid for by the Exchequer. It is possible that this model may need to change in future, but we note that the net costs of installing heat pumps (around £1 billion per annum) is lower than the combined fiscal revenues of the EU ETS (support for the carbon price), CRC and CCL (around £1.4 billion), which are all currently passed on through energy bills.

Under DECC's central gas price scenario the retail gas price for households would decline from 4.9 p/kWh in 2013 to 4.5 p/kWh by 2020. It would then rise in the 2020s to 5.1 p/kWh by 2030.

On this basis, the average gas bill for a dual-fuel household would decline by £55 to £630 (in real terms) by 2020, before rising by £95 to £725 by 2030. All of this increase would be due to rising wholesale gas costs, while DECC estimates that the roll-out of smart meters could reduce the bill in 2030 by £15 compared to 2020 (Figure 2.10).



Figure 2.10: Changes in the typical gas bill (2013, 2020 & 2030)



Source: CCC calculations.

Note: Numbers may not sum due to rounding. Potential savings at 2030 prices.

Energy efficiency opportunities

As for electricity, there are considerable opportunities to reduce gas bills through improvements in the energy efficiency of heating systems and insulating homes:

- Replacing boilers at the end of their lives with more efficient new boilers could reduce annual bills in 2020 by around £75 in households making the replacement, or by around £20 when averaged across all households.
- In our review of the fourth carbon budget, we identified potential by 2030 to insulate a further 7 million homes with cavity walls and to top-up insulation in an additional 9 million lofts.

Alongside some other measures like floor insulation and improved glazing, these would deliver an average bill reduction by 2030, allowing for capital costs, across all households of £40 from measures taken up between 2013 and 2020 and a further £20 by 2030 from additional measures in the 2020s. Key measures to reduce gas consumption include building fabric insulation, hot water tank insulation and installation and use of heating controls (Table 2.2).

Overall, there is scope for energy efficiency improvements to reduce the gas bill by £60 (7%) to £665 by 2030.

Table 2.2: Main measures to reduce gas consumption by 2030

Energy efficiency measure	Savings averaged across housing stock (KWh/household)	Savings averaged across housing stock (£/household)
Condensing boiler	385	£20
Cavity wall insulation	355	£20
One degree centigrade decrease in thermostat setting	250	£15
Reduced flow showers	180	£10
Hot water tank insulation	120	£6
Heating controls	90	£5
Loft insulation	80	£3
Other measures (e.g. double glazing, floor insulation)	210	£10
Total	1,115	£60

Source: CCC calculations.
Notes: Total household savings take account of increased gas use due to having more efficient appliances and lighting ('heat replacement effect'). Savings averaged therefore do not add up to the total. Fabric measures exclude the uptake of solid wall insulation given the gas savings would not, in many households, offset the high capital and installation costs; numbers are rounded.

(c) Outlook for combined dual-fuel energy bill

We now combine our analysis of typical electricity and gas bills for the 87% of households in the UK that use natural gas for space heating, hot water and some cooking. Our analysis suggests that the costs of low-carbon policies will increase by £55 between 2013 and 2020 (Figure 2.11). The carbon price would account for £15 and low-carbon generation support for £40, assuming DECC's central gas price scenario. Overall however, the bill could decrease from £1,140 to £1,100 over the period, driven by a £105 reduction in the costs of wholesale energy, supplier costs and margins in a central case.

Post 2020, we estimate a £205 increase in the combined bill from £1,100 in 2020 to £1,305 by 2030, partly driven by increasing costs of low-carbon generation support:

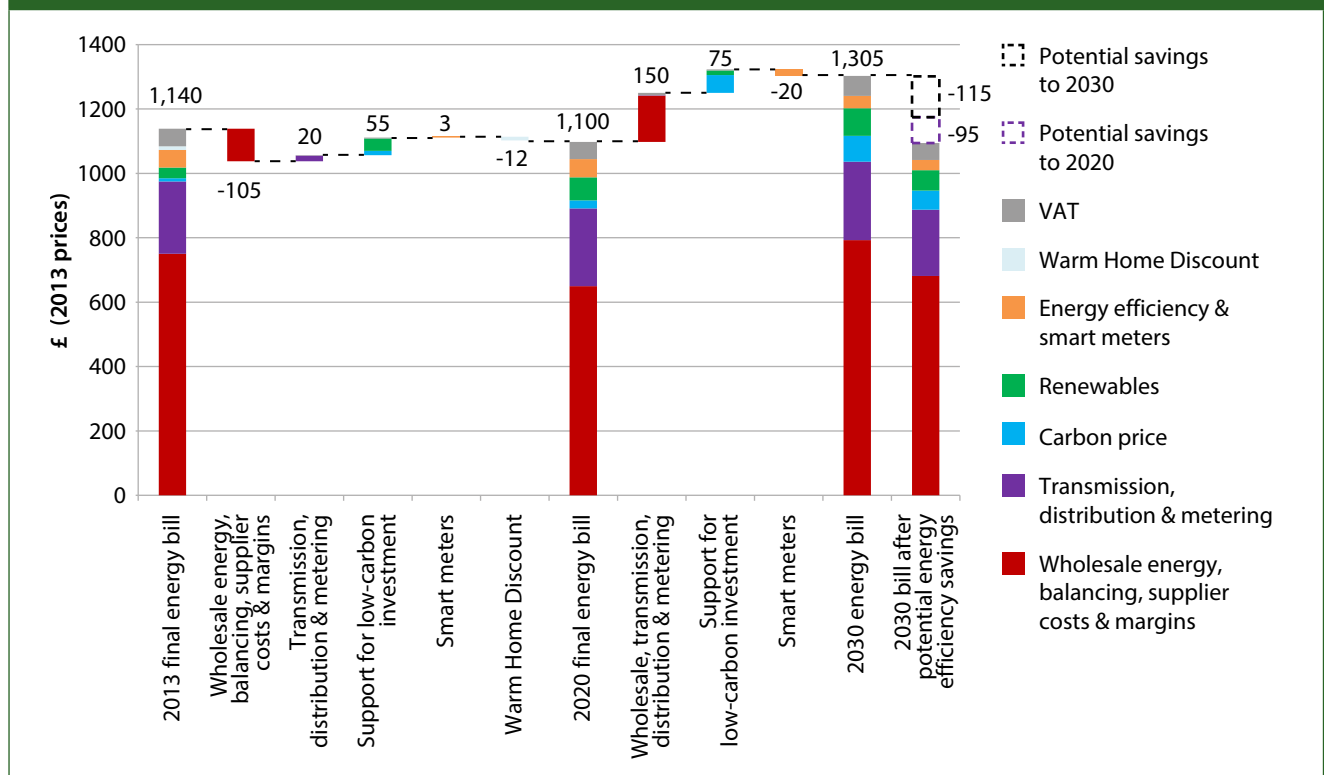
- Under DECC's central gas price scenario, support for low-carbon investment accounts for around 45% of the estimated increase, equivalent to £75 (ranging between £45 and £115 depending on the gas and carbon prices). Within this, £60 is due to the carbon price and the remaining £15 related to direct support for low-carbon investment.
- The additional costs of wholesale energy, supplier costs and margins, assuming DECC's central gas price scenario, account for around £150 of the increase by 2030.
- DECC assumes that the roll-out of smart metering will be delivering bill savings of £20 compared to 2020.



These estimates are for a central case. However there is considerable uncertainty around them, for example related to projected gas and carbon prices (Table 2.3). The total cost impact of low-carbon policies could range between £45 and £115 depending on gas and carbon prices, with the higher low-carbon cost occurring in a scenario with low gas prices, although the total dual-fuel bill would be lower in this case.

These uncertainties demonstrate that low-carbon investment acts to reduce volatility in energy prices and energy bills by reducing exposure to uncertain fossil fuel and carbon prices.

Figure 2.11: Changes in the typical dual-fuel bill (2013, 2020 & 2030)



Source: CCC calculations.

Note: Numbers may not sum due to rounding. Potential savings at 2030 prices.

Table 2.3: Range of low-carbon policy costs and bill impacts in different scenarios

Scenarios	Change in low-carbon policy costs (2013-2020)	Change in overall bill (2013-2020)	Change in low-carbon policy costs (2020-2030)	Change in overall bill (2020-2030)
Central scenario	£55	£-40	£75	£205
High gas price	£50	£225	£30	£180
Low gas price	£60	£-195	£120	£100
High carbon price	£70	£-25	£70	£200
Low carbon price	£30	£-65	£85	£220
High gas price & low carbon price	£25	£205	£45	£195
Low gas price and high carbon price	£75	£-180	£115	£95

Source: CCC calculations.

Energy efficiency opportunities for individual homes

Energy efficiency improvements provide opportunities to offset some of the increase in the energy bill. This includes the replacement of old inefficient boilers, and the take-up of other energy efficiency measures and behavioural change. Taken together, these could reduce the typical dual-fuel bill by £210 by 2030.

On an individual household basis however, potential savings may vary considerably:

- Savings could be higher, where for example a property's thermal performance is poor and as a consequence energy demand is high (Table 2.4).
- If a household takes out a Green Deal plan, some of the savings would be used to pay back the capital costs of energy efficiency measures through the electricity bill.

Realising these savings is contingent on having effective policies in place to incentivise energy efficiency improvement. The reduction in funding for the remainder of the Energy Company Obligation, which is currently only committed until 2017, coupled with the poor performance to date of the Green Deal suggests that current policies are insufficient. Therefore, there is a need to strengthen incentives under current policies and introduce new ones in the future.

Table 2.4: Potential savings per individual household basis in 2020 and 2030: illustrative case with high savings potential

1950s semi-detached house	Energy use (kWh)	Total bill (2013)	Total bill (2020)	Total bill (2030)
Pre-installation of measures	Gas: 23,250 Elec: 4,650	£1,840	£1,770	£2,100
Savings from measures				
New condensing boiler			£80	£90
Cavity wall insulation			£85	£95
Suspended timber floor insulation			£35	£40
Efficient lighting			£10	£10
Total bill (post-insulation)	Gas: 19,680 Elec: 4,385		£1,565	£1,865

Source: Energy Saving Trust and CCC calculations.



(d) Outlook for non-dual fuel households

The analysis presented above covers the majority of UK households (around 87%) who consume both mains gas and electricity (dual-fuel). However, around 13% of households are not connected to the gas network and use other fuels to meet their requirements for space heating and hot water.

Electricity is the main alternative heating source for around 7% of UK households. These are mostly smaller properties, in particular flats, with a large proportion in the rental sector and with high levels of fuel poverty. As the costs of support for low-carbon investment is currently passed through the electricity bill, these households pay a higher proportion of their energy bill towards low-carbon policy costs than dual-fuel households. This will increase further to 2030:

- In 2013, we estimate the annual bill for a typical electrically-heated household¹⁴ was around £925 £90 of which was for support for low-carbon generation. This is based on an assumed demand of 7,800 kWh.
- We estimate that support for low-carbon generation will increase to £210 by 2020 (out of a total bill of £1,025) and to £360 by 2030 (out of a total bill of £1,255).
- Due to regional variations in electricity prices, some electrically-heated households face even higher bills (section 2.5).

However, there is scope to offset rising electricity prices. In addition to installing efficient lighting and appliances, replacement of an existing electric heater/storage unit with a low-carbon heat technology such as a heat pump can reduce the electricity bill (Box 2.5).

Box 2.5: Illustrative case study: Reducing the heating bill by installing an air-source heat pump

The impact of rising electricity prices for an electrically-heated household can be reduced significantly by switching to a low-carbon heat technology. In this example, the existing heating technology is an electric resistance system (e.g. storage heater) on an Economy 7 tariff.

Based on electricity demand for space heating and hot water only of 9,800 kWh (this would be for a household with higher consumption than our typical electrically-heated home), the estimated electricity bill for heating in 2020 would increase to £1,140 compared to £975 in 2013. By switching to an air-source heat pump (ASHP), the household could reduce the heating portion of the electricity bill by just over half to £540 by 2020. The Renewable Heat Incentive (RHI) is designed to offset the additional capital costs of the heat pump:

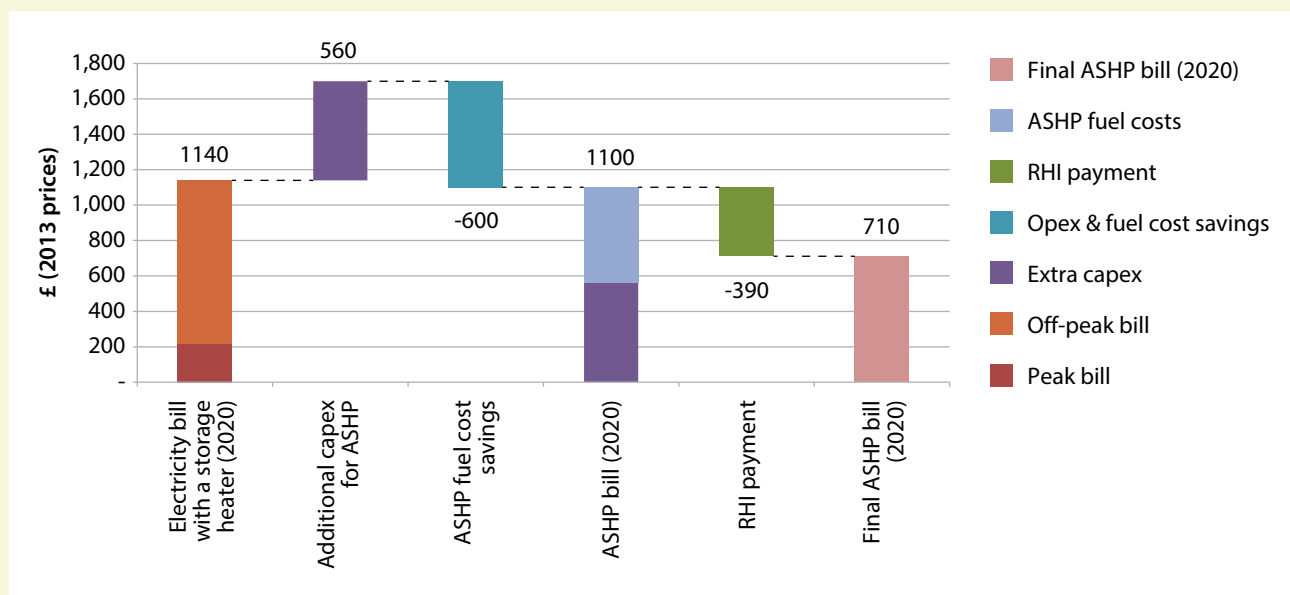
- **Reduced electricity use:** Due to the higher efficiency of an ASHP, around a third less electricity is required as an input to meet the same thermal level of output compared to a resistive heater, such as an electric storage heater. As a result, electricity costs in our example fall by £600 to £540.
- **Renewable Heat Incentive (RHI):** The additional costs of buying and installing a heat pump, which in our example totals £560 (annualised over 7 years), are partly offset by the RHI. This scheme provides a guaranteed payment for each unit of heat produced from a renewable heat technology. The 7.3 p/kWh tariff for an ASHP would provide an annual income of around £390 for the first seven years for a heat pump generating 5.3 MWh/year of heat output.

The combined impact of switching to an ASHP would reduce the total cost of heating by £430 to £710 in 2020 (Figure B2.5).

¹⁴ As these are smaller properties, typical energy consumption is lower than for dual-fuel households. We use electricity consumption of 7,800 kWh, which is the revised high median Typical Domestic Consumption Value (TDCV) used by Ofgem. It compares to 3,000 kWh for electricity and 14,000 kWh for gas in dual-fuel households. Electricity prices are based on an Economy 7 Tariff.

Box 2.5 Case study: Reducing the heating bill by installing an air-source heat pump

Figure B2.5: Energy savings by switching from a storage heater to an air-source heat pump (2020)



Source: CCC calculations.

Note: Additional CAPEX annualised at 7.5% over seven years.

Another 6% of UK households rely on other forms of fuel such as LPG, coal and oil for their heating requirements.

- The average total energy bill for a household using oil for heating¹⁵ was higher than for households with gas heating (at around £1,230 compared to £1,140) in 2013. This reflects the higher fuel costs. Using DECC central assumptions this would increase to £1,310 by 2020 compared to a decrease to £1,100 for dual-fuel households.
- The costs of energy efficiency are recovered through gas and electricity bills. Households that meet their heating requirements with other fuels do not pay for the element covered in gas bills and therefore, in respect of this element, paid £37 less than the average dual-fuel household in 2013.
- To run their appliances and for lighting, these households will incur the rising price of supporting low-carbon investment, as these costs are recovered through the electricity bill. They will therefore face a similar increase in the bill due to low-carbon policies, of around £55 by 2020 and £75 by 2030, as the typical dual-fuel household.

There are opportunities for these households to reduce energy bills through improvements in energy efficiency. Heating costs can be further reduced by switching to a low-carbon heat technology. However, given the projected retail price of heating oil, savings are generally only achievable when installing a ground-source heat pump (which attracts a higher RHI tariff), or when installing a biomass boiler and having access to a low-cost local supply of biomass.

¹⁵ Assuming the same heating demand as our typical dual-fuel household.



2.4 Fuel poverty impacts

The 2008 Climate Change Act requires us to consider the impacts of carbon budgets on fuel poverty.

Given that high energy prices are a key driver of fuel poverty, any policy that increases energy bills (without compensating measures) will have a negative impact on fuel poverty.

We recently commissioned the Centre for Sustainable Energy (CSE) to provide an in-depth analysis of the implications of meeting carbon budgets on fuel poverty levels,¹⁶ using the National Household Model (which has been developed for DECC). This included looking at the impact of fuel bill increases due to support for low-carbon generation, as well as the potential benefits from energy efficiency improvement and low-carbon heat options.

The results of this work have given us a clearer picture of the types of households who are currently fuel poor and how fuel poverty might develop under different scenarios.

(a) Who are the fuel poor?

A household is considered to be in fuel poverty when its members cannot afford to keep adequately warm at a reasonable cost, given their income. The exact definition of fuel poverty, which is a devolved matter, differs between England and the devolved administrations.

- England uses the Low Income High Cost (LIHC) definition. Households are considered fuel poor if they have required fuel costs that are above average (the national median level) and, were they to spend that amount, they would be left with a residual income below the official poverty line. In practice this means that people living in efficient homes with low fuel bills are generally unlikely to be considered fuel poor, as are those with high fuel bills and higher incomes. The definition also includes a measure of the severity of fuel poverty through the 'fuel poverty gap' (the fuel bill reduction required to take a household out of fuel poverty).
- Scotland, Wales and Northern Ireland use the 10% definition. A household is considered fuel poor if 10% or more of the household income (including housing benefit) is required to be spent on fuel to maintain an adequate level of warmth. Estimates of fuel poverty are higher under this definition and are significantly affected by energy price rises.

For illustrative and comparative purposes, CSE looked at both definitions for all the countries of the UK. Under the 10% definition, it is estimated that in 2013 there were a total of 5.6 million fuel poor households in the UK. The number under the LIHC definition is 2.9 million. The LIHC measure estimates the 2013 depth of fuel poverty at around £640 per household and an aggregate fuel poverty gap of around £1.8 bn.

Detailed analysis was undertaken to explore the key characteristic of fuel poor households. The results for the devolved administrations, under the 10% definition, are discussed in section 2.5.

16 CSE (2014) *Research on fuel poverty – The implications of meeting the fourth carbon budget*. Available online at http://www.theccc.org.uk/wp-content/uploads/2014/11/CCC_FinalReportOnFuelPoverty_Nov20141.pdf

For England only, the analysis identified nine distinct groups of fuel poor households (LIHC definition). The two largest single groups (together making up almost a third of fuel poor households) have a high predominance of electric heating. Several groups of fuel poor households have many of the characteristics of living in older homes (especially uninsulated solid wall homes);

- Rural, off-gas households with older occupants. This group of around 338,000 households (14% of the fuel poor population) has the largest mean fuel poverty gap (£1,350 vs £605 for the average of all fuel poor households). It comprises mainly owner-occupying older adults, in detached, uninsulated solid wall homes in rural areas. They are not connected to the gas grid and are mainly on oil and/or electric heating.
- Households in small, urban flats. Almost 400,000 households (17% of the fuel poor population) live in small, predominantly electrically-heated rented dwellings (flats and/or homes with uninsulated walls) in urban areas.
- Older homes in urban areas. Three otherwise distinct groups (families in large houses, single retired adults, out-of-work single parents in rented homes), making up around 736,000 households (30% of the fuel poor population), share the characteristic of living in older, uninsulated homes, mainly with solid walls.

Poor thermal performance is a common factor in all these fuel poor households and hence higher than average energy bills. Only about 20% of fuel poor households live in newer and/or better insulated homes. As discussed in section 2.3, those who live in homes that are electrically-heated are currently already paying the highest energy bills. This also has implications for the future, when electricity prices will increase due to low-carbon policies.

(b) Outlook for fuel poverty under carbon budgets

As discussed above, bill increases in recent years have been primarily due to factors unrelated to low-carbon policy support. However, it is important to understand how low-carbon policy costs that are passed-through to energy bills could affect fuel poverty in the future.

