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Energy-efficiency and environmental policies & income supplements in the UK: Their evolution and distributional impact in relation to domestic energy bills

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Keywords
Energy-efficiency and environmental policy; income supplements; distributional impact; policy costs; targeting

JEL Classification Q48

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6th December, 2012

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Section 1: Introduction

The objective of this paper is to study the direct costs of major energy-efficiency and environmental policies that have affected domestic electricity and gas bills in the UK over a period of 12 years. It is also a first attempt to understand the current distributional impact of these policies and others that act as income supplements resulting in a net decrease in the burden of paying higher energy bills for the beneficiaries. Ultimately, the aim is to allow equity implications of current policies to guide future

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policy makers in restoring consumers' trust in the energy market and protecting low-income households from paying higher energy bills.

The UK has developed a wide range of policy instruments to achieve environmental objectives such as reducing greenhouse gas emissions, increasing energy efficiency and promoting a greater adoption of clean energy (Bowen and Rydge, 2011). Some examples of these policies include emissions trading schemes, legally-binding efficiency standards for automobiles and appliances, voluntary arrangements between energy suppliers and government to reduce emissions, and schemes promoting greener technological innovation (Fullerton et al., 2007). These policies are tailored to different sectors of the economy (domestic or industrial or both). The domestic policy framework also incorporates the social objective of income redistribution (Sunderland and Croft, 2011).

Although these policy instruments translate into indirect tax measures resulting in higher energy bills, their ability to provide a 'double-dividend' of improved environmental conditions and reduced fiscal distortions[3] is appealing (Newbery, 2005). For instance, the revenue collected under these taxes can be used to lower general labour-income tax for all (or invest in infrastructure) and provide subsidies for vulnerable[4] households. Thus, realisation of 'double dividend' hinges on efficiency with which public revenue is raised and distributional benefits delivered.

The paper focuses on a subset of current policies that can be categorised into two groups, namely, energy-efficiency and environmental policies, and energy income supplement schemes. The former set includes policies that directly affect domestic energy bills through improved domestic thermal efficiency and/or increased energy prices. This set includes Carbon Emissions Reduction Target and its predecessors (CERT et al.), Community Energy Saving Programme (CESP), European Union Emissions Trading Scheme (EU ETS), Feed-in Tariffs (FiTs), Renewables Obligation (RO), and Warm Front Scheme (WFS). Examples of energy income supplements are Cold Weather Payment (CWP), Winter Fuel Payment (WFP) and Warm Home Discount (WHD). Such schemes help relieve their recipients of the financial burden imposed by energy efficiency and environmental policies. This paper only examines the financial costs of these policies and not their impact on energy-efficiency or environmental emissions. A brief description of these policies along with indicative eligibility criteria can be found in Table 1 below.

The term 'CERT et al.' represents statutory obligations between energy suppliers and government to reduce domestic carbon emissions since 2000.[5] Similar in its concept to CERT et al., CESP only targets households in the low-income areas of Great Britain. The primary attraction of these policies is the cost-effectiveness of delivering domestic thermal efficiency measures (DECC, 2007). It is

[3] Costs incurred in raising public money by imposing taxes such as income tax.
[4] According to Palmer et al. (2008, p.18), '*The fuel poverty programme uses a very broad – and non-standard – definition of vulnerability, namely, any household with a child, an older person or someone receiving state benefits.*'
[5] Energy Efficiency Standards of Performance, 2000-2002; Energy Efficiency Commitment Phase 1, 2002-2005; Energy Efficiency Commitment Phase 2, 2005-2008; CERT, 2008-11; and CERT Extension, 2011-12.

understood that in a competitive environment, suppliers aim to achieve their emissions-reduction obligations at minimum costs possible in order to maintain their market shares.

Policies such as FiTs and WFS also aid in improving domestic thermal efficiency (Hill, 2012). FiTs promote households install micro-renewable technologies for low-carbon electricity generation (Stockton and Campbell, 2011). On the other hand, RO policy promotes large-scale electricity suppliers to acquire a proportion of their energy from renewable sources. Unlike FiTs and RO policies that are financed by all UK electricity customers, WFS is a government-funded scheme that offers grants ranging from £ 3,500 to £6,000 to help eligible households install heating and insulation measures.[6] Since it's not paid for by a levy on domestic energy bills (as in the case of CERT et al., CESP, EU ETS, FiTs and RO), WFS has no direct impact on household energy costs except for those benefiting from it.

It has been established that there is an underlying link between CERT et al. and WFS in terms of the overlapping nature of their eligibility criteria. Even though WFS does not receive any direct financing from energy suppliers, it appears that a proportion of heating and insulation measures delivered under the Scheme can be traded with suppliers for their CERT obligations. The money collected in this manner is put back in the WFS budget and can then be used to reach out to a larger number of households.[7]

Likewise, in order to protect fuel poor[8] households and those who are at the risk of fuel poverty, the government has in place few schemes that provide monetary help for paying off energy bills. Currently, there are three such income supplements that either increase the income of households or result in a net decrease in energy bills. These are Cold Weather Payment (CWP), Winter Fuel Payment (WFP), and Warm Home Discount (WHD). Introduced in 1986, CWP provides financial help to eligible individuals during periods of severe winter.[9] It replaced an earlier known scheme called *Exceptionally Severe Weather Payments* which were distributed only when the mean weekly temperatures were -1.5 degree Celsius or lower.

Implemented in 2011, WHD is a recent scheme which replaced the earlier voluntary agreement between the suppliers and the government on social price support. It provides one-time annual rebates on the electricity bills of eligible customers (Hough et al., 2011). WFP, On the other hand, is a non means-tested payment given out to older people annually to help them out with their energy bills. Running since the winter of 1997-98, the scheme has evolved over time both in terms of eligibility criteria and amount of payments distributed. It is estimated that in the financial year 2011-12, almost

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[6] Last accessed on April 16, 2012 from http://www.direct.gov.uk/en/Environmentandgreenerliving/Energyandwatersaving/DG_10018661.

[7] Please see annexure A1.

[8] '*A household is said to be fuel poor if it needs to spend more than 10% of its income on fuel to maintain an adequate level of warmth*,' DECC (2011a, p.3).

[9] A period of severe winter is defined as seven consecutive days (observed or forecasted) in which the average mean daily temperature is zero degree Celsius or lower (Kennedy, 2011 a). This period runs from 1st November of a named year to 31st March of the following year.

12.7 million WFPs were given out resulting in a total expenditure of £ 2.13 billion making it one of the largest schemes in the entire policy mix (Kennedy, 2011b).

As Table 2 below indicates, total policy budgets under different schemes have evolved greatly over time. The total nominal expenditure incurred under the entire policy mix (excluding VAT and duties on electricity and gas) has evolved from £1.9 billion in 2000-01 to £ 7.5 billion in 2010-11. In terms of percentage of total GDP, the nominal budget has increased from 0.02% in 2000-01 to 0.51% in 2010-11. This trend of rising investments in achieving 'socially-just environmental'[10] objectives calls for a greater scrutiny of how much households are actually paying towards policies and the extent to which they are able to receive benefits in return.

[10] This highlights the government's aim to ensure a safe and secure move to a low-carbon society without penalising low-income households (Stockton and Campbell, 2011).

Table 1: Description, Annual Costs and Source of Funding for Different Policies

Scheme	Description	Cost	Paid by
Energy-Efficiency and Environmental Policies			
1. Carbon Emissions Reduction Target **(CERT/CERT Extension)**	An obligation on energy suppliers to target domestic carbon dioxide emissions by delivering the installation of energy efficiency measures such as loft insulation **Target Group:** 40% of the target emission reductions focused on a 'Priority Group' of low-income households in receipt of certain benefits and/or with pensioners aged 70 or more. Within this, 15% of the savings will also be achieved in a 'Super Priority Group' of households that are at a high risk of fuel poverty	Total cost for the scheme over the entire period (April 08-Dec 12) is estimated to be £5.5 billion (DECC, 2010b)	Domestic electricity and gas customers
2. Community Energy Saving Programme **(CESP)**	The scheme places upon energy suppliers to improve domestic energy efficiency in low-income areas of GB **Target Group**: Households in 4,500 areas of GB identified using Indices of Multiple Deprivation	Total cost for the scheme over the entire period (Oct 09- Dec 12) is estimated to be £350 million[11]	Domestic electricity and gas customers
3. European Union Emissions Trading Scheme **(EU ETS)**	Since 2005, generators of electricity which use non-renewable sources have been subjected to participate in trading allowances (EUAs) equal to their carbon dioxide emissions	156.4mt emitted by power sector at 14.3 Euro per tonne EUA = £1.92 billion in 2010[12]	All electricity customers

[11] Available February 2012 at http://www.decc.gov.uk/en/content/cms/funding/funding_ops/cesp/cesp.aspx.
[12] Please see annexure A3.