For illustrative purposes, one scenario modelled by CSE assumed that while low-carbon generation support costs¹⁷ are passed through to bills, there would be no energy efficiency improvements. The result was an increase in fuel poverty under both definitions.

- Under the 10% definition, fuel poor numbers increased from 5.6 million in 2013 to 8 million in 2030.
- Under the LIHC definition, the predicted increase is smaller (from 2.9 million to 3.1 million). This is to be expected as the LIHC definition compares energy costs in fuel poor households to those in typical (median) households, which would also see increasing costs. However, what does change is the severity of fuel poverty. For example, the CSE analysis showed an increase from a fuel poverty gap of £640 per household in 2013 to £875 in 2030 (or £1.8 bn to £2.7 bn for the aggregate fuel poverty gap).

¹⁷ The modelling was carried out earlier this year and therefore used our previous, slightly higher, estimates for low-carbon policy costs. The fuel poverty numbers presented here are therefore potentially a slight overestimate.



Households particularly affected would be those with electric heating (many of which live in urban flats or rural areas) and those which who are high energy users due to specific needs (e.g. the long-term ill or disabled).

Improving energy efficiency and a switch to low-carbon heat requires a strengthening of incentives under current policies and the introduction of new ones in the future. This would produce a significant reduction in fuel poverty numbers, while also meeting carbon budgets:

- Our fourth carbon budget scenarios include a large number of energy efficiency and low-carbon heat measures (including almost 6 million loft insulation top-ups, the insulation of a further 1.5 million cavity walls and more than 3 million solid walls, as well as the installation of 4 million heat pumps between now and 2030).
- We assume that to 2030, spending under the ECO (or a similar policy) would be around £1.4 bn per year (as was the case before the recent ECO cuts) and this would be passed through to bills. In addition, low-carbon heat measures would be supported through tax-payer funded policies (as is the case with the Renewable Heat Incentive at present).
- If some of these measures were targeted specifically at the fuel poor, the analysis shows that fuel poverty levels could be significantly reduced (to 3.3 million under the 10% definition and 2.2 million under the LIHC definition, with a reduced fuel poverty gap of on average £430 per fuel poor household).

Successful targeting of measures is not easy to achieve (e.g. due to data availability, people moving in and out of fuel poverty, and householders not always being willing or able to respond to offers of help) but would greatly improve the achievement of both fuel poverty and carbon targets at least cost. Evidence from Scotland and Wales suggests that area-based approaches (focusing on low-income areas more broadly, which will also capture households likely to become fuel poor in the future) and local authority involvement can be effective.

In England, the Government has recently announced that it would introduce a new statutory fuel poverty target based on energy performance. We support this approach¹⁸ but have also advised that the current ambition and funding commitments under the Energy Company Obligation are inadequate. Further funding is likely to be needed to meet carbon budgets and the proposed fuel poverty targets (e.g. return ECO spending to the previous rate of £1.4 bn per annum, as opposed to £0.8 bn, and introduce additional tax-payer funded policies).

¹⁸ CCC response to DECC's *Fuel Poverty Strategy*, October 2014 <http://www.theccc.org.uk/publication/letter-response-to-the-governments-fuel-poverty-strategy-consultation/>

2.5 Energy bills in the devolved administrations

The analysis elsewhere in this report is based on UK-wide average fuel prices and energy consumption. In this section we consider how fuel prices and consumption differ in the devolved administrations and we consider the implications for current and projected energy bills.

(a) Variations in household energy prices

Electricity prices vary across the UK according to supplier region. In 2013, the North of Scotland had the highest prices, while the East Midlands had the lowest. However, not all regions in the devolved nations had higher prices than the UK average. Differences reflect the variation in costs unrelated to low-carbon measures (e.g. higher supply costs per households in sparsely populated areas).

- Scotland: while the North of Scotland had the highest electricity prices (16.2 p/kWh), the South of Scotland price was 15.2 p/kWh, the same as the UK average.
- Wales: North Wales is the same supplier region as Merseyside which had the highest prices in England (16p/kWh), with South Wales slightly cheaper at 15.8 p/kWh.
- Northern Ireland had the second highest electricity prices (16.1 p/kWh).
- The picture is further complicated with Economy 7 and other time-of-use tariffs, where there are variations between regions in day and night time tariffs.

For the electricity bill of the average dual-fuel customer, the annual price difference between the cheapest and most expensive supply region amounted to around £30 in 2013. For electrically-heated homes, the difference is larger: an electrically-heated home in the North of Scotland could be paying around £270 more than one in the East Midlands (based on an Economy 7 tariff)¹⁹. Around 10% of customers (around 80,000 homes) in the North of Scotland are on dynamic tele-switched meters with special tariffs, although according to an Ofgem investigation these do not necessarily result in lower bills²⁰.

Gas prices also vary between supplier regions but these variations are smaller than for electricity prices.

- For gas, in 2013 the North of Scotland actually had the lowest prices (4.8 p/kWh) while London had the highest (5 p/kWh). Taking into account the higher gas consumption in the former, bills were roughly the same in these two regions.
- The South of Scotland also had below average prices (4.8 p/kWh), while both North and South Wales had roughly average prices at 4.9 p/kWh.
- No price information is available for Northern Ireland where relatively few properties (15%) are on the gas grid.

¹⁹ Assuming a consumption of 7,800 kWh a year in the East Midlands and 8,200 kWh in the North of Scotland.

²⁰ Ofgem (2013) *The state of the market for customers with dynamically teleswitched meters*. Available at: www.ofgem.gov.uk.



Payment type also has an impact on energy bills. Households paying on credit and pre-payment meters usually have higher unit prices than those paying on direct debit.

- For electricity, an average of 56% of customers pay by direct debit in England, Wales and Scotland, while in Northern Ireland it is only 39%.
- Northern Ireland also has the second highest electricity prices, which further increases bills. For the average electricity bill, the difference between Northern Ireland (credit) and East Midlands (direct debit price) amounts to around £70 annually.
- For gas, there is no variation in bill payment between the countries.

Taken together, the differences in electricity prices, gas prices and payment methods produce significantly higher bills for some customers in some areas of the UK.

(b) Energy consumption in the devolved administrations

Apart from energy prices per kWh, bills are determined by a range of other factors including differences in consumption due to climate and energy performance of buildings, as well as type of heating fuel. For all these factors, there are variations across the UK.

Electricity consumption for lighting and appliances appears broadly similar in the devolved administrations to the UK average.

The most recent gas consumption data with a breakdown for the devolved administrations shows average 2012 consumption per household in Scotland (14,826 kWh) was just over 5% higher than the Great Britain (GB) average (14,080 kWh). Wales (13,482 kWh) was 4% below GB average, with no data available for Northern Ireland. Scotland's higher consumption primarily reflects the lower winter temperatures, while much of Wales has a relatively mild climate.

In addition, there is some variation in the energy performance of the housing stock. Scotland has the most efficient homes on average, with an average SAP rating of 64.2 in 2012, compared to 59.6 in Northern Ireland (2011 figures) and 58.5 for England. For Wales, the most recent SAP rating published is for 2008 and was lower at 50.3, although this is likely to have improved since.

In terms of heating fuels, there are some distinct differences between England (and the UK average) and the devolved administrations (and between regions). Specifically, there are fewer dual-fuel households in Northern Ireland and Scotland, with fewer homes on the gas grid.

- In Scotland, 14% of homes are electrically-heated (compared to 7% for the UK as a whole). Some areas have higher rates – 28% in the Highlands and Islands and 21% in the North East. Both areas also fall in the supplier region with particularly high electricity prices (see above).
- Wales has only 4% of homes heated by electricity and 8% of homes heated by oil. This is just above the UK average of 7%.
- In Northern Ireland only 15% of homes are on the gas grid, compared to 87% across the UK. Most homes (76%) are on heating oil, with only 4% being electrically-heated.

Higher energy prices in some areas, together with other factors such as higher heating demand and lower incomes, have implications for the level of fuel poverty which is higher in all three devolved administrations.

(c) Fuel poverty in the devolved administrations

Despite good progress with energy efficiency improvement, fuel poverty remains a serious problem in the devolved administrations, partially due to higher energy costs resulting from the factors discussed above, and partially due to lower incomes.

Currently, levels of fuel poverty in the devolved administrations are estimated using a different methodology to England. In England, the low-income, high-cost definition was adopted in 2013 (see above), while Scotland, Wales and Northern Ireland are still using the '10%' definition.

According to this definition, our analysis suggests that in 2013, fuel poverty levels were much higher in the devolved administrations than in England (Table 2.5). In some areas in the devolved administrations, fuel poverty levels are even higher. For example, a recent study estimated fuel poverty levels of 72% in the Western Isles.

Table 2.5: Estimated fuel poverty rates in 2013 across the UK (10% definition)		
Country	Proportion of households that are fuel poor	Number of fuel poor households
UK	21%	5,585,800
Scotland	27%	636,400
Wales	35%	445,400
Northern Ireland	44%	308,200
England	19%	4,195,800

Source: CSE (2014) *Research on fuel poverty – The implications of meeting the fourth carbon budget.*

Under the 10% definition, predominant characteristics of fuel poor households are somewhat different to the LIHC definition, as the former also captures households in which fuel poverty is driven by very low income, even where the household lives in an energy efficient home. The CSE analysis identified distinct groups of fuel poor households in Scotland, Wales and Northern Ireland.

- **Scotland:** The largest single group of fuel poor households (almost 200,000) is made up of young, out-of-work, mainly single adults (some with children) in small social rented flats and lower-than-average fuel costs. The rest of the fuel poor are predominantly retired people, often with above average fuel costs and/or low income. Around 100,000 of these households are in rural areas, with larger houses and higher-than-average fuel costs.
- **Wales:** The two largest groups of fuel poor (almost 300,000 households) are low-income households, either young out-of-work or retired people (who also often live in older urban dwellings). A third group of fuel poor households consists mainly of retired people in rural areas; a fourth group is young professionals on slightly lower income.



- **Northern Ireland²¹:** The largest group of fuel poor (124,000 households) consists of single retired adults on low-incomes. This is the most severely fuel poor group across the whole of the UK. A second group (123,000 households) consists of retired couples in oil-heated detached houses in rural areas with higher-than-average fuel costs. A third group (100,000 fuel poor households) consists mainly of low-income single adults (some with children) in the rented sector, with lower-than-average fuel costs.

Across the three devolved administrations, therefore, there are groups of households (especially in rural areas) already facing higher-than-average energy bills. Some, in particularly those in oil-heated homes, will face lower increases due to low-carbon policies (as currently there is no carbon price on heating oil), while those with electric heating will see further bill increases.

(d) Projected bill impacts from meeting carbon budgets in the devolved administrations

On average, dual-fuel households in the devolved administrations should face similar bill increases from meeting carbon budgets as the UK average. We assume that low-carbon policy costs will be passed through to household energy bills equally across the UK (with increases applied to each kWh consumed), although this will in practice reflect supplier decisions.

The high proportion of electrically-heated households and relatively high heating demand due to colder weather suggest that households in the North of Scotland will pay more for low-carbon policies than the typical UK household, as these primarily affect electricity prices.

- A dual-fuel household could see bills decline from £1,185 today to £1,140 in 2020 before rising again to £1,360 in 2030, compared to £1,305 for the UK average in 2030²².
- An electrically-heated home using an average of 8,200 kWh (5% more than our typical UK electrically-heated household) on a North of Scotland tariff could see its electricity bill increase from £1,055 in 2013 to £1,155 in 2020 and to £1,370 in 2030, compared to £1,255 for the UK average in 2030.
- The costs of low-carbon policies for the electrically-heated home would increase from £100 in 2013 to £240 by 2020 and to £390 by 2030.

As noted at the UK level, this implies that it will be particularly important to target these households with energy efficiency and low-carbon heat measures where appropriate.

Fuel poverty is already a severe problem in the devolved administrations and the governments will need to ensure that their own devolved policies effectively target fuel poor homes (especially those on electric heating). Additionally, for Scotland and Wales, it will be important to secure a proportionate share of ECO funding (and any subsequent policies post-2017). The rural sub-obligation of the ECO should be particularly useful for improving energy efficiency in the most affected areas but has to date resulted in very low levels of delivery, in particular in some remote areas.

21 Totals for Northern Ireland are higher than those presented in Table 2.5. This is an artefact of the Chaid analysis used to generate the fuel poverty groups.

22 Assume higher gas demand of 5% compared to UK average to reflect higher heating demand.

-
- On average 36.5 ECO measures had been delivered per 1000 households across GB (and an average of 43 measures in Scotland) under the ECO to the end of June 2014.
 - The lowest delivery rates in the whole of GB were in the Shetlands (1.9) and Orkney Islands (2.6). Other areas in Northern Scotland were also low (e.g. Moray 8.6, Highlands 15.3).

Electrically-heated homes in these areas are therefore experiencing both higher electricity prices and low access to measures. We will monitor whether the latest ECO changes (including incentives under the Affordable Warmth part of the ECO for measures in non-gas households, and simplification of eligibility rules under the rural sub-target) improve the situation.

3 Commercial sector energy bills



The commercial sector is made up of businesses within the retail, real estate, transportation and the wider service economy (Figure 3.1). It excludes businesses that are part of manufacturing, construction, mining, water and waste. The analysis in this chapter is also relevant to public sector organisations such as hospitals and schools, which face similar energy prices as businesses.

This chapter sets out the current (2013) picture for commercial energy bills, the drivers of historical increases since 2004 and the outlook for bills to 2020 and 2030 assuming measures are on track to meet carbon budgets. We distinguish between those firms covered by different low-carbon policies (i.e. the Climate Change Levy and the CRC Energy Efficiency Scheme) and with different shares of spend on gas and electricity. We also present case studies demonstrating the potential for savings through energy efficiency improvement.

Our key messages are:¹

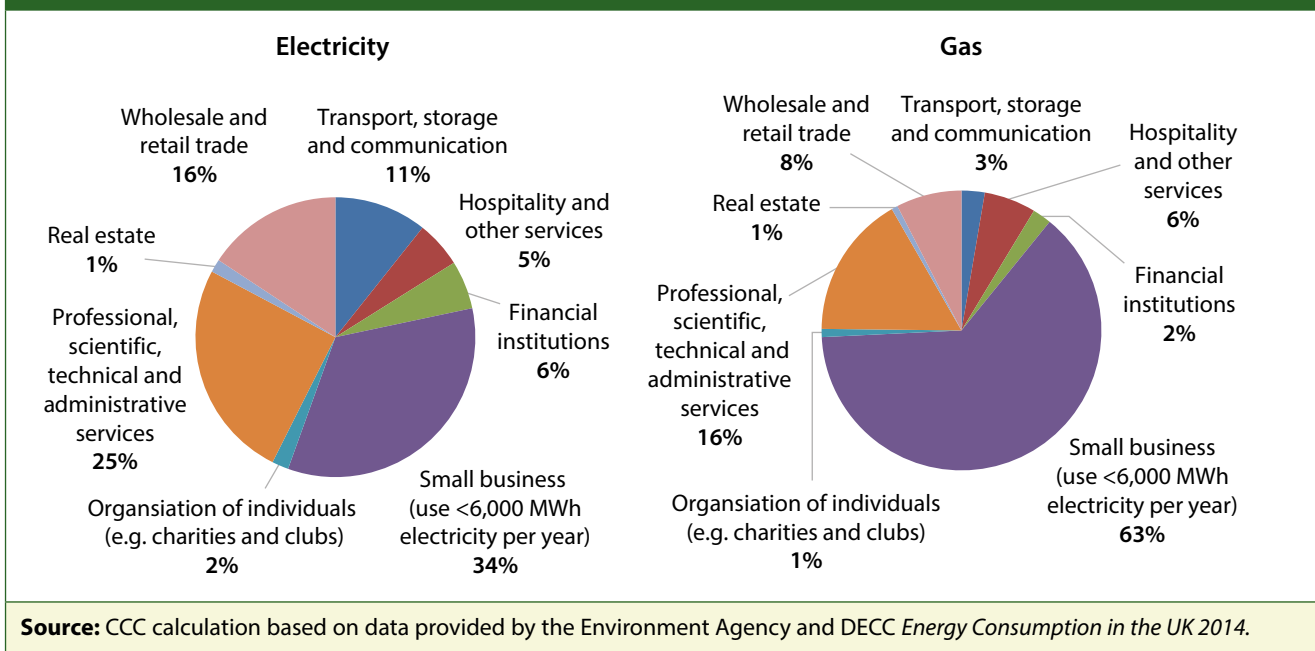
- **Current bills and changes since 2004.** Energy costs make up around 0.5% of total costs on average across the commercial sector, while costs from low-carbon policies within this contribute around 0.1% of total costs. From 2004 to 2013, total commercial sector energy bills increased by 135-155% in nominal terms, primarily due to increases in the wholesale price of gas. Between 15-35% of the increase was due to low-carbon policies, with the share varying depending on the share of electricity in total energy spend and whether or not the firm faces low-carbon policy costs under the CRC.
- **Outlook for energy bills.** Depending on the share of electricity within total spend, bills could increase in real terms by 10-15% to 2020 due to low-carbon policy costs (5-25% under a range of carbon and gas price assumptions) and 30-45% to 2030 (15-65% under different carbon and gas price assumptions). When gas prices are low, the cost of supporting low-carbon investments will be higher, but overall bills will be lower.
- **Energy efficiency opportunities.** Energy efficiency provides opportunities for offsetting part of the bill increase – we estimate average potential savings to 2020 of around 20%. There are examples of more significant savings across a range of businesses and it is likely that there are further savings to 2030 not currently factored into our decarbonisation pathways.
- **Impact of low-carbon policy costs.** We estimate that the direct energy-related costs of meeting carbon budgets to 2020 will lead to a real-terms increase of 0.1% in total costs, equivalent to an additional penny on £10 worth of goods or services.

We set out our findings in three sections:

1. Current energy bills for the commercial sector
2. Changes to commercial sector energy prices and bills since 2004
3. Outlook for energy bills to 2020 and 2030

¹ Percentage figures in the key messages are rounded to the nearest 5%. Throughout the rest of the chapter, percentages are rounded to the nearest digit unless otherwise specified.

Figure 3.1: Energy consumption by commercial sector (2013)



3.1 Current energy bills for the commercial sector

(a) Current energy expenditure in the commercial sector

Energy expenditure in the commercial sector is currently split between electricity (78%), gas (19%), and oil (3%).² Given the small contribution of oil to the total, we focus on electricity and gas bills. The sector accounts for around 25% of total UK electricity consumption (79 TWh), and 10% of gas used outside of the power sector (60 TWh).

Across the commercial sector, the main uses of energy are heating and hot water (54%), lighting (19%) and catering (12%).

Energy spend is a lower proportion of total costs on average compared to industry. In 2013, energy bills were on average around 0.5% of total costs for businesses in the commercial sector. However, use of energy varies significantly between business type, for example hotels are relatively high users, with energy bills making up around 6% of total costs.³

Changes in gas consumption from year to year are partly associated with changes in annual temperature. In order to focus on longer-term trends, we consider gas consumption data adjusted for the variation in temperature. Commercial electricity consumption is not sensitive to fluctuations in temperature.

- Year-on-year fluctuations in temperature have less of an impact on gas consumption for businesses than households, which reflects in part the greater diversity and share of uses beyond space heating.

² DECC (2014) *Energy Consumption in the UK – 2013 figures*.

³ Based on ONS *Annual Business Survey* data, average 2008-2012. Energy consumption estimates are based on an assumption that energy spend makes up around 95% of purchases of energy and water products for own consumption.



- Based on statistical analysis from DECC, we adjust gas consumption data to take out the impact of temperature fluctuations. For example, temperatures in 2013 were relatively low. Without this additional demand for heating, gas consumption would have been around 1 TWh (1%) lower.
- In the case of electricity consumption, there is no significant effect, so we do not adjust the data.

Energy expenditure is determined by both consumption and current energy prices, which we consider in more detail in the following section.

(b) Current energy prices in the commercial sector

As set out in Chapter 1, electricity and gas prices are lower for commercial consumers than for households. The average price faced by a 'medium-sized' non-residential consumer⁴ in 2013 was 10.1 p/kWh for electricity and 3.3 p/kWh for gas, compared to residential prices of 14.4 p/kWh and 4.6 p/kWh ex-VAT.⁵

Commercial customers also face a different mix of low-carbon policies to households. In total these added on average 2.0-2.6 p/kWh to the electricity price for 'medium-sized' firms in 2013.

- All firms face costs for supporting low-carbon investment: 0.4 p/kWh from the carbon price and 1.1 p/kWh for supporting investment in renewable generation.
- Businesses also pay the Climate Change Levy (CCL), a tax on energy consumption with rates which vary by fuel. The full rate for electricity was 0.52 p/kWh in 2013. Discounts are given to businesses that sign up to sectoral Climate Change Agreements (CCA) on condition that they meet targeted energy reductions across the sector, though these are mainly taken up by industrial users.
- Large commercial, public and industrial consumers with half-hourly metered electricity consumption over 6,000 MWh per year are covered by the CRC Energy Efficiency scheme (unless they are part of the EU Emissions Trading Scheme (EU ETS) or have signed up to a CCA). The CRC covered 64% of commercial sector electricity consumption in 2013, requiring that firms buy permits to cover electricity and gas use. Permits were priced at £12/tonne CO₂ (equivalent to 0.6 p/kWh on electricity and 0.2 p/kWh on gas) until the end of the 2013/14 financial year, when the price was raised to £16/tonne CO₂.⁶ Whilst the CRC is not levied on energy bills, it is a tax on energy use, so we include the impact on retail electricity and gas prices.