4. Feed-in Tariffs **(FiTs)**	Introduced in April 2010, FiTs promote renewable electricity generation by both households and businesses **Target group:** Households with eligible micro-generation installations (such as PV) of 5MW or below can be accredited under the scheme	The value of the FiT scheme is calculated at £14.4 million for 2010-11 (Ofgem, 2011b)	All electricity customers
5. Renewables Obligation **(RO)**	Introduced in April 2002, it places upon electricity generators to recoup increasing proportion of electricity generation from renewable sources by purchasing Renewables Obligation Certificates (ROCs) issued by Ofgem	The value of the RO scheme is calculated at £1.487 billion for 2011-12[13]	All electricity customers
6. Warm Front Scheme **(WFS)**	With an aim to reduce carbon dioxide emissions, WFS helps eligible households take-up heating and insulation measures **Target Group:** Individuals in receipt of certain benefits and living in self owned/privately rented properties with low SAP ratings	The value of the WFS scheme is calculated at £143 million for 2011-12[14]	HM Treasury
Energy-related Income Supplements			
1. Cold Weather Payments **(CWP)**	It provides additional monetary help to households during periods of severe winters **Target Group:** Individuals in receipt of certain benefits or who have a dependent child under the age of 5 and are not residing in nursing-care homes	Total cost for 2010-11 is estimated to be £430.8 million (Kennedy, 2011a)	Department for Work and Pensions
3. Warm Home Discounts **(WHD)**	Operational since March 2011, it provides rebates off the electricity bills varying from £120 in year 1, £130 in year 2, £135 in year 3 to £140 in year 4 **Target Group:** Spans 4 groups, namely, Core Group (low-income elderly customers), Broader Group, Legacy Spend, and Industry Initiatives. Eligibility criteria for the last 3 groups vary between energy suppliers	Total cost for 2011-12 is estimated to be £250 million (Energy Action Scotland, 2011)	electricity and gas customers

[13] Available February 2012 at http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Documents1/RO%20Costs%202011_12%20Consultation.pdf.
[14] Email correspondence with DECC.

3. Winter Fuel Payments **(WFP)**	Different from Cold Weather Payments, WFPs are tax-free cash payments given out to older people annually to help them out with their energy bills. **Target Group:** Individuals aged 60 or more	Total cost for 2011-12 is estimated to be £2.1 billion Kennedy (2011b)	HM Treasury

Table 2: Total Nominal Policy Budgets in Million Pounds (2000-2012)[15]

Year [1]	CERT et al.[16] [2]	CESP[17] [3]	EU ETS[18] [4]	FiTs [5]	RO[19] [6]	WFS[20] [8]	Total Policy Budget [2] to [8] [9]	Nominal GDP[21] [10]	Budget as % of GDP [9]/[10] [11]
2000-01	95					72	167	976282	0.017
2001-02	95					197	292	1021625	0.029
2002-03	324				282	163	769	1075368	0.072
2003-04	324				416	164	904	1139441	0.079
2004-05	324				498	166	988	1202370	0.082
2005-06	419		2432		583	192	3626	1254292	0.289
2006-07	419		1437		719	320	2895	1328597	0.218
2007-08	419		872		876	350	2517	1405796	0.179
2008-09	1067		2708		1036	397	5208	1433870	0.363
2009-10	1067	35	1825		1109	369	4404	1393854	0.316
2010-11	1067	105	1438[22]	14.4[23]	1285	366	4276	1463734	0.292
2011-12	1319	105	N/A	N/A	1487	143	N/A	1507585	N/A

15 Figures have been calculated for each financial year.

16 Available April 2012 at at http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/92-9march00.pdf (p. 3); http://www.aid-ee.org/documents/004EEC-UnitedKingdom.PDF (p. 9,10); http://s3.amazonaws.com/zanran_storage/www.defra.gov.uk/ContentPages/4234041.pdf (p. 94); DECC (2009) and DECC (2010b).

17 Available February 2012 at http://www.decc.gov.uk/en/content/cms/funding/funding_ops/cesp/cesp.aspx.

18 For detailed information on EU ETS figures, please see annexure A3.

19 Available April 2012 at http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=278&refer=Sustainability/Environment/RenewablObl and http://www.ofgem.gov.uk/Media/PressRel/Documents1/RO%20buy-out%20Info%20Note%204%20Feb.pdf.

20 Email correspondence with DECC.

21 ONS (2012b, Table A2).

22 Subject to revision.

23 Ofgem (2011b).

Table 2: Continued

Year	**CWP**[24] [12]	**WHD**[25] [13]	**WFP**[26] [14]	**Total Income Supplement Budget [11]to[13]** [15]	**Budget as % of GDP [15]/[10]** [16]	**Total Policy and Income supplement Budget [9]&[15]** [17]	**Budget as % of GDP [17]/[10]** [18]	**VAT and Duties on Electricity and Gas**[27] [19]
2000-01	30		1749	1779	0.182	1946	0.199	
2001-02	15		1681	1696	0.166	1988	0.195	
2002-03	14		1705	1719	0.160	2488	0.231	
2003-04	4		1916	1920	0.169	2823	0.248	678
2004-05	2		1962	1964	0.163	2952	0.246	749
2005-06	8		1982	1990	0.159	5616	0.448	898
2006-07	3		2015	2018	0.152	4913	0.370	1043
2007-08	4		2070	2074	0.148	4591	0.327	1101
2008-09	210		2701	2911	0.203	8119	0.566	1264
2009-10	290		2735	3025	0.217	7429	0.533	1300
2010-11	431		2751	3182	0.217	7457	0.509	1319
2011-12	N/A	250	2136	N/A	N/A	N/A	N/A	964[28]

[24] Kennedy (2010) and email correspondence with the DWP.
[25] Energy Action Scotland (2011).
[26] Kennedy (2011b).
[27] DECC (2012a, Table 1.4). Figures calculated by adding VAT and duties on natural gas and electricity.
[28] Subject to revision.

Section 2: Literature Review

The literature on the cost burden of energy-efficiency and environmental policies on domestic electricity and gas bills in the UK is limited. Apart from regular reports published by DECC, Ofgem and the Committee on Climate Change (CCC), there are some notable papers that discuss related issues of household income and fuel poverty. For instance, in their papers, Jamasb and Meier (2010a and 2010b) study emerging patterns of energy expenditure for households within different income groups. Their findings highlight the importance of devising policy instruments that target specific groups within the domestic sector in order to co-address environmental and fuel poverty issues. Waddams Price et al. (2007) is another important paper that recommends a rolling out of policy instruments that target those households that feel (i.e. perceive themselves to be) fuel poor. Indeed, it is a government commissioned paper by Professor John Hills (2012) that advocates the adoption of new approaches to measuring fuel poverty.

Examination of official reports on energy bills suggests that comparison between them has been difficult (Consumer Focus, 2012). DECC (2011b) calculates bills by constructing energy prices using a bottom-up methodology (all in £/MWh) multiplied by average annual household consumption (after policy) of 4MWh of electricity and 16.2 MWh of gas. Alternatively, Ofgem (2011a) calculates average bills by assuming an average household consumption of 3.3 MWh of electricity and 16.5 MWh of gas. CCC (2011) separately studies the typical 'dual-fuel' and electrically heated households, and calculates their average energy bills by multiplying respective consumption trends over time with energy prices taken from DECC Quarterly Energy Prices (DECC QEP). Whereas SDC (2008) only covers a period between 2000 and 2007 for their research, making them slightly outdated.

With increasing debates on rising electricity and gas bills in the political domain, the research on bill impact of policies has gained impetus like never before (Consumer Focus, 2012). Three factors contributing towards a higher energy bill include higher wholesale prices, funding of carbon abatement programmes, and grants affecting the overall income of the targeted group.[29] Since 2003, domestic electricity and gas prices have increased in real terms by 60% and 103%, respectively.[30] Even though increasing wholesale price of energy is the primary cause of rising bills, the share of policy costs is also significant[31] and is expected to grow more in the future.