4 DECC (2014) *Quarterly Energy Prices* Table 3.4.1. Medium-sized electricity users are defined as 2,000 to 19,999 MWh/yr demand.

5 We do not include the impact of VAT in our assessment of energy prices and bills for business, as energy used for production of goods and services can be claimed back from HM Revenues and Customs.

6 In nominal terms.

The costs of funding low-carbon electricity generation are concentrated on electricity consumption. The only low-carbon costs on gas consumption for businesses are the CCL and the CRC, which give low-carbon costs across the sector of 0.2-0.4 p/kWh (6-12% of the total gas price).

- The full CCL rate on gas in 2013 was 0.18 p/kWh. Businesses with discounts under CCAs face a reduced cost of 0.05 p/kWh.
- Businesses paying for gas consumption under the CRC paid 0.2 p/kWh in 2013, covering 36% of sector gas use.

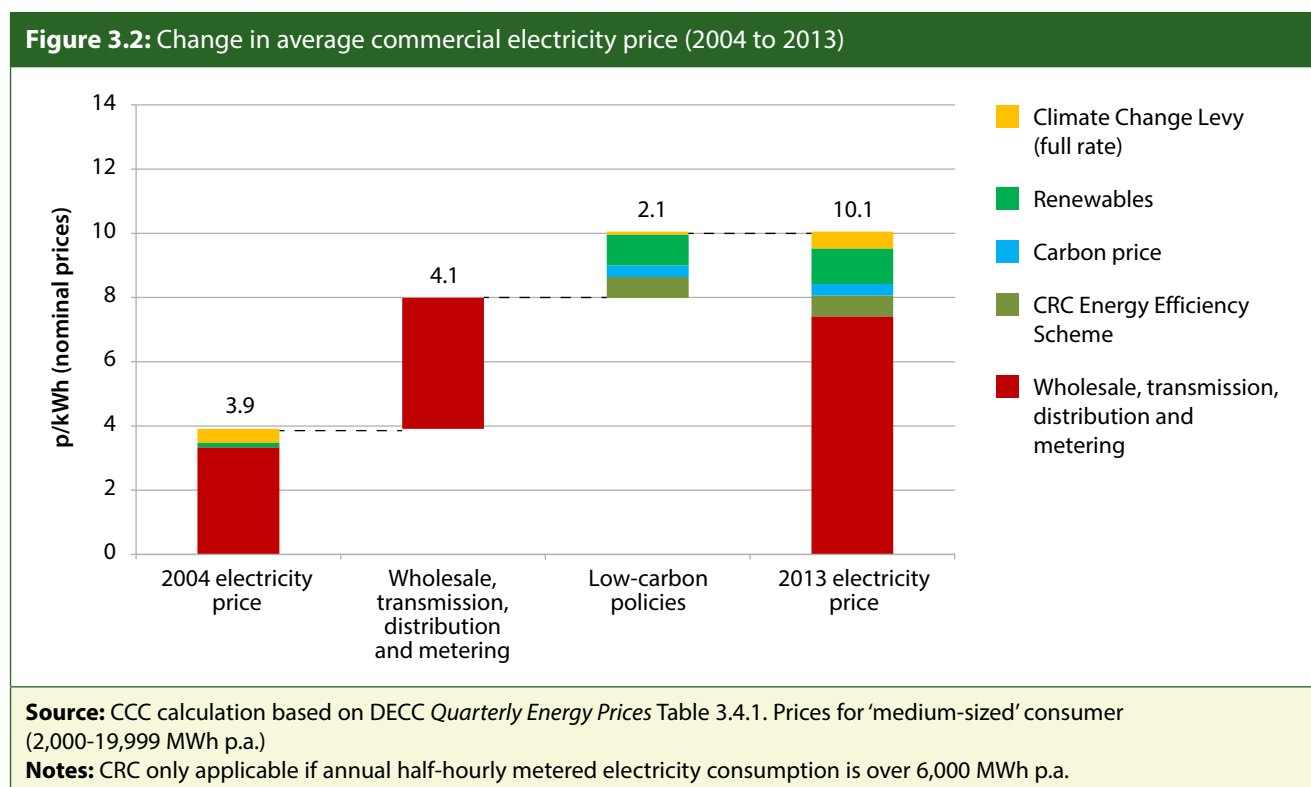
Both the CRC and the CCL raise revenue for the Exchequer, estimated as each contributing just under £0.7 billion in 2013.

3.2 Changes to commercial sector energy prices and bills since 2004

(a) Changes in commercial electricity prices since 2004

From 2004 to 2013, retail electricity prices increased from 3.9 p/kWh to 10.1 p/kWh in nominal terms (157%), compared to 23% general price inflation over the period (Figure 3.2). As for households, this was mainly due to increases in the wholesale price and network costs, which increased 4.1p/kWh in this period.

Low-carbon costs accounted for up to a third of the overall increase – 2.1 p/kWh for firms in the CRC, and an average of 1.4 p/kWh for those below the CRC threshold (0.4 p/kWh for the carbon price on electricity producers and 1.0 p/kWh for support costs for renewable electricity).



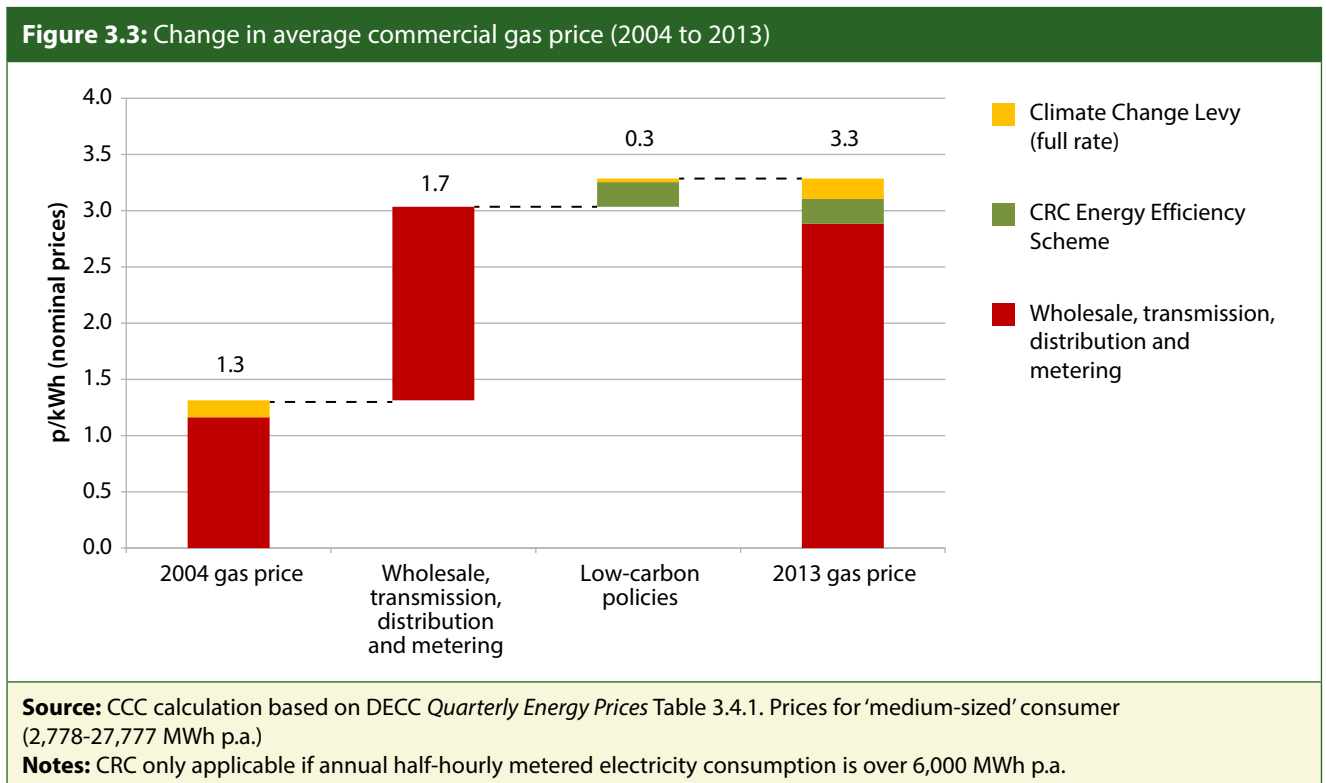


(b) Changes in commercial gas prices since 2004

Between 2004 and 2013, gas prices increased from 1.3 p/kWh to 3.3 p/kWh for a medium-sized firm⁷ covered by the CRC (Figure 3.3). Wholesale price rises and network costs accounted for most (87%) of the increase.

- The wholesale price of gas rose by 1.3 p/kWh over the period, with a further 0.4 p/kWh increase linked to transmission, distribution and metering costs as well as changes in supplier costs and margins.⁸
- CRC costs added 0.2 p/kWh to gas prices for those firms covered by the scheme.
- The CCL rates make a relatively small contribution to the overall price and remained fairly flat over the period.

Overall, this implies a significantly lower impact of low-carbon policies on gas prices compared to electricity. This risks incentivising a shift from electricity to gas, rather than the direction set out in our decarbonisation scenarios, which involves a shift in demand from hydrocarbons to low-carbon electricity.



⁷ DECC, *Quarterly Energy Prices* Table 3.4.1. Medium-sized gas users are defined as those with 2,778 to 27,777 MWh/yr gas consumption.

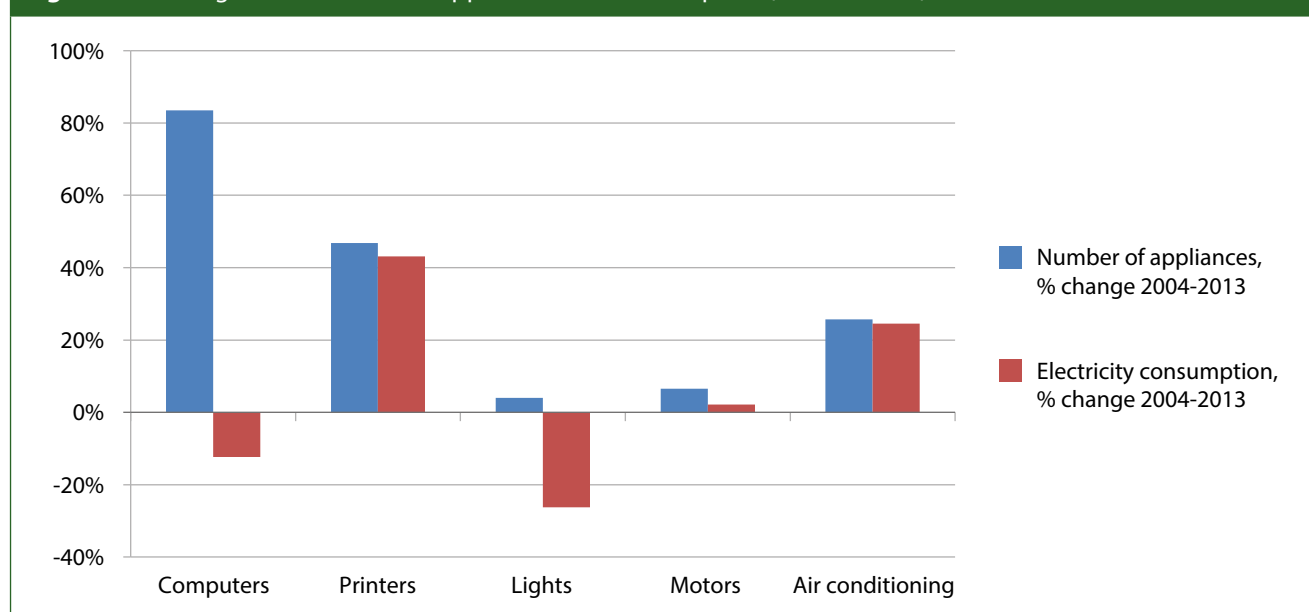
⁸ It is not possible to break this down further due to a lack of data.

(c) Changes in energy bills since 2004

Since 2004, commercial electricity consumption has grown 5%, albeit at a significantly lower rate than commercial output. There is evidence of some increased demand for electricity from new sources such as air conditioning. Gas consumption remained broadly flat over the period.

- Between 2004 and 2013, total electricity consumption increased from 75 TWh to 79 TWh, compared to growth in output of 136% in real terms. Although appliance use increased, this was offset in many cases by improvements in energy efficiency, despite increased demand from sources such as air conditioning (Figure 3.4).
 - The number of computers increased by 83% over the period, but a shift from desktops to laptops, together with an increase in more efficient models, led to a fall in electricity consumption of 12%.
 - Similarly, the total commercial lighting stock grew by 4% over the period whilst electricity consumption from lighting fell 26%.
 - However, electricity demand from air conditioning systems increased 25%, and demand from printers rose 43%, suggesting that in certain cases efficiency improvement has been insufficient to offset growth in demand.
- It is not possible to compare commercial gas consumption figures before and after 2008.⁹ Even since 2008 comparisons are not straightforward, because of the impact of changes in weather from year to year – heating requirements and gas consumption increase in years with cold winters. Adjusting for variation in temperature, gas consumption has fluctuated since 2008, from 65 TWh in 2008 to 54 TWh in 2009, then back up to 60 TWh in 2013.

Figure 3.4: Change in non-domestic appliances and consumption (2004 to 2013)



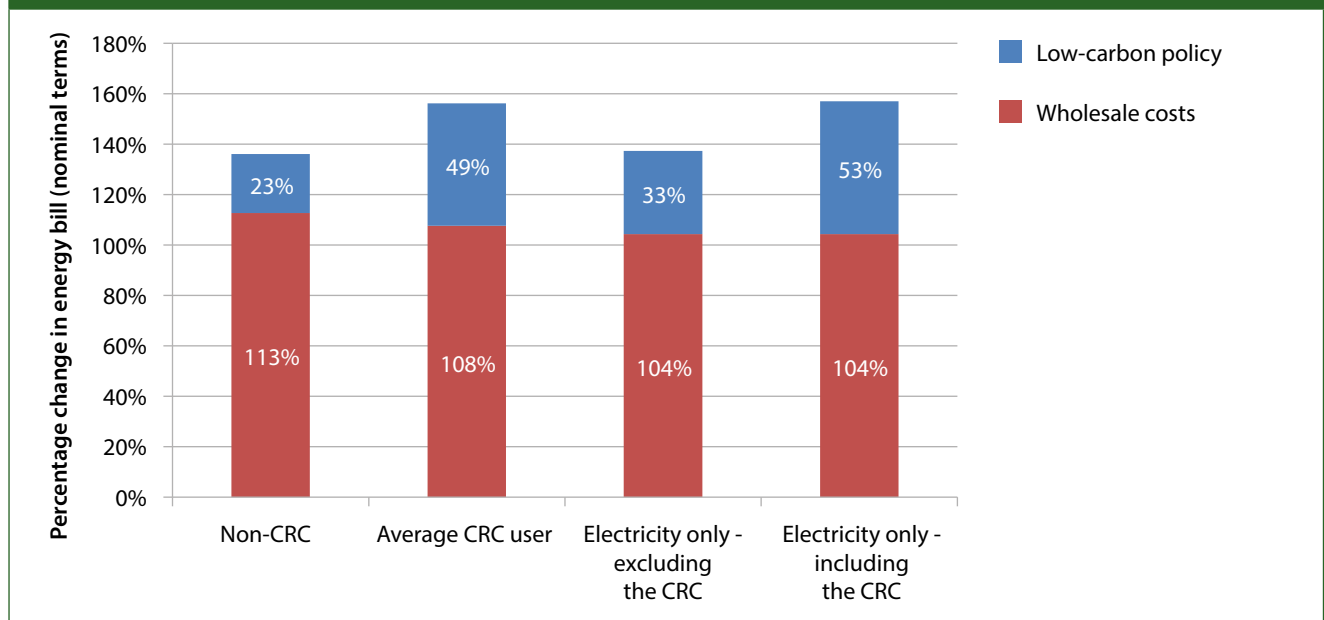
Source: CCC calculations based on DECC *Energy Consumption in the UK 2014*.

⁹ Revisions in DECC statistics have produced a discontinuity in the data.



The combination of rising prices, relatively flat demand and a growing sector has led to the share of energy costs in total sector costs rising from around 0.3% in 2004 to 0.5% in 2013. The scale of the increase varies slightly depending on the share of electricity in energy spend and whether or not the firm is part of the CRC (Figure 3.5). Up to a fifth of the increase in energy costs from 2004 to 2013 was due to low-carbon policies, with the largest impacts seen by consumers in the CRC.

Figure 3.5: Change in average energy costs according to different users (2004-2013)



Source: CCC calculations.

Notes: Bill impact for a 'medium-sized' consumer, defined as consuming 2,000-19,999 MWh electricity p.a. and 2,778-27,777 MWh p.a. (where applicable). Bill impacts include the impact of the CRC Energy Efficiency Scheme, which will only apply to consumers with half-hourly metered electricity consumption over 6,000 MWh p.a. Shares of energy spend an average commercial CRC user were 87% electricity and 13% gas in 2004. For an average user outside the CRC, the shares were respectively 69% electricity and 31% gas.

3.3 Outlook for energy bills to 2020 and 2030

(a) Outlook for electricity prices

As set out in Chapter 1, drivers of future changes in electricity prices for businesses are similar to those affecting households regarding wholesale costs, network costs and support for investment in low-carbon power generation. CRC costs are expected to fall over time in line with the decarbonisation of the power sector.

- **Support for low-carbon generation.** We assume the same costs for the commercial sector as for households, increasing in real terms from 1.5 p/kWh in 2013 to 3.2 p/kWh in 2020 and 5.5 p/kWh in 2030. This includes the impact of the carbon price, rising from £7/tCO₂ in 2013 to £76/tCO₂ in 2030, and support for low-carbon electricity (i.e. renewables, nuclear and CCS) under the Renewables Obligation and Contracts for Difference, consistent with reducing sector carbon intensity to 50-100 gCO₂/kWh.
- **CCL.** We assume this stays constant in real terms to 2030, rising in line with inflation.
- **CRC.** The CRC permit price was increased to £16 tonne/CO₂ in April 2014. We assume that it stays constant at this price to 2030, but that the carbon intensity of electricity generation falls. Under our trajectory for power sector decarbonisation to 2030,¹⁰ achieving an emissions intensity of 50 gCO₂/kWh in 2030,¹¹ CRC costs would fall from 0.6 p/kWh in 2013, to 0.4 p/kWh in 2020 and 0.1 p/kWh in 2030.

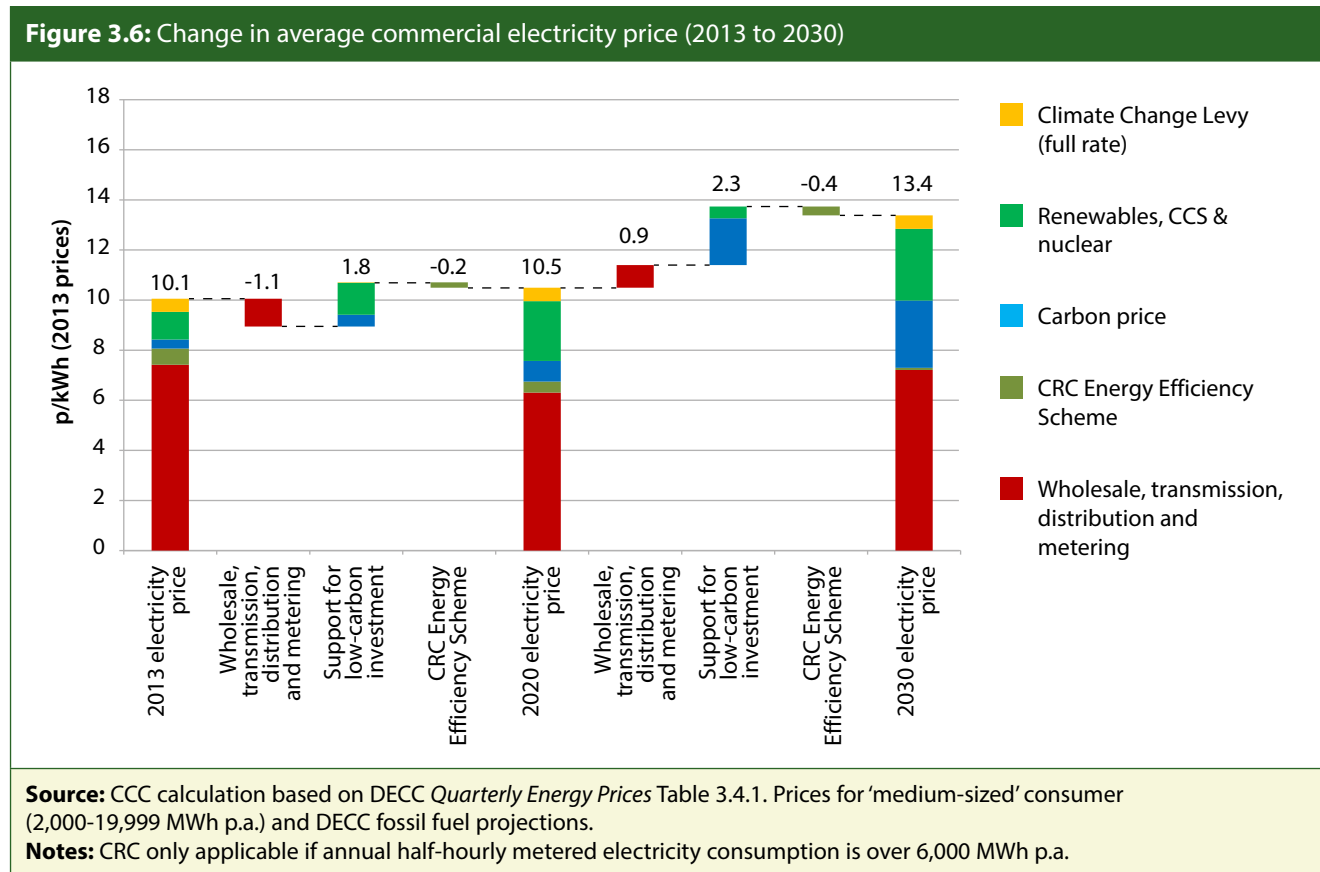
¹⁰ CCC (2013) *Fourth Carbon Budget Review*.

¹¹ The lower bound of the 50-100 g/kWh range.

- **Wholesale and network costs.** Based on historical trends and market design, we assume these change similarly, in proportionate terms, as in the residential sector. This implies a decrease of 1.1 p/kWh to 2020 which is primarily a result of a projected fall in gas prices under DECC's central price projections, compounded by our assumption that supplier margins will return from their current high of 4% to average levels seen between 2008-2013. These impacts are offset by a small increase in network costs.

Overall, we project that low-carbon policies will add a further 1.8 p/kWh in real terms (18%) to the electricity price from 2013 to 2020 (Figure 3.6). In DECC's central scenario for future gas prices, together with changes in network charges, this leads to a real terms electricity price increase from 10.1 p/kWh to 10.5 p/kWh.

From 2020 to 2030, increases in the carbon price are partially offset by a fall in CRC costs due to decarbonising electricity production. We estimate that these low-carbon policies add 1.8 p/kWh (17%) to the commercial electricity price. Other changes under DECC's central scenario for the wholesale gas price are expected to add a further 0.9 p/kWh, bringing the overall price up to 13.4 p/kWh.



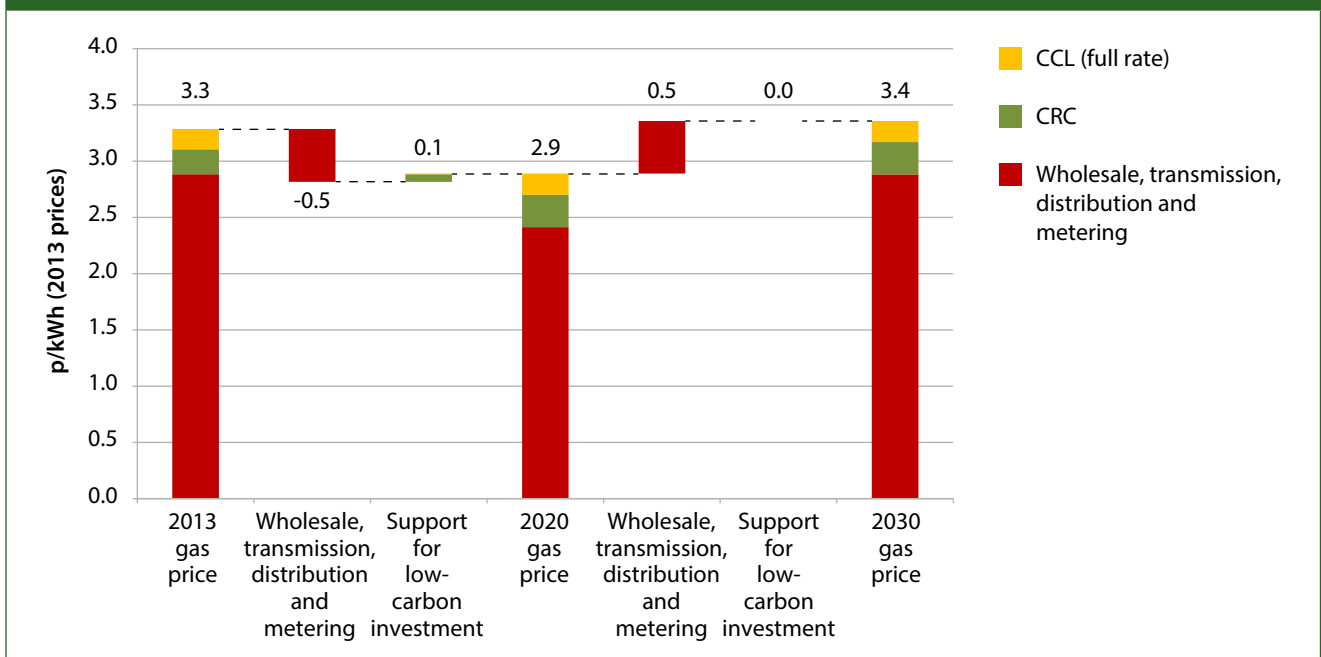
(b) Outlook for gas prices

Low-carbon costs are expected to have a minimal impact on gas prices between now and 2030, with an increase of 0.1 p/kWh (2%) expected to 2020 as a result of the 2014 increase in the CRC price, and no further impacts to 2030 (Figure 3.7).

The main driver of retail gas prices is the wholesale price of gas. According to DECC's central wholesale gas projections and Ofgem's assumptions regarding future network costs, total wholesale gas and network costs will fall by 0.5 p/kWh in real terms to 2020, before increasing again by the same amount to 2030.



Figure 3.7: Change in average commercial gas price (2013 to 2030)



Source: CCC calculations based on DECC *Quarterly Energy Prices* Table 3.4.1. Prices for 'medium-sized' consumer (2,778-27,777 MWh p.a.) and DECC fossil fuel projections.

Notes: CRC only applicable if annual half-hourly metered electricity consumption is over 6,000 MWh p.a.

(c) Outlook for combined energy bills to 2020 and 2030 in the commercial sector

The effect of rising energy prices

The overall impact on firms will depend on levels of consumption, the relative shares of electricity and gas and the extent to which energy efficiency opportunities are taken up.

If energy consumption remains at current levels, bills could increase by 12-17% due to low-carbon policies by 2020, and 30-43% by 2030 under central case assumptions (Figure 3.8).

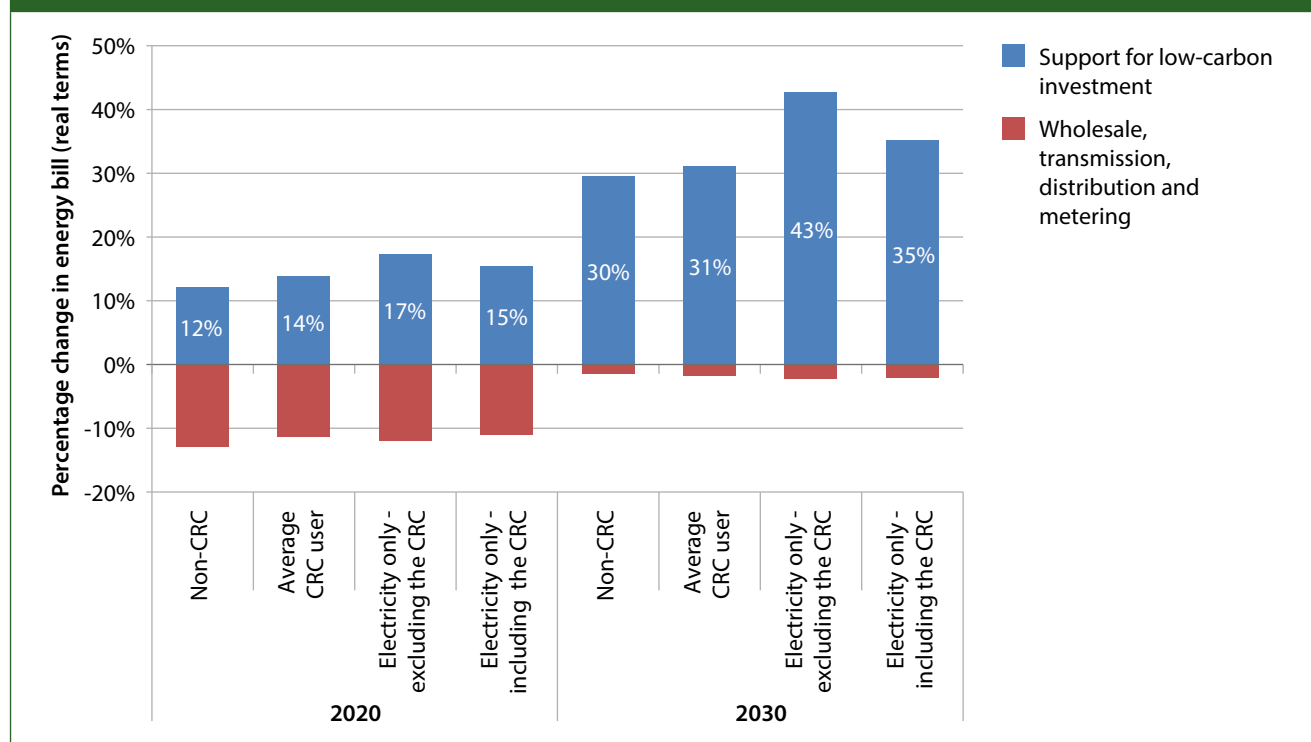
- For an average user covered by the CRC (spending 88% of their bill on electricity), we estimate that the energy bill would increase 14% to 2020 in real terms, and 31% to 2030. This bill includes increases in support for low-carbon electricity generation (renewables, nuclear and CCS) and the carbon price, offset by a reduction as the cost of the CRC falls in line with the decarbonisation of electricity production.
- For users not covered by the CRC, the impacts will be slightly lower, reflecting the smaller relative share of electricity in spend (69% on average).
- The largest impacts in percentage terms are for electricity-only consumers not covered by the CRC.

We estimate that the wholesale prices, network costs and supplier costs and margins would together imply a fall in bills of around 11-13% to 2020 under DECC's central carbon and gas price projections. This decrease is primarily a result of a projected fall in gas prices.

The impact of this fall would be to offset most of the increase due to low-carbon policy costs, implying an overall bill increase of 2% by 2020 for an average CRC user.

By 2030, wholesale electricity prices and network costs are expected to rise back to 2013 levels, implying that the bill for an average CRC user would increase by around 29%.

Figure 3.8: Projected changes in bill to 2020 and 2030 for different commercial users



Source: CCC calculations.

Notes: Bill impact for a 'medium-sized' consumer, defined as consuming 2,000-19,999 MWh electricity p.a. and 2,778-27,777 MWh p.a. (where applicable). Bill impacts include the impact of the CRC Energy Efficiency Scheme, which will only apply to consumers with half-hourly metered electricity consumption over 6,000 MWh p.a. Shares of energy spend an average commercial CRC user were 88% electricity and 12% gas in 2013. For an average user outside the CRC, the shares were respectively 69% electricity and 31% gas.

Uncertainties in future energy prices

These estimates are for a central case. However, there is considerable uncertainty around them, for example related to projected gas and carbon prices (Table 3.1).

- If gas prices are low, then the percentage impact of low-carbon policies will be higher (42-60% by 2030), but overall bills would be lower (17-38% by 2030).
- If gas prices are high, bills will increase by more overall (35-42% by 2030), but the impact of low-carbon policies will be lower (18-26% by 2030).
- If carbon prices rise to meet DECC's high scenario (£114/t CO₂ in 2030), then the bill increase from low-carbon policies overall would be higher (at 32-46% by 2030), but the costs of direct support for low-carbon investment to reach 50-100g CO₂/kWh in 2030 would be lower (1.8 p/kWh, compared to 2.9 p/kWh in the central scenario).

These uncertainties demonstrate that low-carbon investment acts to reduce volatility in energy prices and energy bills by reducing exposure to uncertain fossil fuel and carbon prices.



Table 3.1: Uncertainty ranges in projected bill changes to 2020 and 2030 for a range of consumers

	2020		2030	
	Increase due to low-carbon	Increase in energy bill	Increase due to low-carbon	Increase in energy bill
Central scenario	12-17%	-1 to 5%	30-43%	28-41%
Low gas price	13-19%	-12 to -3%	42-60%	17-38%
High gas price	10-15%	18-20 %	18-26%	35-42%
Low carbon price	7-10%	-6 to -2%	27-39%	26-37%
High carbon price	16-23%	3-11%	32-46%	30-44%
Low gas price/high carbon price	17-24%	-8 to 2%	44-63%	19-42%
High gas price/low carbon price	5-7%	11-13%	15-23%	31-39%

Notes: Ranges are defined as the minimum and maximum values calculated for four user types: a medium-sized firm in the CRC; a medium-sized firm ex-CRC; and electricity-only consumers (in- and ex- CRC).

Potential to reduce bills through energy efficiency

There are significant opportunities to offset the increase in electricity prices through uptake of energy efficiency measures. Our scenarios for meeting carbon budgets include opportunities for reducing energy consumption by around 18%, although more may be possible.

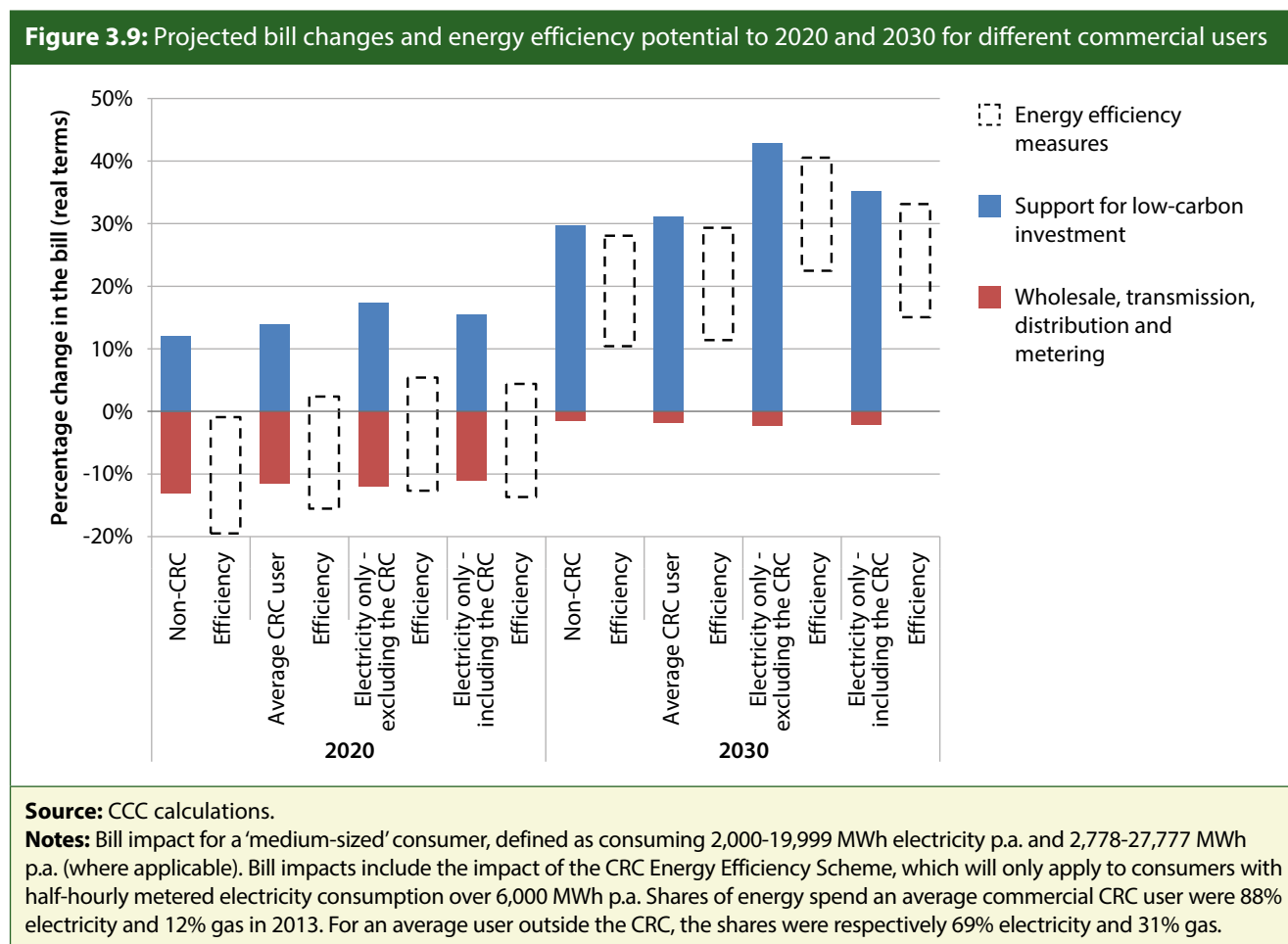
- A 10% energy saving can be achieved through measures such as energy management and building fabric efficiency measures.
- An estimated further 8% saving is possible from replacing appliances and products, due to EU regulations on minimum efficiency standards for electric appliances.
- This compares to an estimate of 16% of energy efficiency potential that can be incentivised by 2020 by current and proposed policies, identified in DECC's 2012 Energy Efficiency Strategy.
- Examples of best practice in the sector suggest larger reductions are feasible in many instances, irrespective of size of firm (Box 3.1).
- We do not currently include additional energy efficiency potential to 2030 in our decarbonisation pathways, apart from the impact of EU minimum standards on appliances. As a result, our estimates may be conservative.

There is therefore potential for many businesses to at least partly offset the 15-17% increase in electricity prices to 2020 expected to result from low-carbon policies.

There is similar scope to reduce gas bills through energy efficiency measures such as new efficient boilers and insulation, and through better energy management (e.g. heating controls). In our 2013 Fourth Carbon Budget Review, we estimated the potential to be in the order of 16%.

There is an investment cost for the energy efficiency measures to deliver these energy savings, which we estimate at £1.5 bn, or around 11% of the total public and commercial energy bill on an annualised basis. Energy efficiency opportunities therefore imply net savings potential of around 6% on average on the bill.

The size of the saving opportunity for different types of consumer is set out in Figure 3.9.



Outlook for energy bills as a share of total costs

Assuming no change in consumption or energy efficiency improvement, the expected impact on energy spend as a share of total costs would be a rise from 0.5% of spend in 2013 to 0.6% in 2030. Within this, costs resulting from low-carbon policies were around 26% of total costs in 2013 and would rise to 39% in 2020 and 45% in 2030. Including energy efficiency would marginally reduce these costs,¹² but as noted above there may be more significant energy efficiency potential.

Given the small share of energy in total costs, the impact of low-carbon costs on consumer prices will be limited. By 2020, under our decarbonisation scenarios, low-carbon costs would add an additional 1p to a £10 basket of goods (equivalent to a 0.1% increase in total costs).¹³ This compares to an expected rise of around £1.45 due to general price inflation in that period. By 2030, a further 1p would be added from the costs of supporting low-carbon investment. Some examples of impacts on consumer goods are set out in Box 3.2.

¹² Though the rounded share of energy in total costs remains 0.6% in 2030.

¹³ Assuming that 100% of the cost increase is passed on to the consumer.



Box 3.1: Case studies of commercial sector energy efficiency improvements

Many UK businesses are already achieving sizable energy savings and cutting bills, ranging from SMEs to large multinational corporations.

Pub

Energy bill savings	20% in 2009
Measures installed	New gas boiler and solar panels

The Bunch of Grapes is an established community pub with 30 staff, set in the valleys of Pontypridd, south Wales. The pub was built in the mid-1800s, catering for the workers from the local chainworks.

In 2009, the pub's dual-fuel energy bill had reached almost £40,000 a year. This reflected large quantities of gas used for space heating via an inefficient 1980s boiler and for cooking, as well as electricity predominantly for lights and refrigeration.

The owner installed three 0.64kW thermal solar panels and a new high-efficiency gas central heating system. The work was financed through an interest-free loan from the Carbon Trust costing a total of £17,500, with the measures taking six weeks to install. The new system saved around £8,000 per year (20% of their original bill), meaning the pub claimed back their initial outlay in just over two years.

Now, nearly five years on, the owner acknowledges that further savings can be made given advancing technologies and higher energy prices. He plans to upgrade the heating system again next year to either an air source heat pump or wood pellet boiler when the pub undergoes full refurbishment.

Supermarket

Energy bill savings	40% 2006-2013
Measures installed	Doors on chillers, LED lighting and controls, smart meters, voltage optimisation, staff engagement programme

Over the past five years, UK supermarkets have reported energy efficiency improvements of between 2.5% and 5.5% a year, and expect this to continue for a further five to ten years.¹⁴ As set out in our 2014 Progress Report, carbon and energy savings are being achieved by the largest firms despite significant expansion in recent years, although it is not clear that this progress is being replicated in smaller firms.