Motivation for this study lies in the fact that there is a dearth of research that deals with the interplay of these factors directly. Also, the misleading presentation (some of it unintentional) of the statistics that are available has added much to consumers' concerns.[32] In a recent paper, Renewable Energy Forum Ltd. (2012) has expressed doubts whether DECC should even be evaluating the success of its

[29] DECC (2010c).
[30] DECC (2012b).
[31] Some studies have shown that a percentage increase in energy bills can result in more than proportionate increase in the number of fuel poor households (Sunderland and Croft, 2011).
[32] Webster, R. (2012) *Green costs on energy bills 101*, 28 February, The Carbon Brief. Available April 2012 at http://www.carbonbrief.org/blog/2012/02/laying-out-the-numbers-on-energy-bills.

own policies. Hence, in compiling data from various sources and organisations, this study attempts to present a consistent picture across time and income deciles. Eventually, it aims to arrive at policy recommendations for future decision making processes that seek to protect vulnerable households from paying higher energy bills without losing focus on environmental targets.

In relation to distributional impacts of energy-policy mix, reports such as DECC (2011b) and White et al. (2010) discuss the issue for households across different income (and expenditure) deciles in 2020. However, the existing literature lacks a published report on the issue in the current context. Hence, the attempt to uncover the disparity between the bill costs of energy-efficiency and environmental policies and the energy-related income supplements for households across different income deciles (in 2009-10) makes this study even more relevant.

Section 3: Historical Development of Shares of Policy Costs in Domestic Electricity and Gas Bills

Typical domestic electricity and gas bills are made up of a number of elements (Ofgem, 2011a). Some of these elements include wholesale costs, supplier margins, transmission and distribution costs, VAT, and costs of energy-policy mix. In order to analyse the bill impact of policies over time, the study relies on information from a number of sources such as DECC, Ofgem, ONS and SDC. Currently, there are five main energy-efficiency and environmental policies that directly affect domestic energy bills in the UK, namely, CERT et al., CESP, EU ETS, FiTs and RO. While CERT et al. and CESP require energy suppliers to target reductions in domestic carbon-dioxide emissions by delivering energy-savings measures, policies like EU ETS, FiTs and RO focus on reducing overall (domestic or industrial) greenhouse gas emissions. This is done by promoting a greater proportion of electricity generation from renewable sources of energy.

It is understood that energy suppliers charge these policy costs[33] to their customers via higher energy bills but as a matter of commercial sensitivity, it has not been established how these costs are recovered either as annual standing charges or on the basis of per unit of energy used.[34] For the analysis, the study considers a period of 12 years between 2000 and 2011. The data for policy costs from 2000 to 2007 is taken from SDC (2008). Whereas for the period between 2008 and 2011, the study relies on information from Ofgem and DECC.[35] The data on average bills (inclusive of policies and policy-related VAT) between 2000 and 2011 is taken from DECC (2012b). Until 2007, the figures (for a typical annual bill and share of policy costs in it) reflect the prices for Q4 of the previous year and Q1, Q2 and Q3 of the named year. From 2007 onwards, the numbers represent the prices for the named calendar year. All the figures are stated in £ 2010 using RPI numbers[36] from ONS.

3.1: Domestic Electricity Bills (2000-2011)

The current debate on rising domestic energy bills demands an understanding of the evolution of both the bill and the bill impact of policies over this last one decade. Figure 1 below presents a typical[37] annual domestic electricity bill (inclusive of policies and policy- related VAT) for households on a

[33] We exclude the impacts of benefits delivered by CWP, WFP and WFS (policies that are government funded). WHD, on the hand, is a recent scheme that starts to affect domestic electricity and gas tariffs from 2011 onwards. Since there is uncertainty on how costs of WHD are recovered, i.e., either through tariffs of electricity, gas or both, their impact on bills have been excluded.

[34] Though there is a call for energy suppliers to show breakdown of energy bills in the future. Available August 2012 at http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/writev/engagement/ce27.htm.

[35] For information on how policy shares are calculated, please see annexure A2.

[36] Please see annexure A4.

[37] Typical domestic electricity and gas bills are calculated using typical annual domestic electricity (3.3 MWh) and gas (18 MWh) consumption figures instead of using average annual domestic electricity and gas consumption figures. This is done so in order to maintain consistency in the data for year-on-year comparisons.

standard credit payment method assuming an annual consumption of 3.3 MWh.[38] From the graph, we observe that the typical annual domestic electricity bill steadily declined from £338 in 2000 to £308 in 2004 (all in £2010). Although over the same period, the amount of policy costs (excluding policy-related VAT) consistently increased from £1 (0% of the total electricity bill) in 2000 to £10 (3%) in 2004.

However, the pattern reversed from 2005 onwards. The typical domestic electricity bill (which was at £308 in 2004) increased from £332 in 2005 to £469 in 2009 (all in £ 2010). In 2010, the electricity bill once again declined to £435 before it increased to £449 in 2011. The percentage share of policy costs (excluding policy-related VAT) in the total electricity bill declined from 15% in 2005 to 14% in 2011 even though in absolute terms it did increase by £14 for a typical household during the same period. This implies that recent increases in electricity bills could not have been caused by these policies.

As mentioned earlier, domestic electricity bills are affected by all five main energy-efficiency and environmental policies. While CERT et al. and CESP costs are charged to domestic electricity (and gas) customers, the costs of EU ETS, FiTs and RO are levied on both domestic and non-domestic electricity customers. However, the way in which energy suppliers recover these policy costs is still unclear. For instance, in correspondence with energy companies, it was indicated that suppliers include CERT charges in their general tariff calculations due to consumer opposition to fixed charges. Whereas DECC expects suppliers to pass CERT costs as annual standing charge per customer but there is no requirement for this to happen.

Generators recover the costs of EU ETS through a higher wholesale price of electricity. Retail suppliers simply pick up this cost which results in a higher retail price. The amount charged varies yearly depending on the average carbon emissions factor for a specific year and the price setting plant on the system (which reflects the carbon intensity of this generation). Currently, generators recover costs of all the allowances (free or auctioned) through higher wholesale prices.[39] Although, in the future when there will be no free allowances, it is expected that wholesale prices will then truly reflect the financial burden of EU ETS.

Figure 2 below presents the percentage shares of policy costs in typical annual domestic electricity bills (in 2010 prices) from 2000 to 2011. The graph suggests that the largest real increase in the share of policy costs was between 2004 (3%) and 2005 (15%). This increase can be entirely attributed to the participation of UK in EU ETS. On the other hand, the largest percentage increase in the total electricity bill (inclusive of policy costs and policy-related VAT) occurred between 2005 and 2006. This rise in the electricity bills can only be linked to the wholesale cost element because the percentage share of policy costs in bills declined over the same period.

[38] For consistency in compilation, we maintain the same assumption as the one used by DECC (2012b) for data on typical annual domestic electricity (and gas) bills unlike the changes recommended in Ofgem (2011a).
[39] Available February 2012 at http://www.iea.org/textbase/npsum/price_interaction07sum.pdf.

From the same figure, we see that the shares of individual policies have evolved differently over time. On the one hand, the shares of CERT et al. and RO have steadily increased; on the other, the share of EU ETS has declined[40] while the share of FiTs remains small. Between 2010 and 2011, the average typical electricity bill (inclusive of policies and policy-related VAT) rose by 3.2%. Of this rise, 35.7% can be attributed to policy costs and rest to the wholesale cost element of the bill. Hence, figures suggest that in recent years, increases in bills have not been primarily driven by policy costs.

3.2: Domestic Gas Bills (2000-2011)

More than 80% of the households in Britain use gas as their main heating fuel (Baker, 2008). A rise in gas bills is, therefore, a reason for concern for many, especially, those at the risk of fuel poverty. Figure 3 below presents a typical[41] annual domestic gas bill (inclusive of policies and policy-related VAT) for households on a standard credit payment method with an annual consumption of 18 MWh. The study uses data from Ofgem to estimate shares of CERT et al. and CESP in gas bills (and electricity bills from section 3.1).

Unlike electricity, domestic gas bills are only affected by CERT et al. and CESP. Figure 3 below shows that the domestic gas bill has steadily increased between 2001 and 2009, after which it only fell for a year before rising again in 2011. On an average, gas bills have increased by 84% from £386 in 2000 to £710 in 2011 (all in £2010). The largest real increase (19.1%) in bills was noticed between 2005 (£450) and 2006 (£536).