The Co-operative is a large supermarket chain with 87,000 staff, founded with an ethos of improving the environment and community. In 2006 the group set an ambitious target of reducing emissions by 50% by 2020. Reducing energy bills is also seen as a key business priority, and since 2006 the supermarket has invested £6 million per year in an energy efficiency programme, producing savings of £3 million per year.

- Good housekeeping was the first step, with smart meters installed in every food store to allow stores to understand their energy usage.
- The programme targeted the highest energy stores first, saving up to 20% in each store.
- The greatest savings have been made from installing doors on chillers which are now fitted as standard, as well as fluorescent and LED lighting and controls.
- Innovative ways of harnessing the 'free' heat produced by fridges have been implemented and the company is starting to install heat pumps.

The energy manager at Co-operative says the success of the programme means that "stores now know if a new efficiency initiative is suggested, they will make genuine savings".

¹⁴ Guardian, 'Are there limits to energy efficiency for supermarkets?' <http://www.theguardian.com/sustainable-business/limits-energy-efficiency-supermarkets-retail>

Box 3.1: Case studies of commercial sector energy efficiency improvements

Professional services

Energy bill savings	22% for Embankment Place office, 2010-2013
Measures installed	Tri-generator, LED lighting, hot desks

PricewaterhouseCoopers (PwC) is one of the world's largest professional services firms with 18,000 staff employed in the UK alone. In 2011 PwC moved 5,500 staff into a new office at 7 More London, designed by PwC and the first building to achieve the BREEAM outstanding standard. Three years later, PwC began improving its second-largest office, Embankment Place, to bring it up to the same workspace and sustainability standards.

- PwC chose two 400 kW tri-generators to simultaneously produce power, heating and cooling, fuelled using waste cooking oil from local restaurants. The technology cost £1 million and generates 60% of the office's energy, with a four year payback period.
- Embankment Place was fitted with 55% LED lighting. Having demonstrated a 3-4 year payback period, PwC are now looking into retrofitting its More London office.
- PwC say they 'operate their business like a hotel', with staff and clients booking in to use desk and meeting room space. They have fewer desks than staff, which saves an estimated £20 million in overheads each year across both offices.

Embankment Place's energy bill has fallen 22%, from £1.02 million in 2010 before the upgrade to £0.8 million in 2013 (including biofuel for the tri-generator). As most of the measures were installed as part of the refurbishment, PwC incurred relatively low additional capital costs. As part of the lease restructuring, the cost of the refit was shared between landlord and tenant.

PwC used learning from More London to optimise energy usage at Embankment Place, which achieved the highest ever BREEAM rating. They hope to retrofit other offices around the UK and continue to upgrade their London offices.

Source: Bunch of Grapes – Carbon Trust Wales loan'. Available at: <http://www.carbontrust.com/our-clients/b/bunch-of-grapes>; The Co-operative Group (2013) *Sustainability report 2013*; PricewaterhouseCoopers, 'Managing our Energy Consumption'. Available at: <http://www.pwc.co.uk/corporate-sustainability/energy.jhtml>



Box 3.2: Impact of low-carbon policy costs on product prices

In Chapter 4, we set out an expected rise in costs in industry due to low-carbon policies of 0.3% by 2020, which compares to a rise in costs of 0.1% by 2020 in the service sector. As goods generally include a number of separate components (for example, packaging of foodstuffs as well as the food product), this suggests products will see an increase in costs of this order of magnitude, with some variation according to the embodied energy of the product.

- Services like restaurants spend around 0.7% of total costs on energy. This implies that £50 spent on a meal is expected to increase due to low-carbon policies by around 15p by 2020, and 40p by 2030.
- Items such as computers and electrical goods have energy costs at around 1.2% of total costs. On a £200 games console, low-carbon policies would increase the cost by 60p by 2020 and £1.35 by 2030.
- The manufacturing of food and drink is more energy-intensive. The cost of energy as a proportion of total costs comprises 1.2% for meat, 1.4% for dairy, 2.0% for bakery items and 3.3% for alcoholic drinks. If we also include the embodied energy from supply-chain production (agricultural production, as well as the energy used to produce other inputs such as packaging), the implication is that for a £100 weekly shop, the increase in cost due to low-carbon policies is likely to be around 70p to 2020, and £1.70 to 2030. These are high-end estimates, as they assume no energy efficiency improvement, that the industry receives no compensation and that manufacturers pass on all of any energy cost increase.
- Products with a large manufacturing footprint such as cars will see the largest impacts, due to increases in production costs, as well as raw inputs such as steel, rubber and glass. Car manufacturers are also part of the EU ETS, and face additional costs of up to 0.4 p/kWh for gas in 2020 and 1.4 p/kWh in 2030 (see Industry chapter). For a £10,000 conventional car, this implies a cost increase of £70 by 2020 and £190 by 2030. However, running costs are expected to fall by more by 2020 (around 40% for a conventional vehicle, equivalent to around £500 a year) due to low-carbon fuel efficiency initiatives, as set out in our 2013 report, *Reducing the UK's carbon footprint and managing competitiveness risks*.

Therefore, for many consumer goods and services, the increase in cost due to low-carbon policy costs will be limited, reflecting the relatively low share of energy spend out of total costs. Products with a larger energy footprint will see a larger impact.

Notes: Calculations based on ONS Supply and Use Tables. We include first order supply-chain energy consumption, assuming 100% of the cost increase is passed through. Additional supply-chain impacts (i.e. more than one stage removed) are considered more uncertain and not included in the estimates. The example of the weekly shop is for a hypothetical shop composed in equal parts of these goods and is therefore a high-end estimate. Car running cost estimates are based on Ricardo-AEA (2013) *Current and Future Lifecycle Emissions of Key 'Low-Carbon' Technologies and Alternatives*, Report for the Committee on Climate Change.

4 Industrial energy bills



This chapter covers energy consumed in businesses that are part of manufacturing (i.e. the manufacture of goods such as iron and steel and chemicals), construction, mining, water and waste.

We set out the current (2013) picture for industrial energy bills, the drivers of changes since 2004 and the outlook for bills to 2020 and 2030 assuming measures are on track to meet carbon budgets.

Low-carbon policies have important potential implications for the competitiveness of specific industrial sectors, which we have a statutory duty to consider under the Climate Change Act. We distinguish between those sectors that are energy intensive and non-energy intensive¹ (Figure 4.1), and consider the outlook for energy bills in sectors that are eligible for compensation or exemption from the cost of low-carbon policies. We also present case studies demonstrating the potential for savings through energy efficiency improvement.

Our key messages are:

- **Current bills and changes since 2004.** In 2013, firms faced an average grid electricity price of 8.1 p/kWh, of which 1.8 p/kWh was due to low-carbon policies, and a gas price of 2.7 p/kWh, of which 0.1 p/kWh was from low-carbon policies. Overall, energy costs currently make up around 2.3% of total costs across the industrial sector, although this varies between sub-sectors. Low-carbon policy costs contribute around 0.3% of total costs. From 2004 to 2013, average industrial sector energy bills increased by 140% to 145% in nominal terms, primarily due to increases in the wholesale price of electricity and gas. Between a fifth and a third of the increase was due to low-carbon policies, with the share varying depending on the share of electricity in total energy spend.
- **Outlook for energy bills.** Depending on the share of electricity in total energy use, we estimate that bills could increase from 2013 to 2020 by 10-15% in real terms due to low-carbon policy costs (5-20% under a range of carbon and gas price assumptions) and 20-30% to 2030 (10-50% under a range of carbon and gas price assumptions). We estimate that the costs of meeting carbon budgets will lead to a real-terms increase of 0.3% in total sector costs to 2020 and 0.6% to 2030, equivalent to a 3 and 6 pence increase on £10 worth of goods or services.
- **Energy efficiency.** Opportunities are available for offsetting part of the bill increase through energy efficiency measures – we estimate potential savings of around 5% on bills on average across industry to 2020 and 9% to 2030 for energy-intensive industries. If our relatively conservative assessment of potential savings (i.e. 5% compared to the 6% to 20% identified in DECC's Energy Efficiency Strategy) were realised, then energy costs as a proportion of total industrial sector costs would not increase from 2013 to 2020.

1 Energy-intensive industries are defined as those with energy spend of 10% of their Gross Value Added or more.

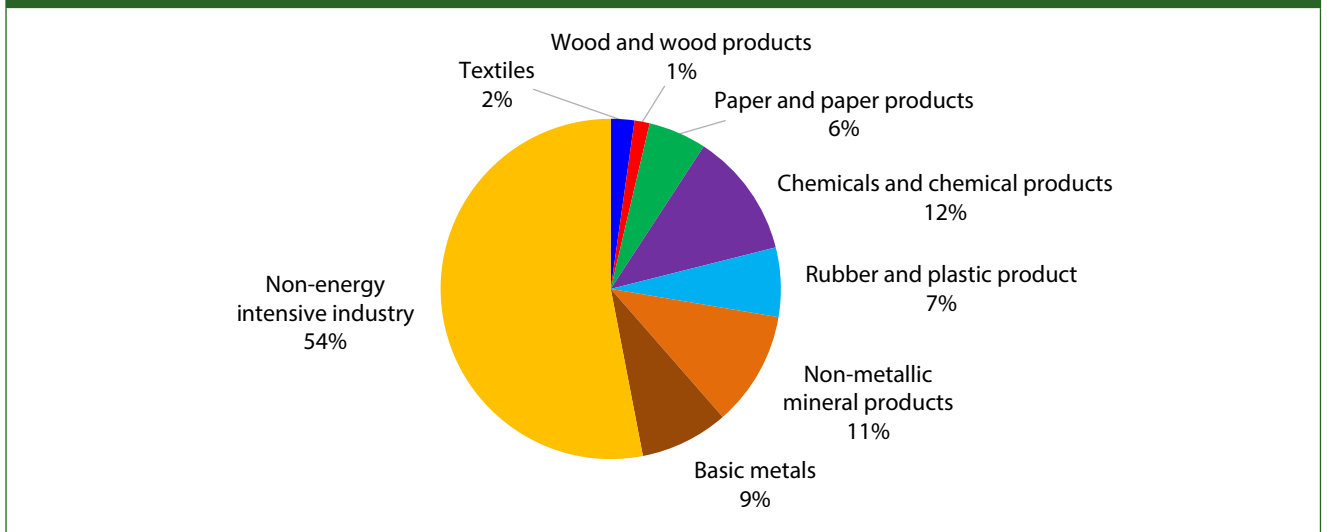


- Competitiveness impacts.** It is important to ensure that increased energy costs resulting from low-carbon policies do not result in offshoring of UK industry. There has been no significant industry relocation as a result of low-carbon policies to date. The £500 million total annual value of all the governments announced compensation measures is in line with our estimates of support needed to 2020.

We set out our analysis that underpins these messages in four sections:

- 4.1 Current industrial energy prices and bills
- 4.2 Changes in industrial energy prices and bills since 2004
- 4.3 Outlook for industrial energy prices and bills to 2020 and 2030
- 4.4 Energy-intensive industries and potential competitiveness impacts

Figure 4.1: Industrial energy consumption by sector (2013)



Source: CCC calculation based on data provided by the Environment Agency and DECC *Energy Consumption in the UK 2014*
Notes: Sector disaggregation is shown for energy-intensive industries (defined as those with energy spend of 10% of their GVA or more). Non-energy-intensives industries are reported in aggregate, but include many smaller sectors (e.g. manufacturing of electrical equipment, furniture, etc.).

4.1 Current industrial energy prices and bills

(a) Current industrial energy prices

In 2013, the price of electricity supplied through the grid was on average 8.1 p/kWh, of which 1.8 p/kWh was from low-carbon policies. Electricity prices for industrial customers are generally lower than in the residential and commercial sectors, reflecting direct contracts with suppliers for large electricity consumers. Prices also vary according to other factors such as Climate Change Levy (CCL)² discounts.

- Wholesale cost.** The wholesale cost of electricity was on average 6.3 p/kWh. This is a lower cost than for households, as large industrial consumers of electricity may be able to negotiate lower prices through direct contracts with suppliers. This also reflects lower costs of supply (e.g. connecting directly to the transmission network and avoiding distribution costs) and in some cases flexible users.³

² CCL is a tax on non-residential energy consumption. The main rates of CCL tax the supply of specified energy products such as electricity, gas and coal for use as fuels. Carbon Price Support (CPS) rates of CCL tax the supply of specified energy products such as coal and gas for use in electricity generation.

³ We have not assumed any changes in the relative negotiating power of industry, commercial firms or households over time. We note, however, that the importance of flexibility in demand is likely to increase in future as the share of intermittent generation (e.g. wind) increases; all sectors have opportunities to increase the flexibility of their demand.

- **Support for low-carbon investment.** The carbon price effectively contributed 0.2 p/kWh to the electricity price paid by an energy-intensive user receiving compensation for the indirect cost of the EU Emission Trading Scheme (EU ETS)⁴. For those not receiving compensation, the carbon price impact was 0.4 p/kWh. The Renewables Obligation (RO) and micro-generation Feed-in-Tariffs (FiTs) contributed 1.1 p/kWh.
- **CCL.** On average industry paid 0.27 p/kWh in CCL for electricity. Some industrial users will face the full cost of the CCL on their electricity use (i.e. 0.5 p/kWh in 2013). However, the majority of industrial electricity consumption (57%) is by firms with Climate Change Agreements (CCAs)⁵ who receive a 90% discount⁶ on the CCL (i.e. they pay 0.05 p/kWh).
- **CRC.** Electricity consumption by industry not covered by the EU ETS or CCAs, which is around 13% of industrial electricity consumption, is subject to an additional cost of 0.65 p/kWh under the CRC Energy Efficiency Scheme.⁷ The CRC contributed an average 0.1 p/kWh towards the electricity price.

Although many industrial users are covered by the EU ETS, they currently receive many of their allowances for free and there is a large surplus of allowances.⁸ The EU ETS therefore has not yet significantly affected their costs, and we have not included these costs above that paid for the carbon price.⁹

The cost of electricity supplied through autogeneration (i.e. generated on-site, see Box 4.1) was 6.1 p/kWh, of which 0.2 p/kWh was due to low-carbon policies. Autogeneration is not exposed to many of the costs of electricity bought through a supplier and delivered through the national grid. In particular, autogeneration avoids costs in transmission, distribution and metering, as well as costs of supporting low-carbon generation (which are paid via electricity suppliers).

Box 4.1: Autogeneration

Autogeneration is defined as the generation of electricity by a company whose main business is not electricity generation, with the electricity being produced mainly for that company's own use.

In 2013, 9 TWh of electricity was consumed on site (out of a total of 13 TWh generated through autogeneration) and the rest sold back to the grid. Natural and process gases (blast furnace/coke oven gas) make up the majority of fuels used for autogeneration (53% and 32% respectively), with the remainder a combination of renewables/wastes (9%) and coal/petroleum (5%).

We include all autogeneration costs in our assessment of electricity prices and bills, but note that heat for use in industrial processes is also produced. We do not cover electricity sold back to the grid.

- 4 In 2013, the government introduced a scheme to compensate up to 85% of the indirect cost of the ETS for those energy-intensive sectors at risk of offshoring and carbon leakage from international competition. See section 4.3(a) and 4.4 for more discussion on compensation and exemption schemes.
- 5 Climate Change Agreements (CCAs) are voluntary agreements that allow eligible energy-intensive sectors to receive up to 90% reduction in the Climate Change Levy if they sign up to energy efficiency targets agreed with government.
- 6 CCC calculations based on average CCL paid and CCL rates.
- 7 The CRC energy efficiency scheme is designed to target emissions not already covered by Climate Change Agreements (CCAs) and the EU Emissions Trading System (EU ETS). Organisations which participate within the CRC are required to monitor their energy use, and report their energy supplies annually. Participants must purchase and surrender allowances to offset their emissions. Allowances can either be bought at annual fixed-price sales, or traded on the secondary market.
- 8 Auctioning for the industrial sector has previously been minimal, but has begun to increase from the start of Phase III of the scheme in 2013.
- 9 This does not preclude the possibility for the EU ETS to have an impact at the margin (i.e. the opportunity cost of using allowances may encourage firms to take actions to reduce their emissions and may be reflected in final goods prices).



Box 4.1: Autogeneration

In 2013, industrial autogeneration had an overall electrical efficiency of 38% (i.e. the electricity energy produced was equivalent to 38% of the fuel energy used for its generation).

Combined Heat and Power (CHP) provides around 75% of total autogeneration. CHP units had an overall efficiency of 68% (i.e. including the production of heat).

The main drivers of the cost of electricity from autogeneration are the wholesale fossil fuel price and electrical efficiency of the autogeneration units, with a lower impact from the cost of low-carbon policies than for grid electricity:

- Costs paid via electricity suppliers (i.e. support under the Renewables Obligation and Electricity Market Reform) do not apply to autogeneration.
- Autogeneration from CHP (75%) is exempt from the Climate Change Levy (CCL) paid on electricity produced.
- The Government plans to exempt the Carbon Price Support (CPS) rates of CCL of the fuels used to generate the electricity if it qualifies as Good Quality CHP under the UK's CHP Quality Assurance scheme.
- Much of the remainder will not face the full CCL cost as it is covered under Climate Change Agreements (CCAs) and thus eligible for the 90% discount.

The decision to use autogeneration depends upon the availability of low-cost fuel (e.g. blast furnace gas for iron and steel), efficiency of the unit and the cost of the alternative (grid-supplied electricity). There is therefore a risk of increased emissions if higher electricity prices for grid-supplied electricity provide an incentive to shift towards autogeneration with a higher carbon intensity.

Source: DECC (2014) *Digest of UK Energy Statistics* (DUKES).

The average industrial gas price was 2.7 p/kWh, of which 0.1 p/kWh was from low-carbon policies including the CCL and CRC Energy Efficiency Scheme.

Comparing UK industrial electricity and gas prices in 2013 against other countries that make up the EU 15 shows that the UK had one of the lowest gas prices, and average electricity prices (Box 4.2).

The most recent energy price statistics indicate that for manufacturing industries, average gas prices have been 6% lower in 2014. Average electricity prices have remained relatively flat.

Box 4.2: Comparison of industrial energy prices for the EU 15

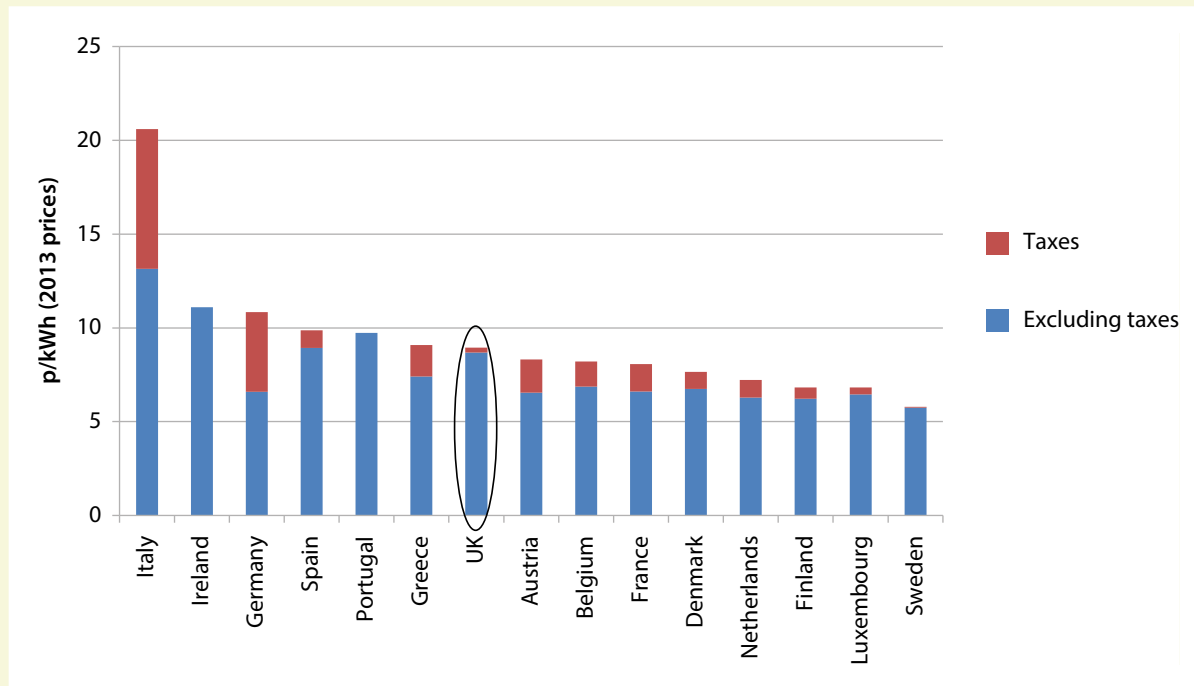
Comparing UK industrial electricity and gas prices in 2013 against other countries that make up the EU 15 shows that the UK had one of the lowest gas prices, as well as average electricity prices.

- The UK industrial electricity price is in the middle of the pack compared to the EU 15, with the highest prices paid in Italy, Ireland and Germany. The UK has a higher than average electricity pre-tax price but a relatively low level of tax on electricity consumption (Figure B4.1).
- The UK has the third lowest gas price (behind the Netherlands and Belgium), with the highest prices paid in Sweden and Denmark. This partly reflects a relatively low amount of tax levied on energy consumption (Figure B4.2).

Eurostat, which collects these statistics, does not provide a breakdown of taxes and levies.

Box 4.2: Comparison of industrial energy prices for the EU 15

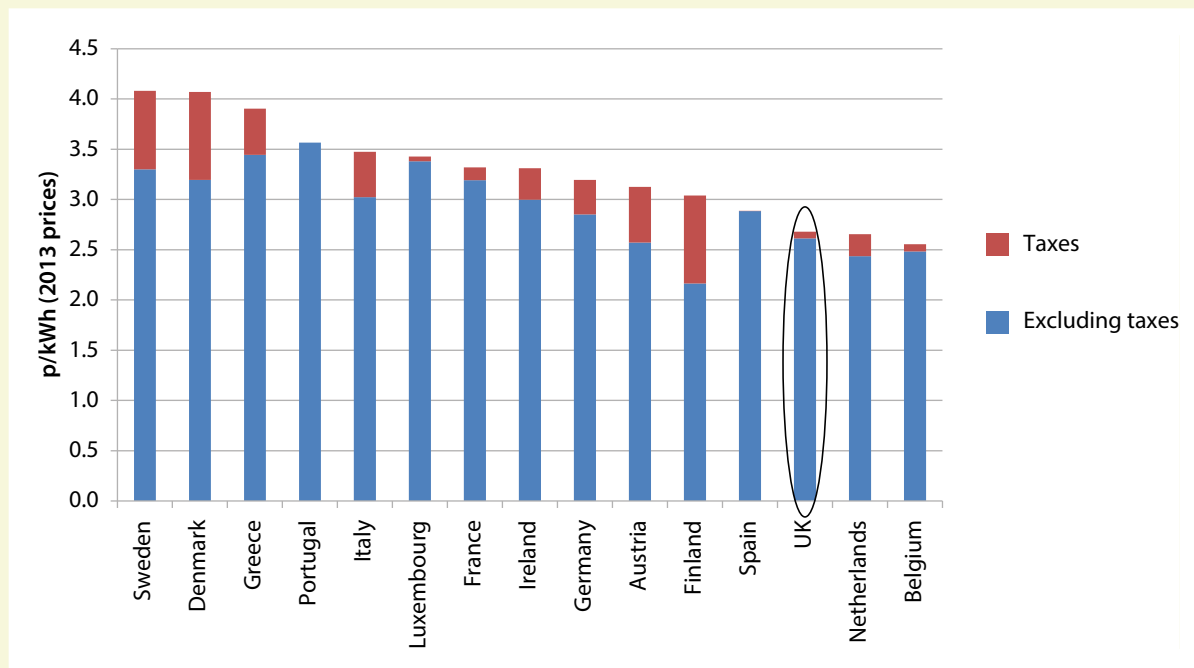
Figure B4.1: Industrial electricity prices across EU with and without taxes (p/kWh, 2013)



Source: Eurostat

Notes: Prices converted to pounds sterling using annual average exchange rates. Prices include all taxes where not refundable on purchase. Prices excluding taxes have been estimated using a weighted average of general sales taxes and fuel taxes levied by individual states.

Figure B4.2: Industrial gas prices across EU with and without taxes (p/kWh, 2013)



Source: Eurostat

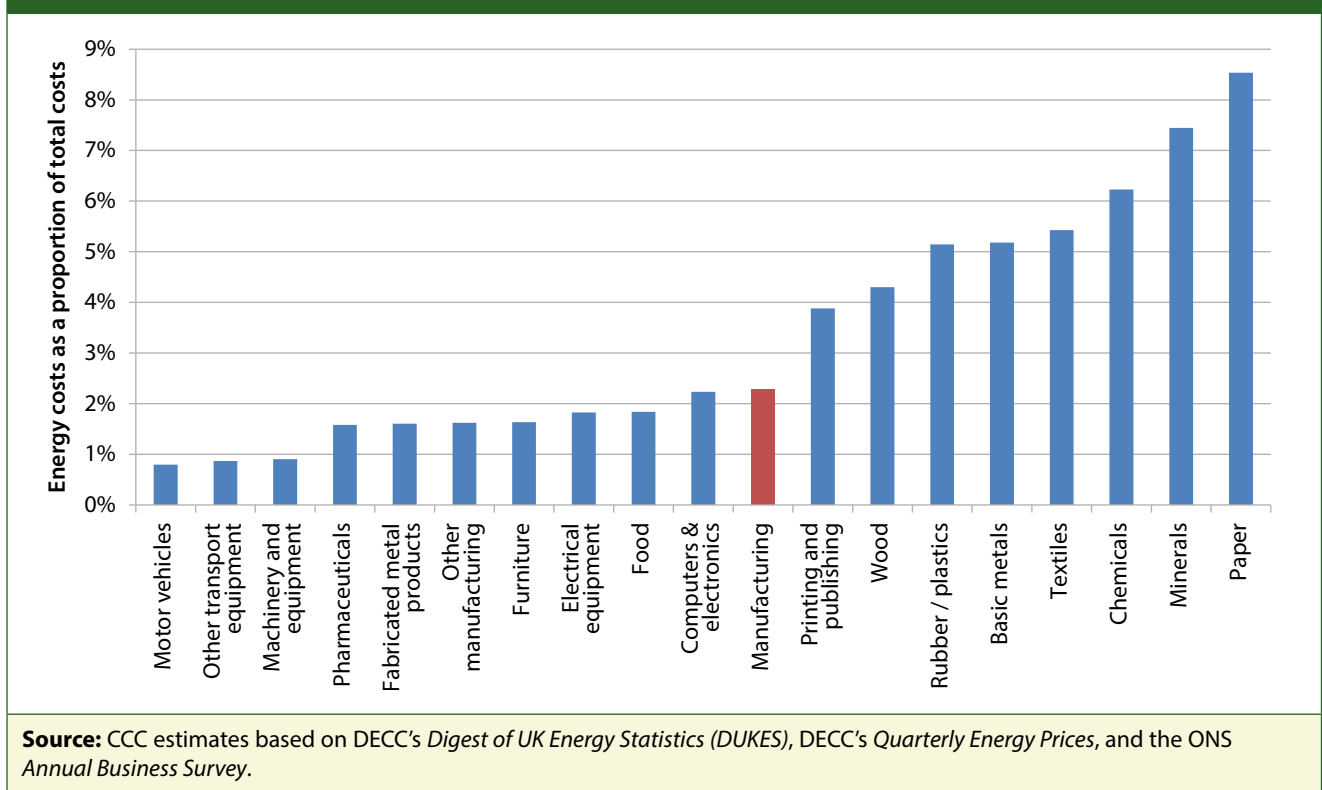
Notes: Prices converted to pounds sterling using annual average exchange rates. Prices include all taxes where not refundable on purchase. Prices excluding taxes have been estimated using a weighted average of general sales taxes and fuel taxes levied by individual states.



(b) Current industrial energy bills

Overall, energy costs make up around 2.3% of total costs across the industrial sector, while costs from low-carbon policies within this contribute around 0.3% of total costs.¹⁰ Energy costs as a proportion of total costs vary between sub-sectors of industry (Figure 4.2).

Figure 4.2: Energy spending as a proportion of total costs by sub-sector (2013)



4.2 Changes in industrial energy prices and bills since 2004

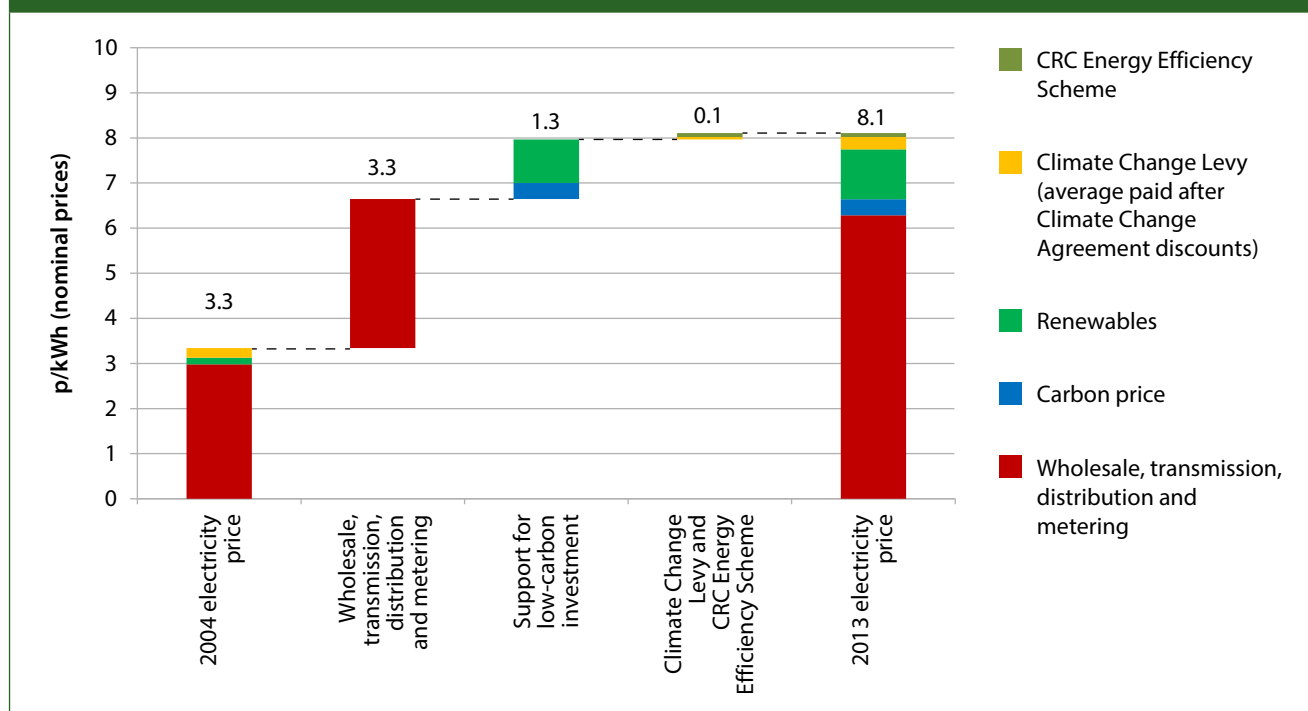
(a) Changes in electricity prices and bills since 2004

From 2004 to 2013, average industrial prices for electricity supplied through the grid rose from 3.3 p/kWh to 8.1 p/kWh in nominal terms (i.e. by 142%, compared to general price inflation of 23%), largely due to increases in wholesale and network costs (Figure 4.3). Nearly a third of this increase was a result of low-carbon policies.

- **Wholesale costs.** Wholesale energy and network costs increased by 3.3 p/kWh.
- **Support for low-carbon investment.** Costs of supporting low-carbon investment increased by the same amount as in the residential and commercial sectors: the carbon price increased electricity prices by 0.4 p/kWh, and the RO and FITs added 1.0 p/kWh.
- **CCL.** Increases in the CCL added just over 0.06 p/kWh on average (i.e. after discounts for CCAs).
- **CRC.** The introduction of the CRC Energy Efficiency Scheme added around 0.09 p/kWh on average.

¹⁰ CCC estimate based on the DECC (2014) *Digest of UK Energy Statistics (DUKES)*, DECC (2014) *Quarterly Energy Prices*, and the ONS *Annual Business Survey*.

Figure 4.3: Change in average retail industrial electricity price (purchased via a supplier, 2004 to 2013)



Source: CCC calculation based on DECC *Quarterly Energy Prices* Table 3.1.4. Prices for 'average' consumer

From 2004 to 2013, we estimate that industrial autogeneration costs increased from 2.9 p/kWh to 6.1 p/kWh in nominal terms, an increase of 115%. This increase was almost entirely due to increases in wholesale fuel costs.

- **Wholesale costs.** Wholesale costs of fuel input rose by 2.9 p/kWh.¹¹
- **CCL.** The average rate of CCL paid on electricity increased by 0.01 p/kWh.
- **CPS rates for CCL.** The introduction of Carbon Price Support (CPS) rates of CCL for fuel used for autogeneration added 0.1 p/kWh in 2013.

Taking grid supplied electricity and autogeneration together, average electricity prices for industry rose 139%, from 3.3 p/kWh in 2004 to 7.8 p/kWh in 2013 in nominal terms.

Between 2004 and 2013, total electricity costs as a share of total sector costs increased from 1.0% to 1.5%. This takes into account the change in prices, consumption and total sector costs (i.e. including all energy, materials and labour costs) together. Low-carbon policy costs on electricity as a share of total sector costs increased from 0.1% in 2004 to 0.3% in 2013. This increase was partially due to increased cost of low-carbon policy, but also a shift away from autogeneration to electricity supplied from the grid which includes costs of supporting low-carbon investment.

¹¹ Based on fuel input data from DECC (2014) *Digest of UK Energy Statistics* (Table 7.2).

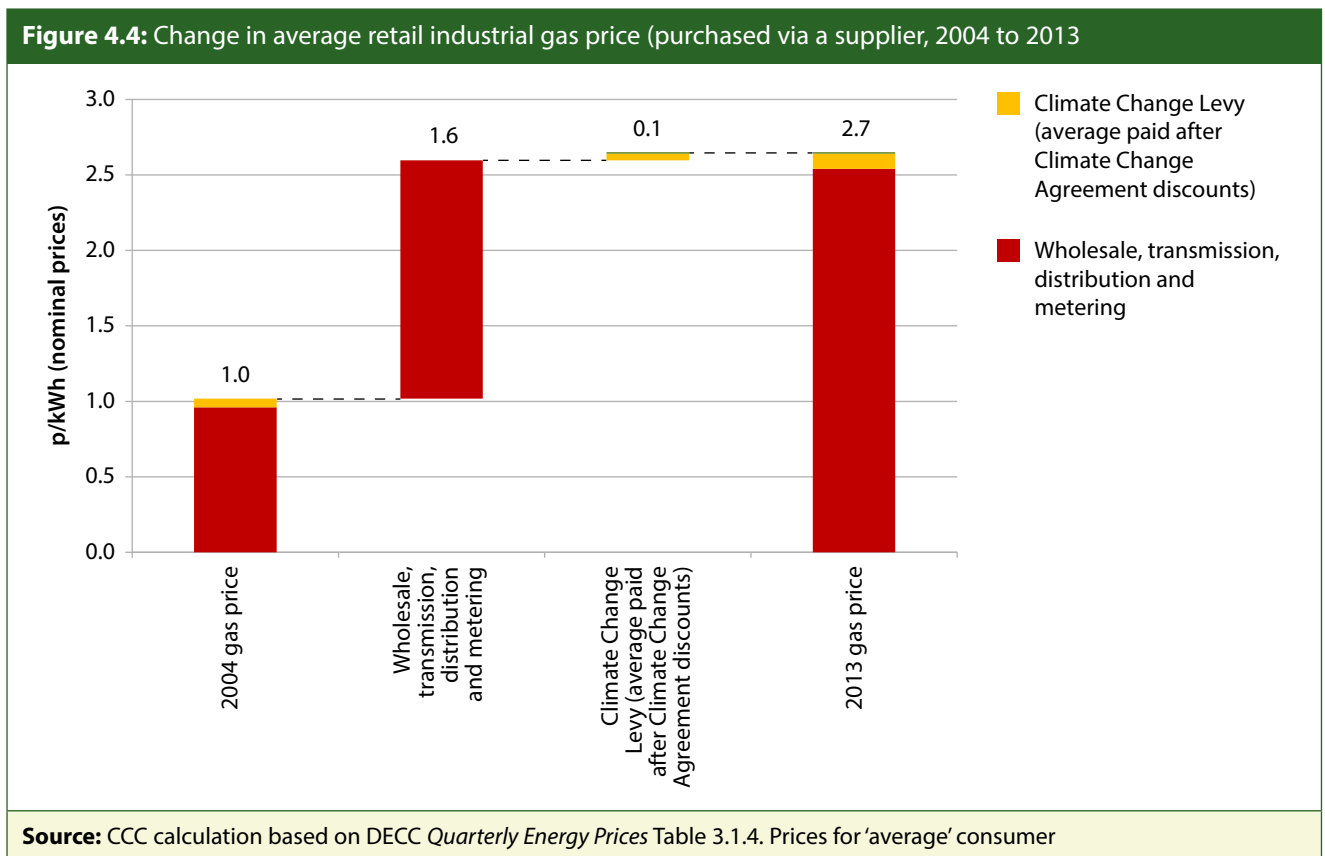


(b) Changes in prices and bills for gas and other fuels since 2004

Prices for all fuels used directly in industry rose from 2004 to 2013¹², largely due to factors unrelated to low-carbon policy.

- Industrial gas prices rose from 1.0 p/kWh to 2.7 p/kWh in nominal terms (161%, compared to general price inflation of 23%, Figure 4.4). As with other sectors, this was almost entirely due to increases in wholesale and network costs.
- Industrial coal prices rose from 0.7 p/kWh to 1.1 p/kWh (62%).
- Prices for gas oil rose from 2.5 p/kWh to 6.0 p/kWh (144%).

The CCL currently adds around 0.1 p/kWh to the industrial gas price. Some industrial users will face the full cost of CCL on their gas use (i.e. 0.15 p/kWh). However, half of industrial gas consumption¹³ is by firms with Climate Change Agreements (CCAs), which receive a 65% discount on the CCL (i.e. they pay 0.05 p/kWh). The CCL adds less than 0.1 p/kWh on average to coal prices, allowing for discounts under CCAs.¹⁴



Between 2004 and 2013, industrial consumption of gas fell by 37%; consumption of solid and manufactured fuels fell by 2%, while for petroleum products it fell by 37%. These reductions reflect falling output during the recession.

¹² Source: DECC (2014) *Quarterly Energy Prices*, Table 3.1.4. Average across all size bands.

¹³ CCC calculations based on average CCL paid and CCL rates.

¹⁴ The CCL is not charged on oil products.

Taking prices, consumption and total sector costs together, between 2004 and 2013 non-electricity energy costs fell from 1.2% of total costs to 0.8%. The CCL and CRC accounted for around 0.02% of total sector costs in 2013.

(c) Changes in combined energy bills since 2004

We now consider the combined effect of changes in electricity and other fuel prices on total energy costs for the industrial sector. We first look at the impact of price changes alone, and then at the effect of changing energy consumption and total sector costs.

Combined energy costs for industrial users increased by 144% on average in nominal terms between 2004 and 2013 (compared to general price inflation of 23%) as a result of higher energy prices, mainly reflecting increases in the wholesale cost of fossil fuels. Low-carbon policies added 24% to the bill, with the other 120% due to wholesale and network costs (Table 4.1).

- For energy-intensive industry (EII),¹⁵ energy costs rose by around 142% on average between 2004 and 2013 as a result of higher energy prices. Low-carbon policies added 29% to the bill, with the other 113% was due to wholesale and network costs.
- For non-energy-intensive industry (non-EII), energy costs rose by around 145% on average between 2004 and 2013 as a result of higher energy prices. Low-carbon policies added 20% to the bill, with the other 125% due to wholesale and network costs.

Table: 4.1: Energy bill impact for different industry groups (2004 to 2013)

		Non Energy-intensive	Industry Average	Energy-intensive
Shares of total energy spend (2013)	Grid	44%	52%	64%
	Autogen	2%	4%	7%
	Gas	18%	20%	23%
	Other	36%	24%	7%
Total increase in energy prices from 2004 to 2013 (of which, increase due to low-carbon policy)	Grid	142% (31%)		
	Autogen	115% (4%)		
	Gas	161% (3%)		
	Other	143% (0%)	137% (0%)	104% (2%)
Increase in total energy bill from 2004 to 2013 (of which, increase due to low-carbon policy)		145% (20%)	144% (24%)	142% (29%)
Note: For fixed level of consumption based on 2013. Numbers in brackets show percentage increase in prices/bills on 2004, due to low-carbon policy only. Energy-intensive industries are defined as those with energy spend of 10% of their GVA or more. These sectors include textiles, wood, paper, chemicals, rubber and plastic, non-metallic minerals, basic metals. Non-energy intensives comprise of many smaller sectors (e.g. manufacturing of electrical equipment, furniture, etc). Change in price of other fuels differs in sectors according to the mix of consumption of oil and solid fuels.				

¹⁵ Energy-intensive industries are defined as those with energy spend of 10% of their GVA or more. These sectors include textiles, wood, paper, chemicals, rubber and plastic, non-metallic minerals, and basic metals. Non-energy intensives comprise of many smaller sectors (e.g. manufacturing of electrical equipment, furniture, etc). Changes in price of other fuels differ in sectors according to the mix of consumption of oil and solid fuels.



Between 2004 and 2013, energy costs as a proportion of sector costs increased from 2.2% to 2.3% across industry. This takes into account increases in total sector costs, reductions in consumption of all fuels, together with increased energy prices. Energy costs resulting from low-carbon policies accounted for around 0.1% of total sector costs in 2004, increasing to 0.3% of total sector costs in 2013.