Over these 12 years, the share of policy costs (excluding policy-related VAT) in total gas bills has increased from a 0% in 2000 (£1) to 4% in 2011 (£27). The largest real increase in the amount of policy costs was observed between 2007 (£11) and 2008 (£20) when Energy Efficiency Commitment (Phase2) was replaced by CERT. During the last year itself, the typical gas bill has increased by 4.25% from £681 in 2010 to £710 in 2011, of which only 10.3% (£3) increase can be attributed to policy costs. This shows that the bill impact of policies in case of gas is also quite small.

[40] The decline in shares is a result of decreasing EU allowance prices (Rotfub et al., 2009).
[41] Please see footnote 37.

Figure 1: Typical domestic electricity bills (inclusive of policies and policy-related VAT) in 2010 prices for an annual consumption of 3.3 MWh (2000-2011)

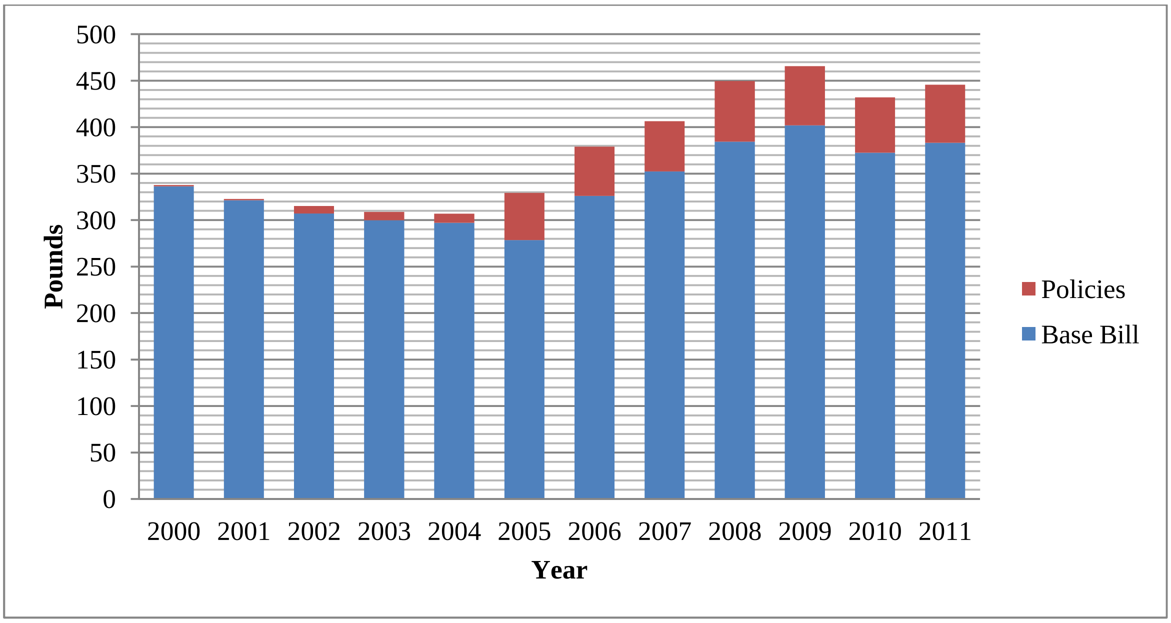


Figure 2: Percentage share of policy costs in typical annual domestic electricity bills in 2010 prices for an annual consumption of 3.3 MWh (2000-2011)

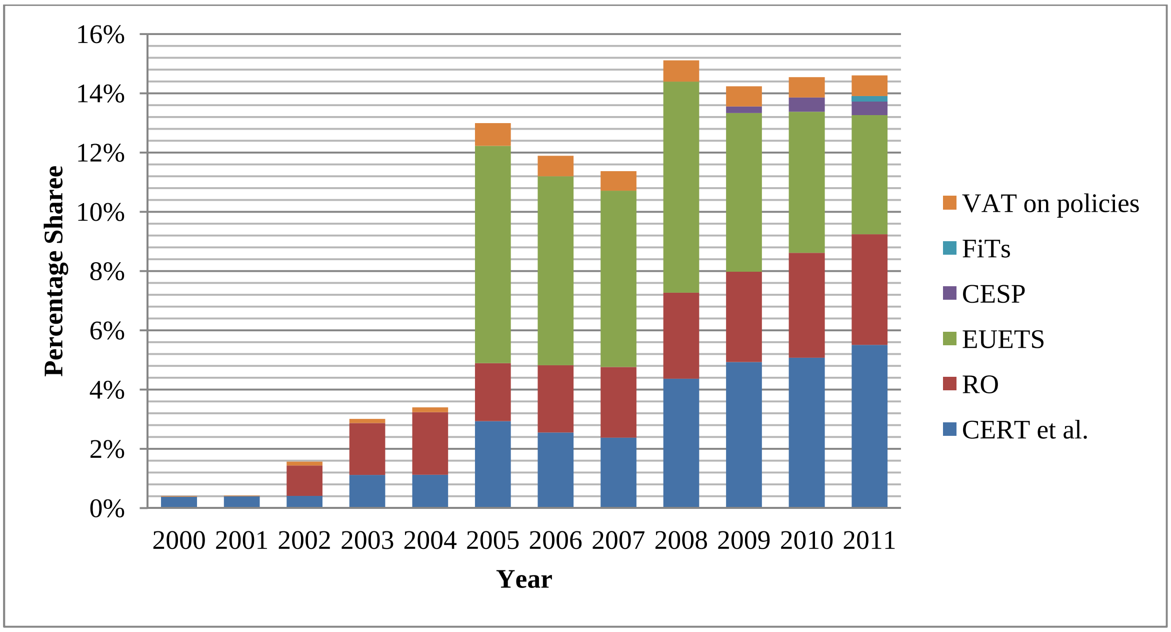


Figure 3: Typical domestic gas bills (inclusive of policies and policy-related VAT) in 2010 prices for an annual consumption of 18 MWh (2000-2011)

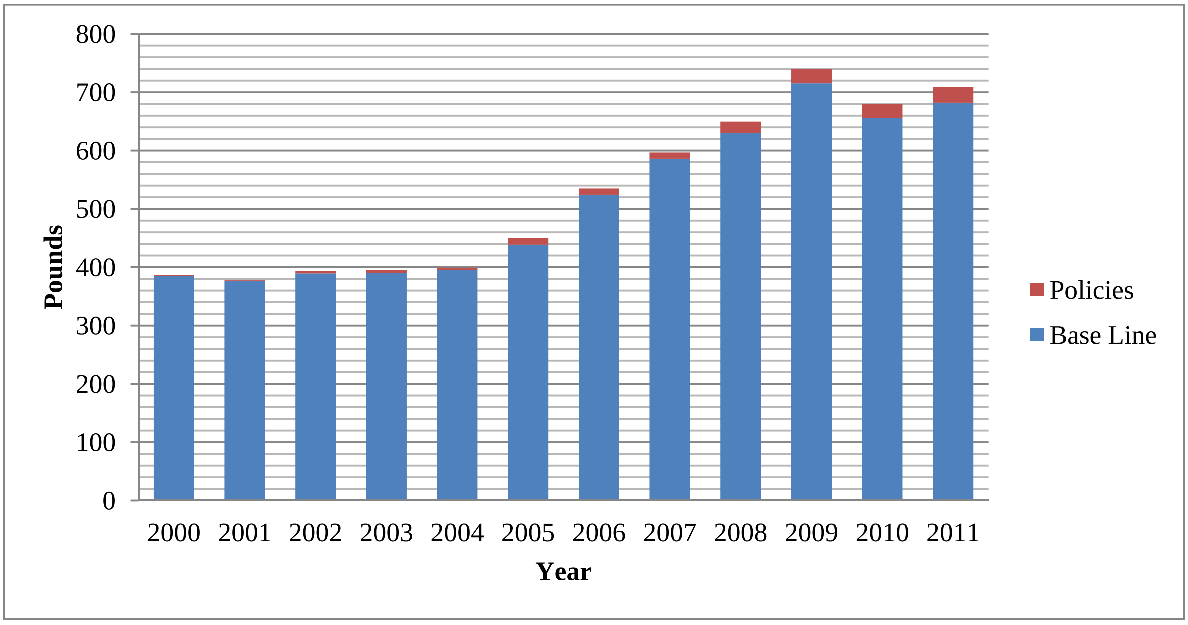
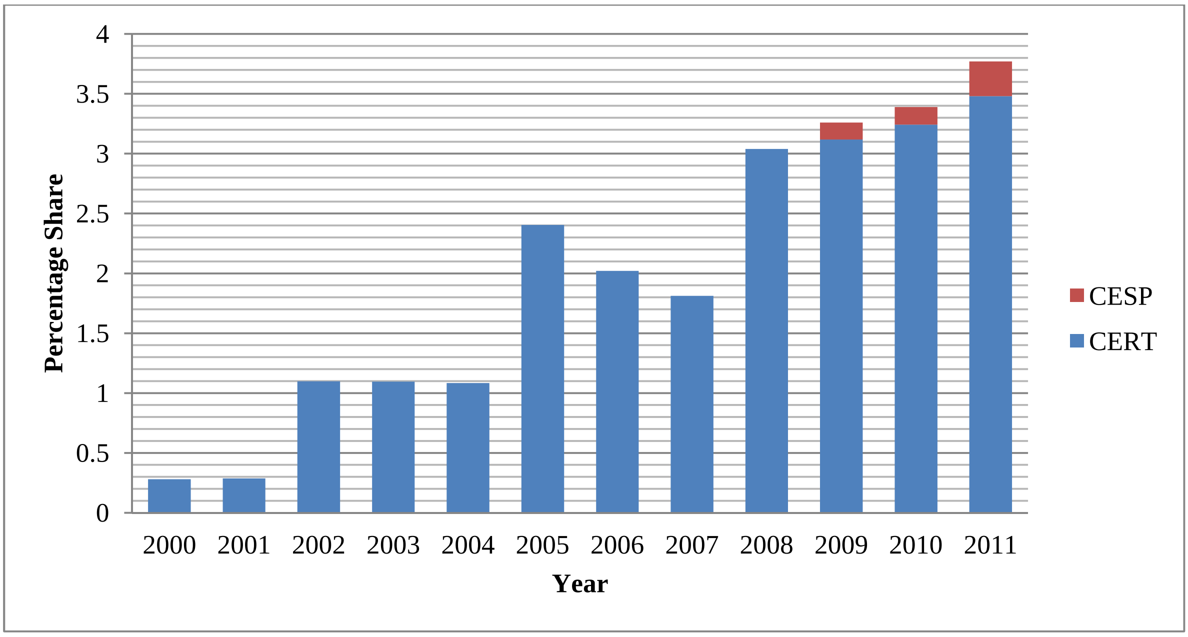


Figure 4: Percentage share of policy costs in typical annual domestic gas bills in 2010 prices for an annual consumption of 18 MWh (2000-2011)



Section 4: Distributional Impacts of Policy Costs and Income Supplements

UK's energy policy is undergoing a significant transition. In March 2012, the government was seeking a consultation to finalise the details of the upcoming Green Deal and a new Energy Company Obligation (ECO) thereby transforming the future energy-policy mix. With the ambitious target of reducing greenhouse gas emissions by at least 80% by 2050, there is a call for greater emphasis on protecting vulnerable households from paying higher energy bills during this transition (Stockton and Campbell, 2011).

Making the first attempt in this direction, the study tries to work out the distributional impacts of financial costs imposed by some of the energy-efficiency and environmental policies and financial benefits delivered by energy income supplements. In particular, we derive costs of CERT et al., CESP, EU ETS, FiTs and RO in electricity and gas bills paid by households across different disposable income deciles in 2009-10. Also, we broadly estimate the number of households among them who would have received financial help in the form of WFP and CWP. Hence, the objective is to understand the impact for households in low-income deciles that are not receiving any benefits (from CERT et al., CESP, FiTs, RO, WFP or CWP) but might be paying for them assuming that energy suppliers charge policy costs proportionately across all their customers.

The biggest challenge in conducting such an analysis has been the availability of reliable data. There is no single publically-available dataset that compiles information on the current distribution of energy consumption, energy requirements, energy tariffs, energy-efficiency measures delivered (by policy or self-funded) and recipients of energy income supplements for households across different strata of population (Roberts et al., 2007).

4.1: Policy Costs by Income Deciles

In this section, the shares of policy costs in electricity and gas bills for households across different disposable income deciles are calculated.[42] For data on domestic electricity and gas consumptions by income deciles, the study relies on the only (publically) available report by CSE.[43] The paper uses data from the Expenditure and Food Survey[44] to calculate the distribution of energy consumption figures for a sample of 24,207 households across (unadjusted) disposable income deciles over a period of 45 months (Apr 2004 – Dec 2007). The information on variable and fixed costs for electricity and gas as well as shares of households by methods of payment is taken from DECC (2012b). Data on average disposable income[45] for households across (unadjusted) disposable income deciles is taken from ONS (2011, Table 24, p. 77).

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[42] An alternate approach to study distributional impacts is to rank households by expenditure. For data availability reasons, we use data on income deciles.
[43] White et al. (2010).
[44] Since 2008, it came to be known as the Living Costs and Food Survey (LCF).
[45] 'Disposable income is average household income after cash benefits (e.g. Income support) have been received and direct taxes (e.g. Income tax) have been taken. Data are before housing costs,' ONS (2011). Alternatively, it can be understood as the average household income net of direct taxes.

The analysis examines the distribution of bills for the financial year 2009-10 under three different categories: 1) average electricity consumption for the entire sample of households (with or without gas) valued at standard electricity tariffs weighted by three payment methods or simply, *Standard Electricity Bills*; 2) average electricity consumption by only 'off-gas' households valued at Economy 7 tariffs weighted by three payment methods or *Off- Gas Electricity Bills*; 3) average gas consumption by only 'gas-supplied' households valued at gas tariffs weighted by three payment methods or *Gas-Supplied Bills*. We assume that the distribution of average household electricity and gas consumptions (2004-07) does not undergo a significant change by 2009-10.

We study the distribution of bills across the aforementioned categories because access to gas is less common among fuel poor households, especially, in rural areas where houses are bigger and more energy-inefficient (Jamasb and Meier, 2010b). Given this situation where some of the households do not have access to any gas at all, it seemed appropriate to separately calculate average gas bills for households who actually rely on it for their energy needs and, hence, *Gas Supplied Bills*. Tables 3-5 below present the distribution of policy costs in electricity and gas bills for three different categories as explained above. Based on Ofgem estimates of policy costs per household[46], the study assumes that CERT et al. and CESP costs are levied on customers as standing charges in their electricity and gas bills. Then again, costs of EU ETS, FiTs and RO are accounted for in the retail price of electricity and vary with consumption.

Figures in Table 3 represent the average electricity bill for all households in the sample estimated using standard electricity tariffs in 2009-10.[47] While the range of average electricity bill varies from £349 in the lowest to £692 in the highest decile, the range for policy costs varies from £55 in the lowest to £89 in the highest decile. The percentage share of policy costs in annual disposable income is found to be 0.84% in decile one to 0.11% in decile ten. This is because the share of the electricity bill in disposable income varies from 5.38% in decile one to 0.85% in decile ten. We observe a similar trend in Table 4 with electricity bills for 'off-gas' households.[48]

Figures in Table 5 suggest that for gas-supplied households, the range of average gas bill varies from £449 in the lowest to £842 in the highest decile whereas the burden of policy costs (only CERT et al. and CESP) seems equitable throughout. Also, we note that the share of policy costs in annual disposable income varies from 0.37% in decile one to 0.03% in decile ten. This is because the share of gas bill in disposable income ranges from 6.92% in decile one to 1.04% in decile ten.

In general, it is observed that electricity/gas bills bills as a percentage of disposable income is higher for households in the low-income deciles than for those in the high-income deciles. Even though the variation among the shares of policy costs in disposable incomes is small across different deciles, the

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[46] Please see Annexure A2.
[47] We realise that electricity consumption would be biased upwards for non-Economy 7 households for this analysis.
[48] Here, electricity consumption would be biased downwards for Economy 7 households.

range of shares of average energy bills as a percentage of the disposable income is significant. This reflects the disparity in the spread of policy costs across households. It is more evident in the case of gas-supplied households (Table 5) where we see that on an average everyone pays the same towards policy costs irrespective of their actual bill amounts.

4.2: Energy Income Supplements by Income Deciles

The Hills' *Fuel Poverty Review* (2012) has confirmed that fuel poverty poses a significant problem for the UK. It is understood that energy suppliers levy all the costs of implementing policies with 'socially-just environmental' objectives on their customers. Earlier in section 4.1, we observed that energy bills tend to make up a significant proportion of the income for households in low-income deciles. It is, therefore, important to recognise that some of these low-income households who pay for policies through higher bills but in-turn may not receive any measures remain trapped within fuel poverty (Hills, 2012).