4.3 Outlook for industrial energy prices and bills to 2020 and 2030

(a) Outlook for electricity prices and bills

Electricity supplied to industry through the grid will face similar price rises as in the commercial sector, allowing for changes in wholesale costs, carbon price, and support for low-carbon investment.

We estimate the low-carbon policy cost of electricity supplied through the grid to rise in real terms from 1.8 p/kWh in 2013 to 3.5 p/kWh in 2020 and to 5.8 p/kWh in 2030. Wholesale costs are estimated to fall to 2020, but then rise to 2030 (Figure 4.5):

- **Support for low-carbon investment.** The price of carbon is estimated to increase average electricity prices from 2013 in real terms by 0.5 p/kWh to 2020 and 2.3 p/kWh to 2030. Support for low-carbon generation¹⁶ is estimated to increase electricity prices from 2013 in real terms by 1.3 p/kWh to 2020 and 1.8 p/kWh to 2030.
- **CCL and CRC.** We assume the cost of the CCL stays constant in real terms from 2013 and that the cost of the CRC falls in real terms by 0.1 p/kWh to 2030, due to a decrease in power sector emissions.
- **Wholesale and network costs.** Wholesale energy and network costs are estimated to fall from 2013 in real terms by 1.0 p/kWh to 2020, and then rise 0.7 p/kWh to 2030¹⁷.

Overall, we estimate the cost of electricity to rise in real terms from 8.1 p/kWh in 2013 to 8.9 p/kWh (9%) in 2020 and 11.9 p/kWh (46%) in 2030.

These increases do not apply in all sectors, as discussed in the next section.

Outlook for sectors with compensation & exemption

We have included an illustrative set of estimates which allow for compensation or exemption from support for low-carbon investment for at risk energy-intensive sectors:

- A small number of electro-intensive industries face international competition from countries that are yet to introduce similar support for low-carbon investment, resulting in possible risks of offshoring of economic activity and emissions.

¹⁶ This includes the Renewables Obligation, Feed-in-tariffs and Contracts for Difference.

¹⁷ As discussed in Chapter 3, these wholesale and network costs are a combination of DECC's fossil fuel price projections, assumptions on supplier margins and changes in network costs.

-
- In response, the UK Government has introduced compensation for EU ETS and the Carbon Price Floor¹⁸, with compensation plans for the Renewables Obligation and micro-generation Feed-in-Tariffs, plus exemption from Electricity Market Reform (EMR) and the costs of Contracts for Difference (CfD)¹⁹. These are due to offset up to around 80% of the costs to support low-carbon investment for those sectors that qualify through to 2020.

We have also included an estimate of the impact that these compensation and exemption arrangements would have for those eligible sectors energy costs through to 2020 and 2030.

There may not be a need for this level of compensation or exemption to 2030. If there is continued risk of competition from countries without similar carbon constraints and associated costs, then compensation and exemption would need to continue. However, if there does not appear to be risk of offshoring due to low-carbon policies, then the Government could reduce the level of compensation and exemption.

We discuss the potential competitiveness impact of low-carbon policy through to 2020 in section 4.4.

We estimate that the full potential compensation and exemption package²⁰ (if maintained through to 2030) makes a significant difference to low-carbon policy costs:

- In 2020 the price of electricity is estimated to be 8.9 p/kWh, of which 3.5 p/kWh from low-carbon policies. The compensation and exemption schemes will offset up to 2.6 p/kWh of this, reducing the low-carbon policy cost to 0.9 p/kWh and the cost of electricity to 6.2 p/kWh.
- In 2030 the price of electricity is estimated to be 11.9 p/kWh, of which 5.8 p/kWh from low-carbon policies. If the compensation and exemption schemes continue to 2030, this would offset up to 4.4 p/kWh of this, reducing the low-carbon policy cost to 0.9 p/kWh and the cost of electricity to 7.4 p/kWh (Figure 4.5).

Therefore the compensation and exemption schemes could mean that both the cost of support low-carbon investment and the overall cost of eligible electricity consumption is lower in 2020 and 2030 than in 2013 in real terms.

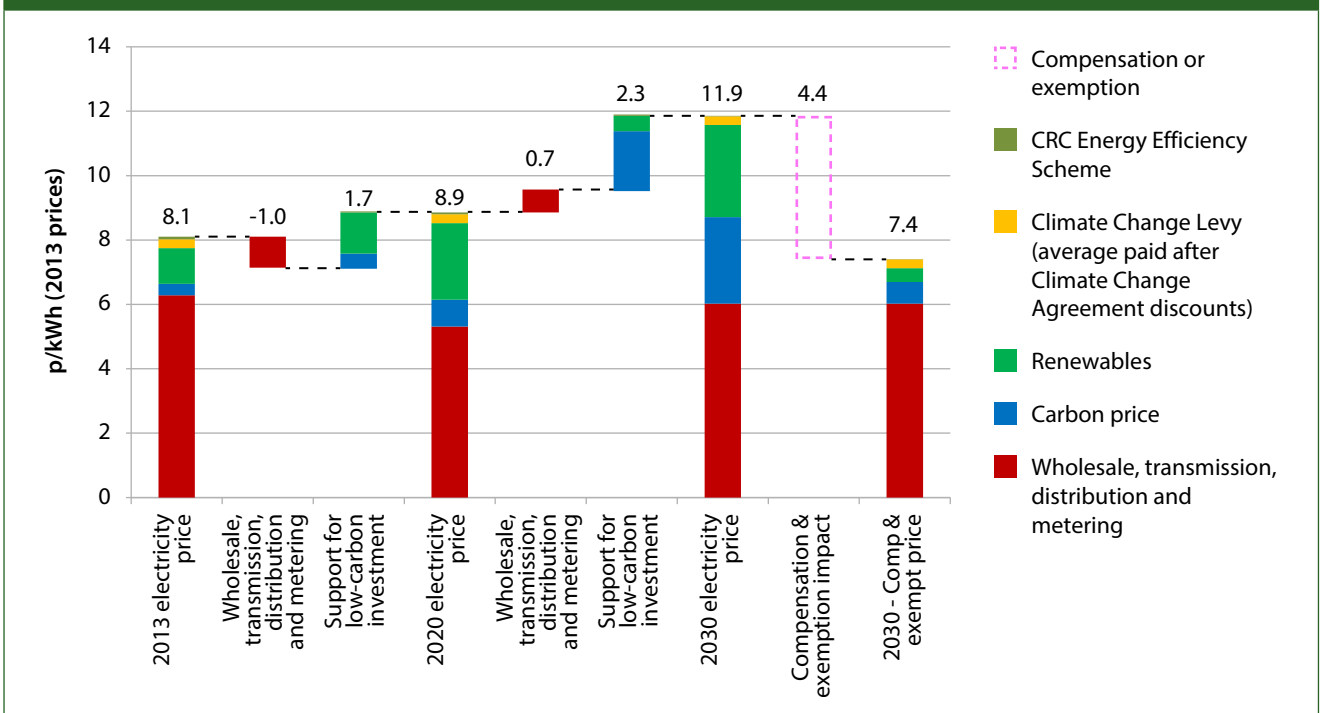
18 Carbon Price Floor (CPF) is a minimum carbon price for fuels, where the Carbon Support Price tops up the carbon price from the EU ETS to the CPF.

19 Subject to State Aid approval.

20 This is an upper-bound estimate based on the maximum compensation of 75% of the cost of the EU ETS and Carbon Price Support, compensation of 85% of the cost of the Renewables Obligation and micro-generation Feed-in-tariff, and 85% exemption of the cost of Contracts for Difference.



Figure 4.5: Outlook for industrial price for electricity supplied from the grid (2013, projected 2020 and 2030)



Source: CCC estimate based on DECC *Quarterly Energy Prices* Table 3.4.1. Prices for 'average' consumer and DECC *Fossil Fuel Price Projections*

Notes: The 'Compensation or exemption price' is the cost per kwh of electricity consumption that qualifies for compensation or exemption from support for low-carbon investment. This is not the initial price of electricity paid, but the 'effective' cost once the compensation has been taken in to account. We have assumed that 75% of the cost of the EU ETS and CPF is compensated and 85% of the costs of the RO, FITs, EMR and CfD are either exempt or compensated for.

Autogeneration

Industrial autogeneration costs are expected to increase due to higher wholesale energy costs and carbon price support. We estimate that the low-carbon policy cost of electricity from autogeneration will remain constant in real terms around 0.2 p/kWh in 2013 through to 2030:

- **CCL.** We assume that the cost of the CCL for electricity generated will stay constant in real terms from 2013 to 2030.
- **CPS rates of CCL.** We assume that the Carbon Price Support (CPS) rates of CCL for fuel used in autogeneration will increase to the equivalent of £18/tCO₂ and then remain constant (i.e. aligned with announced Carbon Price Support policy). We have assumed that these rates will not apply to good quality CHP production of electricity and that this constitutes 75% of industrial autogeneration.
- **Wholesale cost.** Under DECC's central fossil fuel price scenario, the wholesale cost of fuel input is estimated to fall in real terms from 4.5 p/kWh in 2013 to 4.0 p/kWh in 2020 and then rise to 4.7 p/kWh in 2030.

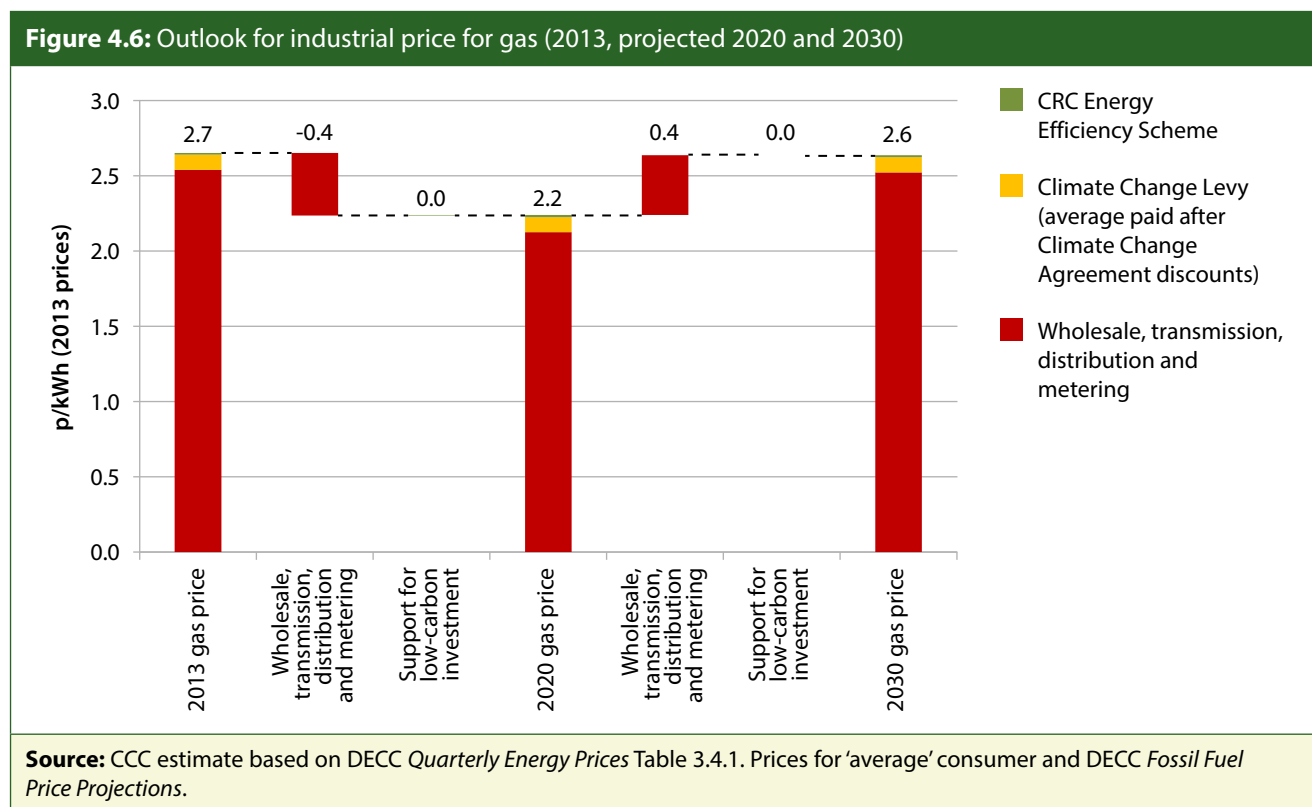
We estimate industrial autogeneration costs in total to fall in real terms from 6.1 p/kWh in 2013 to 5.7 p/kWh (-7%) in 2020 and then rise to 6.4 p/kWh (4%) in 2030.

Autogeneration produced with fuel consumption covered by the EU ETS may include additional costs of purchasing emission allowances. There is a sufficient surplus and free allowance available in the EU ETS to cover all industrial fuel use to 2020. However, it is uncertain if there will be surplus or free allowances by 2030. If there is continued risk of competition from countries without similar carbon constraints, then free allocation may need to continue. However, if there does not appear to be risk of competition then the cost of autogeneration from fuel consumption covered by the EU ETS may rise in real terms to 8.0 p/kWh in 2030.

Taking grid supplied and autogeneration together, the average electricity price for industry that is not eligible for compensation and exemptions is estimated to rise in real terms from 7.9 p/kWh in 2013 to 8.6 p/kWh (8%) in 2020 and to 11.3 p/kWh (43%) in 2030.

(b) Outlook for other fuels

Under DECC's central fossil fuel price scenario, the wholesale cost of gas will reduce the average industrial gas price in real terms from 2.7 p/kWh in 2013 to 2.2 p/kWh in 2020, before increasing to 2.6 p/kWh in 2030 (Figure 4.6).

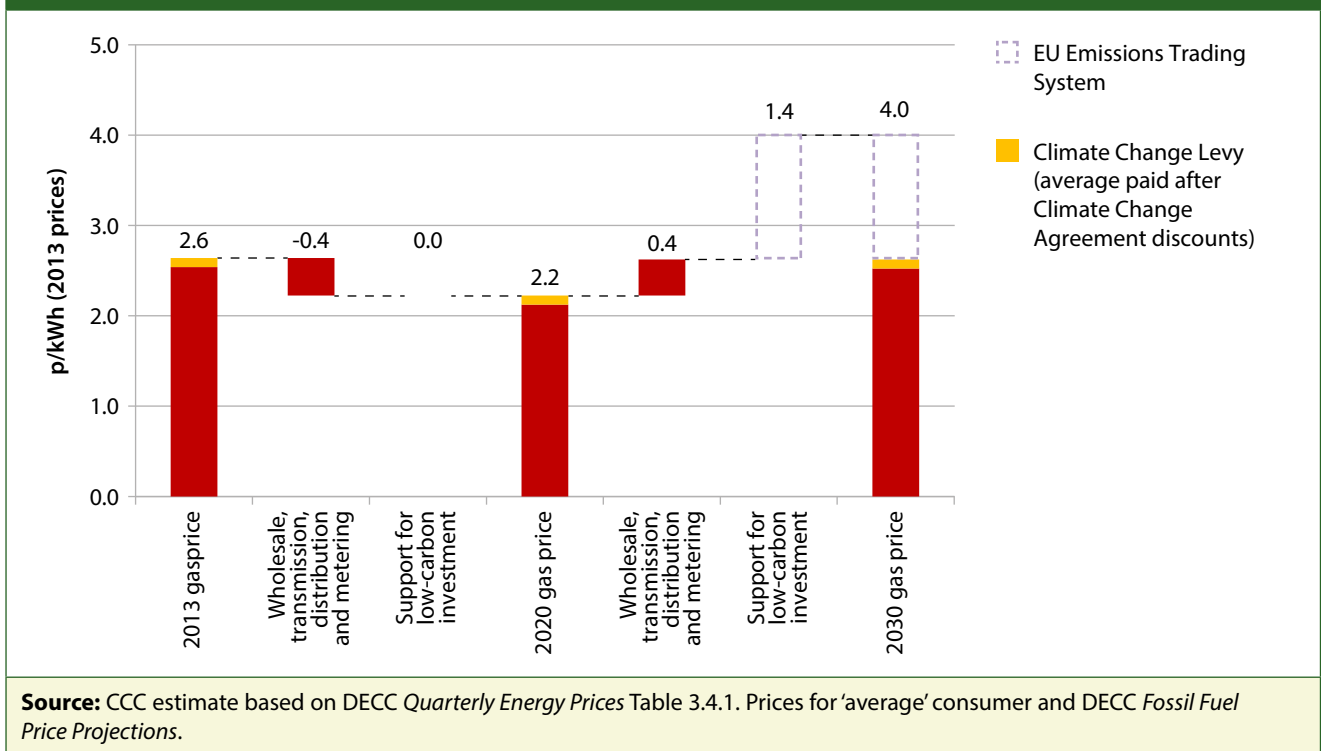


The only costs related to low-carbon policies for fuels other than electricity are through the EU ETS and the CCL (which, as above, we assume stays constant in real terms). As discussed, it is uncertain if there will be surplus allowances by 2030. If there is a need to purchase emissions allowances, then the cost of gas consumption covered by the EU ETS may rise in real terms from 2.6 p/kWh in 2013 up to 4.0 p/kWh in 2030 (Figure 4.7)²¹.

²¹ Figure 4.7 does not include cost of the CRC, as gas consumption within the EU ETS would not also be covered by the CRC.



Figure 4.7: Outlook for industrial price for gas consumption within the EU ETS (2013, projected to 2020 and 2030)



(c) Outlook for combined energy bills to 2020 and 2030 in the industrial sector

The impacts of projected changes in prices of electricity and other fuels for combined energy bills will differ across industry groups depending on the fuel mix:

- For a firm where all its electricity use is eligible for compensation and exemption, the impact of low-carbon policies on energy costs will effectively fall in real terms from 2013 by 6% by 2020 and 3% by 2030. This fall is due to the additional compensation and exemption schemes that could mean the cost of support for low-carbon investment for eligible electricity consumption is lower in 2020 and 2030 than in 2013. (Table 4.2 and Figure 4.8).
- For a firm not eligible for compensation and exemption, then we estimate that from 2013, low-carbon policies may add in real terms 9%-14% to energy costs for industrial users by 2020 and 22%-32% by 2030.
- Under DECC's central fossil fuel price scenario and with no change in energy consumption, we estimate that from 2013 wholesale costs will reduce energy costs for industrial users by 5%-10% by 2020, but increase energy costs by up to 6% by 2030.

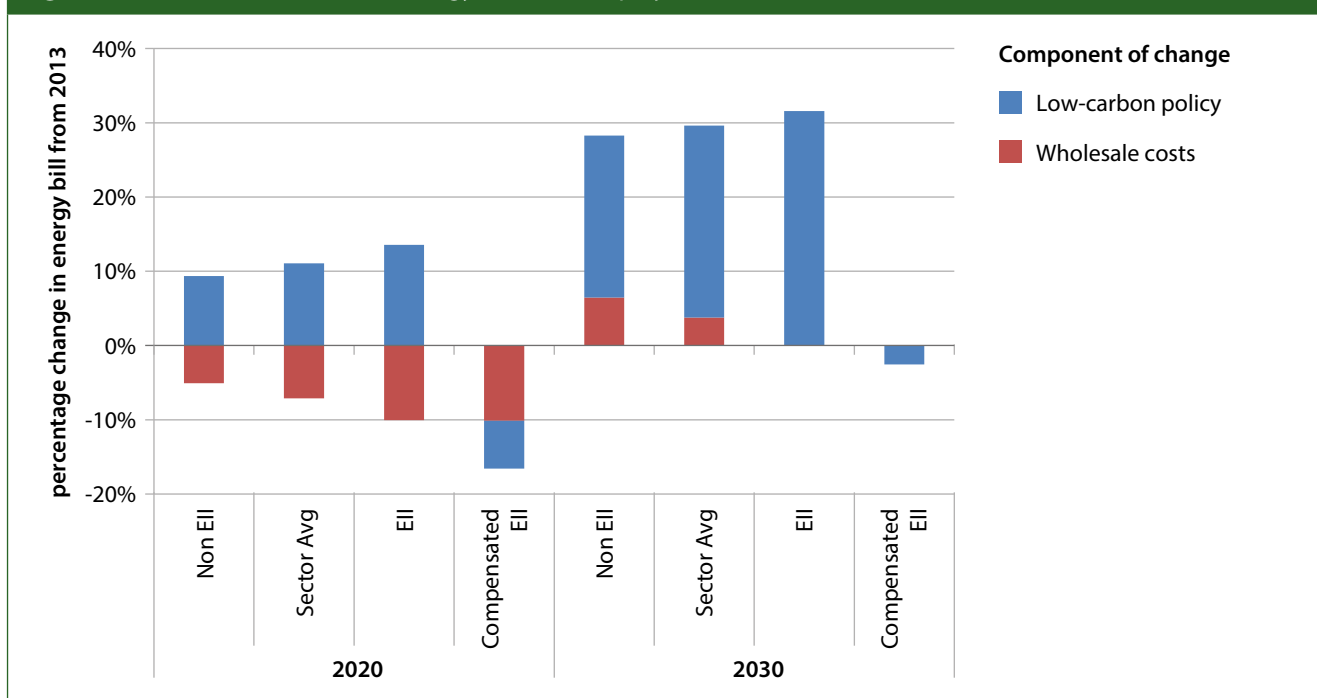
Overall, for a firm where all its electricity use is eligible for compensation and exemption, we estimate energy costs to fall in real terms from 2013 by 17% to 2020 and 3% to 2030. For a firm not eligible for compensation and exemption, we estimate energy costs to increase in real terms from 2013 by around 4% to 2020 and 28%-32% to 2030.