Consequently, imperfect targeting (by various energy-efficiency and environmental policies) poses a grave problem for these low-income households. As the figures in Table 3 and 5 point, the range of average total policy costs in 2009-10 for a dual-fuel[49] household varies from £79 in the lowest income decile to £113 in the highest. According to DECC (2011c), any household from the non-Priority Group that receives a professionally installed cavity wall or loft insulation, approximately needs to contribute an upfront cost of £75-250 under CERT[50]. Therefore, a household, say, from the highest income decile that pays this upfront cost and also bears the annual total policy costs of £113, still manages to accrue net benefits over time due to improved domestic thermal efficiency.[51]

Then again, a household from the lowest income decile that bears the average annual total policy costs of £79 and receives no measures from any of the energy-efficiency and environmental policies remains in net loss. In order to protect low-income households from such situations, the government has in place three energy-related income supplements that provide additional monetary support. Since the analysis is for the financial year 2009-10, the study focuses on those schemes that were running at the time, i.e., CWP and WFP.[52]

The aim of distributing CWP is to ensure that people are provided with sufficient funds to keep them warm when the temperatures are low. For the winter of 2009-10, CWPs worth £25 were given out to those who claimed certain benefits. With the help of information provided by ONS[53], figures in Table 6 were estimated. We observe that although a small number of households in the highest income

[49] A household consuming both electricity and gas to meet their energy demands.
[50] According to one of the 'Big-6' suppliers, many NPG households get these installations for free now as the CERT deadline approaches.
[51] Households can save more than £100 pounds per annum in total energy bills due to cavity wall insulation. Available April 2012 at http://www.markgroup.co.uk/products/cavity-wall-insulation/homeowner/?gclid=CKeMjZDnvq8CFe8htAodTm5kxQ.
[52] Here, we also present additional information on the distribution of CWPs and WFPs for 2010-11.
[53] Available at August 2012 at http://www.ons.gov.uk/ons/about-ons/what-we-do/publication-scheme/published-ad-hoc-data/economy/august-2012/index.html.

decile receive CWPs, the coverage in the lowest income decile is not encouraging. This situation improves in the following year (2010-11) with 18% of households in the lowest income decile receiving CWPs unlike only 10% from the previous year.

Different from CWPs, WFPs are tax-free non-means tested benefit payments that are given out annually to help older people with their energy bills. For the winters of 2009-10 and 2010-11, WFPs worth £200 and £300 were given out to households with a member aged 60 and 80 years, respectively (Kennedy, 2011b). Multiplying the average number of people over 60 years of age per household with the total number of households in each decile, we estimate the distribution of the number of recipients of WFP using the data from ONS.[54] As shown in Table 7, in 2009-10, the number of recipients of WFP varies from 1.27 million in decile one to 0.57 million in decile ten. These figures highlight inefficiency in the scheme's approach to target low-income households that are at a risk of fuel poverty. A similar pattern of figures in observed in 2010-11 where the number of recipients of WFP varies from 1.47 million in decile one to 0.71 million in decile ten.

[54] ONS (2011, Table 24, p. 77) and available at August 2012 at http://www.ons.gov.uk/ons/about-ons/what-we-do/publication-scheme/published-ad-hoc-data/economy/august-2012/index.html.

Table 3: Standard Electricity Bills, 2009-10[55]

Decile		1	2	3	4	5	6	7	8	9	10	Mean
Disposable Income		6488	10884	13844	17080	20944	25400	30670	37481	47465	81174	29143
WO Policies		292	329	353	385	406	429	462	475	522	598	425
CERT et al		23	23	23	23	23	23	23	23	23	23	23
RO		12	13	14	16	16	17	19	19	21	25	17
EUETS		19	22	23	26	27	29	31	32	35	41	28
CESP	**Bill**	1	1	1	1	1	1	1	1	1	1	1
FIT		0	0	0	0	0	0	0	0	0	0	0
VAT (Policies)		3	3	3	3	3	4	4	4	4	4	3
W policies		349	390	418	453	477	503	540	555	607	692	498
Policy Costs		55	59	62	65	68	70	74	76	81	89	70
% of Policy in Disposable Incom		0.84	0.54	0.45	0.38	0.32	0.28	0.24	0.20	0.17	0.11	0.24
% of Bill in Disposable Income		5.38	3.59	3.02	2.65	2.28	1.98	1.76	1.48	1.28	0.85	1.71

Table 4: Off-Gas Electricity Bills, 2009-10[56]

Decile		1	2	3	4	5	6	7	8	9	10	Mean
Disposable Income		6488	10884	13844	17080	20944	25400	30670	37481	47465	81174	29143
WO Policies		373	436	462	536	549	584	597	631	662	814	540
CERT et al		23	23	23	23	23	23	23	23	23	23	23
RO		14	17	18	22	22	24	25	26	27	34	22
EUETS		24	28	30	36	37	39	40	43	45	56	36
CESP	**Bill**	1	1	1	1	1	1	1	1	1	1	1
FIT		0	0	0	0	0	0	0	0	0	0	0
VAT (Policies)		3	3	4	4	4	4	4	5	5	6	4
W policies		439	509	539	622	637	675	690	729	764	934	627
Policy Costs		62	70	73	82	83	88	89	93	97	115	82
% of Policy in Disposable Incom		0.96	0.64	0.53	0.48	0.40	0.34	0.29	0.25	0.20	0.14	0.28
% of Bill in Disposable Income		6.76	4.68	3.89	3.64	3.04	2.66	2.25	1.94	1.61	1.15	2.15

[55] Calculations using information from ONS (2011, Table 24, p. 77), DECC (2012b, Tables 2.2.4, 2.3.4, 2.4.2, 2.4.3 and 2.5.2) and White et al. (2010). Figures are estimated for the financial year 2009-10 by adding 3/4th of the 2009 estimate and 1/4th of the 2010 estimate where original figures are given for calendar years.

[56] Please see footnote 55.

Table 5: Gas-Supplied Bills, 2009-10[57]

Decile		1	2	3	4	5	6	7	8	9	10	Mean
Disposable Income		6488	10884	13844	17080	20944	25400	30670	37481	47465	81174	29143
WO Policies		424	487	521	551	595	597	631	657	700	816	602
CERT et al		23	23	23	23	23	23	23	23	23	23	23
CESP		1	1	1	1	1	1	1	1	1	1	1
	Bill											
VAT (Policies)		1	1	1	1	1	1	1	1	1	1	1
W policies		449	512	546	577	621	622	656	683	726	842	627
Policy Costs		24	24	24	24	24	24	24	24	24	24	24
% of Policy in Disposable Incom		0.37	0.22	0.17	0.14	0.12	0.10	0.08	0.06	0.05	0.03	0.08
% of Bill in Disposable Income		6.92	4.71	3.95	3.38	2.96	2.45	2.14	1.82	1.53	1.04	2.15

Table 6: Cold Weather Payments[58]

2009-10

Decile	1	2	3	4	5	6	7	8	9	10	Mean
Disposable Income	6488	10884	13844	17080	20944	25400	30670	37481	47465	81174	29143
Number of HHs (in 1000s)	2600	2605	2610	2601	2607	2602	2611	2604	2603	2609	(All HHs)26053
Total no. of Recipients of CWP ('000s)	247.00	445.00	231.00	255.00	179.00	109.00	65.00	62.00	25.00	11.00	1629.00
Percent Coverage	0.10	0.17	0.09	0.10	0.07	0.04	0.02	0.02	0.01	0.00	0.06

2010-11

Decile	1	2	3	4	5	6	7	8	9	10	Mean
Disposable Income	6885	11094	14062	17656	21667	25956	31323	38224	48545	87473	30288
Number of HHs (in 1000s)	2625	2626	2625	2628	2623	2632	2624	2629	2624	2629	(All HHs)26265
Total no. of Recipients of CWP ('000s)	465.00	470.00	416.00	299.00	210.00	142.00	47.00	66.00	13.00	41.00	2169.00
Percent Coverage	0.18	0.18	0.16	0.11	0.08	0.05	0.02	0.03	0.00	0.02	0.08

[57] Please see footnote 55.
[58] Please see footnote 53.

Table 7: Winter Fuel Payments[59]

2009-10

Decile	1	2	3	4	5	6	7	8	9	10	Mean
Disposable Income	6488	10884	13844	17080	20944	25400	30670	37481	47465	81174	29143
Number of HHs (in 1000s)	2600	2605	2610	2601	2607	2602	2611	2604	2603	2609	(All HHs)26053
Total no. of Recipients of WFP ('000s)	1274	2057.95	1853.1	2028.78	1616.34	1274.98	1122.73	807.24	728.84	573.98	13287.03
Percent Coverage	0.49	0.79	0.71	0.78	0.62	0.49	0.43	0.31	0.28	0.22	0.51

2010-11

Decile	1	2	3	4	5	6	7	8	9	10	Mean
Disposable Income	6885	11094	14062	17656	21667	25956	31323	38224	48545	87473	30288
Number of HHs (in 1000s)	2625	2626	2625	2628	2623	2632	2624	2629	2624	2629	(All HHs)26265
Total no. of Recipients of WFP ('000s)	1470.00	1864.46	1863.75	1944.72	1678.72	1579.20	1023.36	893.86	708.48	709.83	13657.80
Percent Coverage	0.56	0.71	0.71	0.74	0.64	0.60	0.39	0.34	0.27	0.27	0.52

[59] Please see footnote 54.

Section 5: Results

In section 3, we first saw that over a period of 12 years, typical domestic electricity and gas bills had on an average increased in real terms by 32.9% and 84%, respectively. Simultaneously, the percentage share of policy costs in them had increased by 14% and 4%, respectively. Even though a significant proportion of this rise is due to increasing wholesale price of energy, the growing share of policy costs in bills over time cannot be ignored. Additionally, in section 4 of the paper we looked at the distributional impacts of policy costs and benefits for households across different disposable income deciles during 2009-10.

Figures in Table 6 suggest that in 2009-10, CWPs targeted only 10% of the households in the lowest-income decile even though a small number of households in the highest-income decile also received them. Likewise, WFPs benefited 22% of the households in the highest-income decile while 51% of the households in the lowest-income decile did not receive any benefits. Though, the coverage of the scheme for households in income deciles 2, 3 and 4 was significant.

We also notice that during 2009-10, the range of average total policy costs for a dual-fuel household varied from £79 in the lowest-income decile to £113 in the highest accounting for 10% and 7.4% of their respective energy bills. If a household, say, from the highest-income decile received a WFP during 2009-10, it would have benefited overall even without having received any energy-efficiency improving measure. On the other hand, if a household from the lowest-income decile that did not receive any WFP during 2009-10 but would have contributed £79 for policy costs, would be in net financial loss. This shows the potential overall distributional impacts of the energy-policy mix.

The following observation from Table 2 (section 1) echoes a similar finding. During 2010-11, the total (nominal) policy budget was around £4276 million (column 9). We know that a sizeable proportion of this policy budget is recouped through higher domestic energy bills.[60] Yet we also observe that during 2010-11, the total (nominal) budget for income supplement schemes (i.e., CWP and WFP) was around £3182 million. As a result, one might expect that the poorest domestic customers are not net adversely affected given the current policies.

Examining this more carefully, we see that during 2010-11, the combined (nominal) budget under the schemes that deliver energy-efficiency measures (CERT et al., CESP, FiTs and WFS) was around £1552.4 million. This was less than half the total (nominal) budget under the income supplement schemes for that year. Moreover, of this pot of funding for energy-efficiency schemes, 76% of the resources were handled by energy suppliers. If it is understood that long-term solutions to fuel-poverty can be mainly provided by improving domestic thermal efficiency then there are serious concerns to the amount of resources being allocated for the schemes and the ways in which they are collected.

[60] Except for EU ETS, FiTs and RO policy costs that are also recouped through energy bills of the non-domestic sector.

Section 6: Conclusion

In this research, we have tried to understand and link the information available on bill payments for energy-efficiency and environmental policies and energy income supplements delivered by the current energy-policy mix that aims to instigate 'socially-just environmental' improvements. The Hill's Fuel Poverty Review (2012) has been instrumental in highlighting the fact that fuel poverty is a significant problem and is likely to remain so. With details of the Green Deal and a new ECO being finalized in early 2013, it is, therefore, important to improve our knowledge of the current distribution of financial payments and receipts related to energy policy as well as apply the lessons learnt for future decision making.

We understand that there are three ways in which low-income households can be protected against rising energy bills; namely, improving thermal efficiency of houses, increasing household incomes and curbing energy prices. Policies that deliver energy-efficiency measures (such as CERT et al., CESP and FiTs) could result in considerable transfers between those who pay for them but do not receive any measures and those who actually receive them (Renewable Energy Forum Ltd., 2011). Due to a lack of data on the distribution of the number of policy measures delivered, it has been difficult to work out the extent to which financial payments and receipts related to energy policy directly affect low-income households. This research highlights that imperfect targeting by the current energy-policy mix poses a serious problem for the low-income households.

We have seen that in terms of targeting low-income households, government-run polices (CWPs and WFPs) are not faring well. Moreover, with the launch of Green Deal and ECO as well as shutting down of WFS in the near future, reliance on energy suppliers to collect and manage such funds will only increase (Sunderland and Croft, 2011). The need for transparency on ways in which policy costs are charged is important. If policy costs are calculated on a per customer basis (as DECC and Ofgem assume) then there should be a greater debate on whether or not these calculations should be switched to a per unit basis for future schemes keeping in mind the trade-offs between equity and efficiency.

While deliberating on system-wide impacts, it is also imperative to consider how policies affect incentives. For instance, figures in Table 2 suggest that in terms of funding WFPs is the largest scheme in the entire-policy mix. It is a universal benefit that helps those not necessarily in need. In principle, it is not an energy policy as the credit can be used for other consumption needs. Suggestions are being made to make WFPs means-tested.[61] While this makes the scheme more progressive, it may also lead to greater administrative costs, decrease in the take-up and misalignment of household incentives to work and save (NAO, 2011).

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[61] Robinson, J. (2012). *No more winter fuel payments for you! Government told to cut benefits for middle-class pensioners who don't need them*, 8 June, This is Money. Available August 2012 at http://www.thisismoney.co.uk/money/pensions/article-2155992/Call-cut-winter-fuel-benefits-middle-class-pensioners.html#ixzz26NWEwLiX. Also, see Schofield et al. (2010).

Similarly, more thoughts should be put in making carbon price more uniform by equalising the VAT on energy with other goods in the economy.[62] Arguments in favour of a higher VAT suggest that households will be more incentivised to adopt energy-efficiency measures once bills reflect the true social costs of energy usage. It is also the case that policy costs fall much more heavily on electricity than on gas customers, distorting the consumption choices between the two. It would be worth considering a rebalancing of policy costs between electricity and gas customers. Indeed given that CERT et al. primarily funds heat related domestic efficiency improvements, it is advisable to charge it disproportionately to gas customers.

With high volumes of public money being spent to achieve environmental objectives, it is important to realise that there are still a number of 'unknowns' in this line of research for any definitive conclusions to be drawn. In the absence of relevant data, the current distributional analysis by disposable income deciles instead of equalized expenditure deciles may not be accurate.[63] Then again, DECC's evaluation of its own policies seems to have fallen far short (Renewable Energy Forum Ltd., 2012). Without any knowledge on how energy suppliers charge policy costs to their customers, DECC's assessment of future policy costs lacks empirical grounding. There is a greater call to understand why there are significant differences in the presentation of official statistics on energy bills and how can one compare between them. Ultimately, a better understanding of the distributional impacts of current energy policies would facilitate in developing more equitable policies in the future keeping in mind our environmental commitments.

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[62] Harvey, F. (2011) *Raise VAT on energy to improve efficiency, ministers told*, 18 August, The Guardian. Available August 2012 at http://www.guardian.co.uk/environment/2011/aug/18/raise-vat-energy-ministers. Also, see Bowen and Rydge (2011).

[63] For a detailed discussion on conducting distributional analysis using income versus expenditure deciles, please see Carrera (2010).