Table 4.2: Projected energy bill impact for different industry groups (2013 to 2020 and 2030)

		Non EII	Sector Total	EII	EII with compensation & exemption
Shares of total energy spend (2013)	Grid	44%	52%	64%	64%
	Autogen	2%	4%	7%	7%
	Gas	18%	20%	23%	23%
	Other	36%	24%	7%	7%
Projected increase in energy prices from 2013 to 2020 (of which, increase due to low-carbon policy)	Grid	9% (21%)			-22% (-10%)
	Autogen	-7% (0%)			-7% (0%)
	Gas	-16% (0%)			-16% (0%)
	Other	9% (0%)	10% (0%)	24% (0%)	24% (0%)
Increase in total energy bill from 2013 to 2020 (of which, increase due to low-carbon policy)		4% (9%)	4% (11%)	4% (14%)	-17% (-6%)
Projected increase in energy prices from 2013 to 2030 (of which, increase due to low-carbon policy)	Grid	46% (49%)			-7% (-4%)
	Autogen	4% (0%)			4% (0%)
	Gas	-1% (0%)			-1% (0%)
	Other	22% (0%)	23% (0%)	28% (0%)	28% (0%)
Increase in total energy bill from 2013 to 2030 (of which, increase due to low-carbon policy)		28% (22%)	30% (26%)	32% (32%)	-3% (-3%)

Note: For fixed level of consumption based on 2013. Numbers in brackets show percentage increase in prices/bills on 2004, due to low-carbon policy only. Energy-intensive industries are defined as those with energy spend of 10% of their GVA or more. These sectors include textiles, wood, paper, chemicals, rubber and plastic, non-metallic minerals, basic metals. Non-energy intensives many smaller sectors (e.g. manufacturing of electrical equipment, furniture, etc.). Change in price of other fuels differs in sectors according to the mix of consumption of oil and solid fuels.

Figure 4.8: Outlook for industrial energy costs (2013, projected 2020 and 2030)



Source: CCC Estimates



In 2013, low-carbon policy costs were between 11%–16% of energy costs and this is projected to rise to 19%–28% by 2020 and 25%–36% by 2030 (Table 4.3). For energy-intensive firms eligible for compensation and exemption from support then low-carbon policy costs were 15% in 2013; we estimate this to fall to 10% by 2020 and then rise to 13% by 2030.

Table 4.3: Low-carbon policy as a % of energy costs for different industry groups (2013 to 2020 and 2030)

Low carbon policy as a % of energy costs	2013	2020	2030
Non-energy intensive	11%	19%	25%
Industry average	13%	23%	30%
Energy-intensive	16%	28%	36%
Energy-intensive, compensated	15%	10%	13%

Notes: CCC estimates.

(d) Uncertainties in future energy prices

These estimates are for a central case. However, there is considerable uncertainty around them, for example related to projected gas and carbon prices.

- If gas prices are low, then the percentage impact of low-carbon policies will be highest, with energy costs rising in real terms from 2013 by 10–15% by 2020, and 30–44% by 2030. However, overall bills will fall -2% to -6% by 2020 and rise less (23–25%) to 2030 than with central prices.
- If gas prices are high, bills will increase by more overall (by 15–19% to 2020 and 33–38% to 2030), but the impact of low-carbon policies will be lower, rising from 2013 at 8–12% to 2020 and 13–19% to 2030.
- If carbon prices rise to meet DECC’s high scenario (£114/tCO₂ in 2030) – for example because options to meet an ambitious global agreement are more costly – then the bill increase from low-carbon policies overall would be higher (24–34% by 2030), but the bill increase from direct support for low-carbon investment to reach electricity decarbonisation of 50-100gCO₂/kWh in 2030 would be lowest (4–6%).

These uncertainties demonstrate that low-carbon investment acts to reduce volatility in energy prices and energy bills by reducing exposure to uncertain fossil fuel and carbon prices.

Table 4.4: Industry energy bill impact of low-carbon policy for different carbon and gas prices (2013 to 2020 and 2030)

	2013-2020		2013-2030	
	Low-carbon policy energy cost impact	Total change in energy costs	Low-carbon policy energy cost impact	Total change in energy costs
Central gas and carbon prices	9-14%	4%	22-32%	28-32%
Low gas price	10-15%	-2% to -6%	30-44%	23-25%
High gas price	8-12%	15-19%	13-19%	33-38%
Low carbon price	5-8%	-2%-0%	20-29%	27-29%
High carbon price	12-17%	7%	24-34%	30-34%
Low gas price & high carbon price	13-18%	-2%-1%	32-47%	25-27%
High gas price & low carbon price	4-6%	11-13%	12-17%	31-35%

Notes: The ranges are the difference in average impact between energy intensives (upper bound) and non-energy intensives (lower bound).

(e) Opportunities for energy efficiency

There are many opportunities for energy efficiency improvement in industry. There is evidence of substantial energy savings already having been implemented in a number of industrial firms, including non-energy intensive firms (Box 4.3).

We estimate that opportunities for energy efficiency in use of electricity and other fuels could reduce combined energy bills by at least 5% on average by 2020, and 9% for energy-intensive firms by 2030.²² Offsetting this, we estimate investment costs associated with these measures equivalent to 2% and 4% of energy costs respectively.

DECC has identified in its 2012 *Energy Efficiency Strategy* a larger potential for energy efficiency of around 6% to 20% by 2020. This includes the implementation of both incremental energy efficiency (e.g. more efficient motors) and more substantial refurbishment of existing plant (e.g. relining blast furnaces in the iron and steel sector).

In our 2014 *Progress Report to Parliament*, we concluded there is no clear evidence to date of significant energy efficiency improvement at the aggregate level. This reflects significant capital and deployment constraints (e.g. long lead-times for replacing existing plant such as iron and steel blast furnaces) and weakened incentives for energy efficiency through CCAs and the low price of carbon in the EU ETS.

To ensure sufficiently strong incentives are in place, a higher ambition is required that is consistent with meeting carbon budgets. DECC and BIS are currently working with industry to develop a series of 'Industrial Sector 2050 Decarbonisation Roadmaps'. These roadmaps are investigating the potential carbon abatement options, barriers to deployment and enabling activities that firms,

²² CCC (2013) Fourth Carbon Budget Review.



sectors and government can undertake for eight energy-intensive sectors (iron & steel, paper & pulp, chemicals, glass, ceramics, cement, refineries and food & drink). The roadmaps project is due to be completed by spring 2015. Availability of dedicated finance for energy efficiency opportunities (e.g. through the Green Investment Bank or Electricity Demand Reduction pilot scheme) will also be important in overcoming capital constraints.

Box 4.3: Industrial sector energy efficiency case studies

Construction equipment manufacturer

Measured energy bill savings	19% reduction of heating and lighting bill so far in 2014
Measures installed	Energy management system

JCB is the world's third largest manufacturer of construction equipment, employing 12,000 people worldwide. JCB's main energy use is associated with industrial processes – heating process gas and fans, motors and pumps – as well as lighting.

Since 2008, the company has worked to become more energy efficient, both in response to the rise in costs associated with the CRC Energy Efficiency scheme and to meet environmental objectives. In 2008, JCB installed half-hourly meters across ten sites at a cost of £45,000 and revised light and heat settings, turned down thermostats and encouraged energy conservation behaviours such as ensuring external doors were kept shut.

In 2013, JCB became aware that behaviours towards energy management had relaxed and wanted to improve its understanding of energy use. It added a small number of additional sub-meters to the existing system to improve understanding of energy use by key consumers. Weekly performance reporting and a champions working group were established to increase uptake of the system and to drive ownership of energy consumption across business units.

During 2014 (January to October), JCB's improved energy-management behaviours have helped deliver the equivalent of a 19% reduction in their space heating and lighting bill for UK manufacturing facilities, compared to the same period in 2013.

JCB found the 'back to basics' process to be 'invaluable' in raising awareness of energy management and costs and allocating ownership among staff for making improvements. It now has the confidence to invest in capital-improvement projects knowing that the carbon and cost savings will not be eroded by poor behaviours.

Farm and food manufacturer

Measured energy bill savings	75% of electricity demand from lighting on one site
Measures installed	LEDs, natural ventilation, small wind turbines, voltage optimisation, passive infrared sensors

Noble is the largest egg producer in the UK, with sales of 50 million eggs per week to all the main supermarkets, supplied from a flock of 3 million, as well as from 400 contract producers. The firm also produces Gü desserts and supplies poultry meat.

Their main electricity uses are lighting, ventilation, and blast freezing and chilling for chicken meat.

In 2012, the firm installed a range of measures aimed at drastically cutting its energy bill and improving animal welfare.

Box 4.3: Industrial sector energy efficiency case studies

- It replaced all Compact Fluorescent Lights (CFLs) with LED lighting specifically tailored for poultry.
 - One site replaced 3,600 CFLs with 1,800 LEDs, thereby saving 37,800kWh (75% savings).
 - Two CFLs, each of 14 watts, were replaced by one LED of 7 watts (delivering the equivalent of a 60 watt incandescent bulb). The LEDs require significantly less maintenance as each LED light lasts 50,000 hours, compared to around 1,000 hours for the CFL. LEDs also emit less heat, reducing need for ventilation.
 - Noble also secured a 40-50% discount on the LED price through a bulk order, which led to payback of just one year.
- At the same time, Noble moved from cages to free-range production, significantly reducing the need for powered ventilation.
- It also installed small wind turbines, voltage optimisation and motion sensors.

Following the success of the first round of improvements, the company is now scoping out further improvements including looking at Anaerobic Digestion for poultry litter.

(f) Outlook for energy bills as a share of total costs

In the absence of energy efficiency, our estimated future energy prices imply that energy costs as a proportion of total industrial sector costs would increase from 2.3% in 2013 to 2.4% in 2020 and 2.9% in 2030. The resulting share of energy costs relating to low-carbon policies would increase from 0.3% in 2013 to 0.5% of total costs in 2020 and 0.9% in 2030 (Table 4.5). This will vary for different sectors depending on their energy (especially electricity) intensity (Figure 4.9).

For energy-intensive firms eligible for compensation and exemption from support for low-carbon investment, total costs would fall from an average 6.0% in 2013 to 5.0% in 2020 and then rise to 5.8% in 2030, but will still be lower than in 2013. The resulting share of energy costs relating to low-carbon policies would fall from 0.9% in 2013 to 0.5% of total costs in 2020 and then rise to 0.7% in 2030.

Given this small share, the impact on total costs and final prices of manufactured goods will be small. For example, increased energy costs as a result of low-carbon policies to 2020 will add around three pence on average to every £10 spent on goods and services produced by industry²³.

Given new policies to deliver energy efficiency savings, and based on our more conservative assessment of potential savings (i.e. 5% rather than the 6% to 20% identified in DECC's Energy Efficiency Strategy), energy costs as a proportion of total industrial sector costs would not increase from 2013 to 2020.

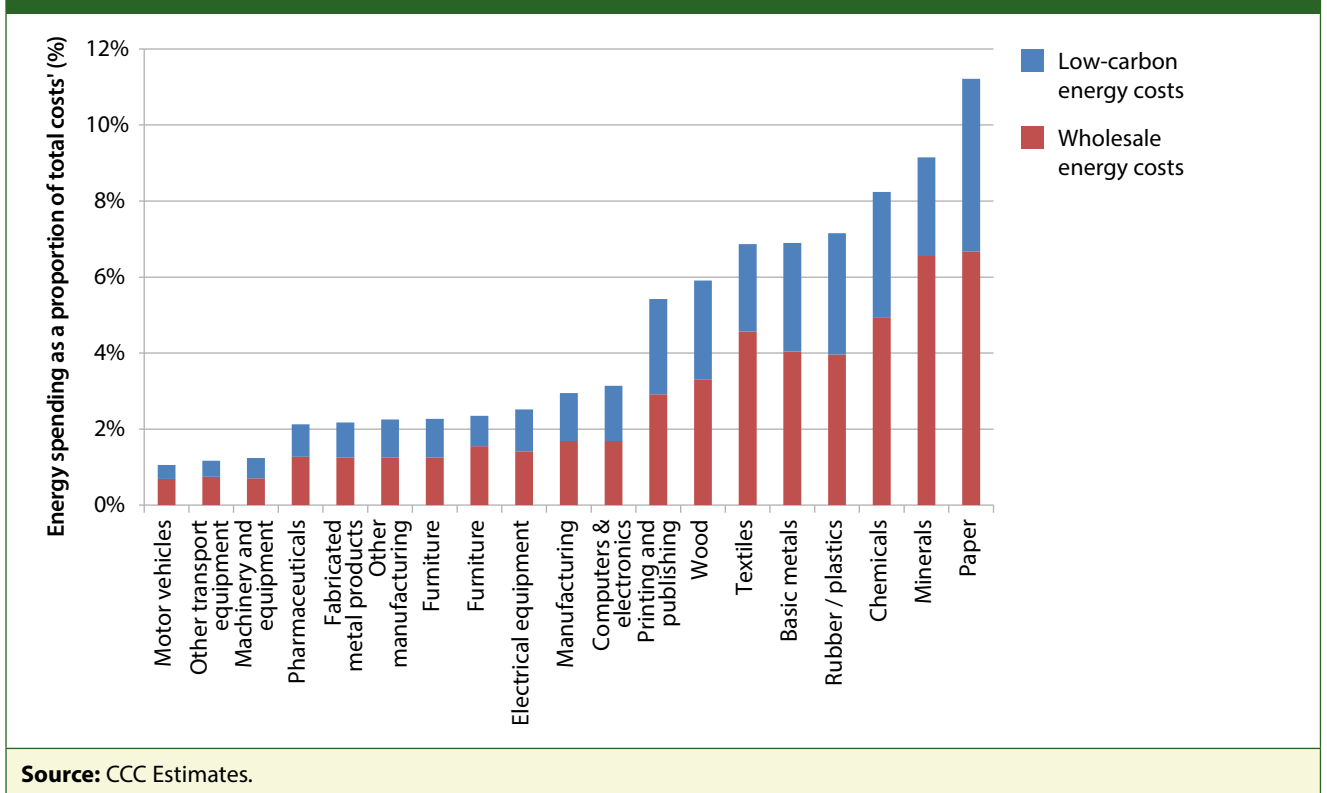
²³ See Box 3.2 in Chapter 3 for a more detailed discussion on impact of energy costs on product prices.



Table 4.5: Low-carbon policy as a % of total costs for industry (2004, 2013, 2020 and 2030)

Low carbon policy as a % of total costs	2004	2013	2020	2030
Industry average				
Energy costs as % of total costs	2.2%	2.3%	2.4%	2.9%
Low-carbon policy as a % of total costs	0.1%	0.3%	0.5%	0.9%
Energy-intensive (EII) firms eligible for compensation and exemption from low-carbon investment policy costs				
Energy costs as % of total costs – for EII with compensation and exemption	3.7%	6.0%	5.0%	5.8%
Low-carbon policy as a % of total costs – for EII with compensation and exemption	0.3%	0.9%	0.5%	0.7%
Notes: CCC estimates				

Figure 4.9: Wholesale and low-carbon energy spending as a proportion of total costs by sub-sector (2030)



4.4 Energy-intensive industries and potential competitiveness impacts

For a small number of energy-intensive industries, the impact on total costs resulting from low-carbon policies could be significantly higher. This is particularly the case for industries where energy costs are a higher share of total costs, where electricity supplied via the grid is an important fuel source (e.g. electric-arc steelmaking), and where there is strong international competition from countries without low-carbon policy costs or where industry is shielded from these costs.

In our 2013 report on managing competitiveness risks of carbon budgets, we noted that there are potential competitiveness risks for electro-intensive industries that are also subject to international competition and face higher relative energy costs. These firms could see a squeeze on profits which could potentially drive output and jobs overseas if support is not available.

It is important to ensure that increased energy costs resulting from low-carbon policies do not result in offshoring of UK industry. Output moving abroad would not have any benefits for the UK's overall carbon footprint (i.e. including consumption emissions) and global emission reductions, and would not be desirable from a wider economic perspective. The Committee's assessment in 2013 highlighted the potential risk of offshoring in the future, but concluded that there has been no significant industry relocation as a result of low-carbon policies to date.

The UK Government has recognised these risks and either put in place exemptions from policy costs or compensation arrangements.

- **Exemptions from CCL** for metallurgical and mineralogical process sectors.
- **Compensation for EU ETS/CPF** impact of rising electricity prices for electro-intensive industries (e.g. iron/steel) to 2019-20.
- **Compensation for Renewables Obligation (RO) and small-scale feed-in tariff (FiTs)** on electricity bill costs from 2016-17.
- **Exemption from Electricity Market Reform (EMR)** on energy bill costs.

The combined cost to the taxpayer of these compensation measures is expected to be around £500 million a year from 2016-17.

Our 2013 competitiveness report made a high level assessment of sectors that are most at risk from carbon leakage. The analysis focused on the sectors with high electricity bills as a proportion of GVA (i.e. around 10% and above), which are trade-intensive and which are relatively large. From these criteria, we developed a list of 8 industrial sub-sectors²⁴ considered most at risk of potential carbon leakage. We then commissioned detailed analysis on these sectors from ICF and Cambridge Econometrics.²⁵

24 Paper, pulp and paperboard (SIC 17.1), Cement (SIC 23.51), Glass (SIC 23.1), Lime and Plaster (SIC 23.52), Manufacture of other basic inorganic chemicals (chlor alkali) (SIC 20.13), Nitrogenous fertilisers (SIC 20.15), Iron and steel (SIC 24.1-3) and Rubber and plastics (SIC 22).

25 ICF and Cambridge (2013) 'Assessment of Competitiveness Impacts of Carbon Budgets on Electro-intensive sectors to 2030' available at www.theccc.org.uk



The level of risk for these sectors, and therefore requirement for support, is dependent on future UK and competitor country's electricity prices and energy efficiency potential, as well as scope for pass-through of higher costs to consumers.

- We estimated that higher electricity prices due to currently legislated carbon budgets could reduce profits of electro-intensive firms by £200 to £400 million in 2020, with an extreme case of zero cost pass-through reducing profits by £600 million in 2020.
- The £500 million total value of all the government's compensation measures is at the high end of the range of modelled profit impacts for electro-intensive sectors in 2020 and therefore broadly in line with our estimates of support needed to 2020.

Beyond 2020 and through to 2030, estimation of the level of support needed for electro-intensive sectors is more uncertain. No support would be needed if other countries were decarbonising like the UK and the costs had to be paid by their industries, creating a level playing field. However, there might be need for support if competitor countries were not decarbonising (or to a lesser degree), or if they were providing support for their industries.

The government is currently consulting on compensation for RO/FiTs cost, and exemption from costs of electricity market reform, as well as evaluating the effectiveness of the compensation scheme for EU ETS/CPF to date. In designing a support package to 2020 and beyond to 2030, the Government will need to develop and monitor the evidence base on future increases in UK electricity prices relative to other countries, scope for energy efficiency improvement²⁶, the surplus of EU ETS allowances expected, the scope for cost pass-through, and materiality of electricity price impacts for firm location and investment decisions. This will aid in ensuring that an appropriate level of support continues to be provided to those businesses at risk.

²⁶ including the potential from the 2050 roadmaps project

Acronyms

ASHP	Air-source heat pump
BREEAM	Building Research Establishment Environmental Assessment Methodology
BSUoS	Balancing Use of System Service charges
CCAs	Climate Change Agreements
CCC	Climate Change Committee
CCL	Climate Change Levy
CCS	Carbon capture and storage
CfD	Contract for Difference
CFL	Compact fluorescent lamp
CHP	Combined heat and power
CO ₂	Carbon dioxide
CPF	Carbon Price Floor
CPS	Carbon Price Support
CRC	CRC Energy Efficiency Scheme (previously Carbon Reduction Commitment)
CSE	Centre for Sustainable Energy
DECC	Department for Energy and Climate Change
ECO	Energy Company Obligation
EII	Energy-intensive industry
EMR	Electricity Market Reform
EU ETS	EU Emissions Trading System
FiTs	Feed-in Tariffs
gCO ₂ /kWh	Grams of carbon dioxide per kilowatt-hour
kWh	Kilowatt-hour
LCF	Levy Control Framework
LED	Light emitting diode
LIHC	Low Income High Cost (fuel poverty definition)
Non-EII	Non-energy intensive
p/kWh	Pence per kilowatt-hour
RHI	Renewable Heat Incentive
RO	Renewables Obligation
SAP	Standard Assessment Procedure
SIC	Standard Industrial Classification
TDCV	Typical Domestic Consumption Value
TDM	Transmission, distribution and metering
TWh	Terawatt-hours
VAT	Value Added Tax
WHD	Warm Home Discount

Committee on Climate Change

7 Holbein Place

London

SW1W 8NR

www.theccc.org.uk