Annexes:

A1: Information on WFS

A1.1: Nominal Value of Traded WFS Works through CERT (2005-12)[64]

Scheme Year	Nominal Value of traded Warm Front works through CERT (£ million)
2005/6	7.20
2006/7	11.50
2007/8	20.50
2008/9	11.00
2009/10	16.40
2010/11	3.30
2011/12 (Year to date April 2011 – end of December 2011)	5.60

Table A1.2: Annual Nominal Expenditure and Number of Households Assisted under WFS (2000-13)[65]

Scheme Year	Households assisted	Budget (£ million)
2000/1	101,000	72.00
2001/2	303,000	197.00
2002/3	215,000	163.00
2003/4	167,000	164.00
2004/5	164,000	166.00
2005/6	165,000	192.00
2006/7	253,079	320.00
2007/8	268,900	350.00
2008/9	233,594	397.00
2009/10	212,963	369.00
2010/11	127,930	366.00
2011/12	N/A	143.00
2012/13	N/A	100.00

[64] Email correspondence with DECC. All expressed in nominal terms for each financial year.
[65] Email correspondence with DECC. All expressed in nominal terms for each financial year.

A2: Insights into Evaluating Percentage Shares of Policy Costs in Bills[66]

Year	Information	Source
	CERT	
2000-07	Figure expressed in 2010 prices using RPI numbers from Appendix 5	SDC (2008)
2008-12	Customer numbers Electricity: 26.3mil Gas: 22mil Total cost of the Original CERT from 1 April 2008 to 31 March 2011: £3,208 mil Duration of Original CERT: 3 years Total number of customers: 48.3 mil Cost to customers: total cost / (time x total no. of customers) ~ £22. 08 Total cost of the CERT Extension from 1 April 2011 to 31 December 2012: £2,308 mil Duration of CERT Extension: 1.75 years Total number of customers: 48.3 mil Cost to customers: total cost / (time X total no. of customers) ~ £27.30 Figure expressed in 2010 prices using RPI numbers from Appendix 5	DECC (2009) and DECC (2010b)
	CESP	
2009-12	Total costs of CESP from 1 September 2009 to 31 December 2012: £350 mil Duration of CESP: 3.33 years Total number of customers: 48.3 mil Cost to customers: total cost / (time X total no. of customers) ~ £2.17 Figure expressed in 2010 prices using RPI numbers from Appendix 5	Available February 2012 at http://www.decc.gov.uk/en/content/cms/funding/funding_ops/cesp/cesp.aspx.

[66] Information used in Figures 1-4 and Tables 3-5.

EU ETS		
2000-07	Figure expressed in 2010 prices using RPI numbers from Appendix 5	SDC (2008)
2008	Figure expressed in 2010 prices using RPI numbers from Appendix 5	Ofgem (2008)
2009	Figure expressed in 2010 prices using RPI numbers from Appendix 5	Ofgem (2009)
2010	Policy cost calculated by multiplying the per unit price figure by 3.3 MWh. Also Figure expressed in 2010 prices using RPI numbers from Appendix 5	DECC (2010a)
2011	EU ETS impact on an average household in year 2011 = Average year 2011 carbon price (£/tCO2) x marginal electricity emission factor[67] for year 2011 (MtCO2/TWh) x 3.3 MWh Figure expressed in 2010 prices using RPI numbers from Appendix 5	Email correspondence with DECC and https://www.theice.com/homepage.jhtml
RO		
2000-07	Figure expressed in 2010 prices using RPI numbers from Appendix 5	SDC (2008)
2008 2009 2010 2011	RO impact on an average households in year Y = RO cost in year Y x 3.3 MWh/total consumption of electricity in the economy Figures expressed in 2010 prices using RPI numbers from Appendix 5	Total budget figure for calendar year Y is obtained by multiplying 1/4th the amount for year Y and 3/4 the amount for year Y+1 in Column [6], Table 1

[67] For 2011, DECC assumes Marginal Emission Factor (MEF) to be around 0.4 MtCO2/TWh of net electricity supplied to the grid. This figure is based on an understanding that given its low prices, coal-fired power plants must be at the baseload with gas at the margin for a significant part of 2011. This assumption seems controversial for two reasons. Firstly, there are several techniques that can be used to calculate MEF and hence, determine the impact of a policy intervention (EU ETS in this case, Hawkes, 2010). It is not correct to assume that dispatch of generators follows a particular 'merit-order' rule. Secondly, even if we assume that gas-fired power plants are at the margin for 2011 then according to DECC (2012a, p. 126) the average emissions factor (AEF) for a gas-fired power plant is around 0.392 MtCO2/TWh of net electricity supplied to the grid. This figure is calculated by using total net electricity supplied to the grid (347.506 TWh, p. 143) instead of using total final consumption of electricity (318.009 TWh, p. 139). This would seem unfair for the households that consume 3.3 MWh of electricity on an average annually that is drawn out of final consumption (318.009 TWh) and not net electricity supplied to the grid (347.506 TWh). Therefore, the AEF figures given in DECC (2012a, Table 5A) should all be scaled up by a factor of 347.506/318.009.

FiTs		
2010	Figure expressed in 2010 prices using RPI figures from Appendix 5	DECC (2010a)
2011	Policy costs calculated by multiplying the per unit price figure by 3.3 MWh. Also, Figure expressed in 2010 prices using RPI figures from Appendix 5	DECC (2011b)

A3: Information on EU ETS[68]

Year	Number of allowances for power stations (million)	Price per allowance (€)	Exchange rate (£/€)	Budget (£ million)
2005	172	22.3	1.4629	2621.915
2006	181	15.1	1.467	1863.054
2007	177.9	1.3	1.4619	158.1982
2008	169.2	22.41	1.2588	3012.212
2009	151.659	13.29	1.1233	1794.31
2010	156.4	14.3	1.1664	1917.455

[68] Sources:
2010
http://publications.environment-agency.gov.uk/PDF/GEHO1111BVEC-E-E.pdf (p. 5)
2009
http://publications.environment-agency.gov.uk/PDF/GEHO1010BTDK-E-E.pdf (p. 4)
2008
http://www.decc.gov.uk/assets/decc/what%20we%20do/global%20climate%20change%20and%20energy/tackling%20climate%20change/emissions%20trading/eu_ets/publications/1_20090924140921_e_@@_euetsreport2008.pdf (p. 11, 12)
2007
http://www.decc.gov.uk/assets/decc/what%20we%20do/global%20climate%20change%20and%20energy/tackling%20climate%20change/emissions%20trading/eu_ets/publications/sectorlevel-ukresults-2007.pdf
and http://www.efa2009.org/papers/SSRN-id1341638.pdf (p. 4)
2006
http://www.nao.org.uk/publications/0809/eu_emissions_trading_scheme.aspx (p. 36) and
http://www.efa2009.org/papers/SSRN-id1341638.pdf (p. 4)
2005
http://www.nao.org.uk/publications/0809/eu_emissions_trading_scheme.aspx (p. 36)
and http://www.efa2009.org/papers/SSRN-id1341638.pdf (p. 4)
Average Euro Sterling spot exchange rate for each year is taken from Bank of England.

A4: RPI figures for 2000-2011 (January 1987=100)[69]

Year	Annual Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	170.3	166.6	167.5	168.4	170.1	170.7	171.1	170.5	170.5	171.7	171.6	172.1	172.2
2001	173.3	171.1	172	172.2	173.1	174.2	174.4	173.3	174	174.6	174.3	173.6	173.4
2002	176.2	173.3	173.8	174.5	175.7	176.2	176.2	175.9	176.4	177.6	177.9	178.2	178.5
2003	181.3	178.4	179.3	179.9	181.2	181.5	181.3	181.3	181.6	182.5	182.6	182.7	183.5
2004	186.7	183.1	183.8	184.6	185.7	186.5	186.8	186.8	187.4	188.1	188.6	189	189.9
2005	192	188.9	189.6	190.5	191.6	192	192.2	192.2	192.6	193.1	193.3	193.6	194.1
2006	198.1	193.4	194.2	195	196.5	197.7	198.5	198.5	199.2	200.1	200.4	201.1	202.7
2007	206.6	201.6	203.1	204.4	205.4	206.2	207.3	206.1	207.3	208	208.9	209.7	210.9
2008	214.8	209.8	211.4	212.1	214	215.1	216.8	216.5	217.2	218.4	217.7	216	212.9
2009	213.7	210.1	211.4	211.3	211.5	212.8	213.4	213.4	214.4	215.3	216	216.6	218
2010	223.6	217.9	219.2	220.7	222.8	223.6	224.1	223.6	224.5	225.3	225.8	226.8	228.4
2011	235.2	229	231.3	232.5	234.4	235.2	235.2	234.7	236.1	237.9	238	238.5	239.4

[69] ONS (2012a, Table 20).

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