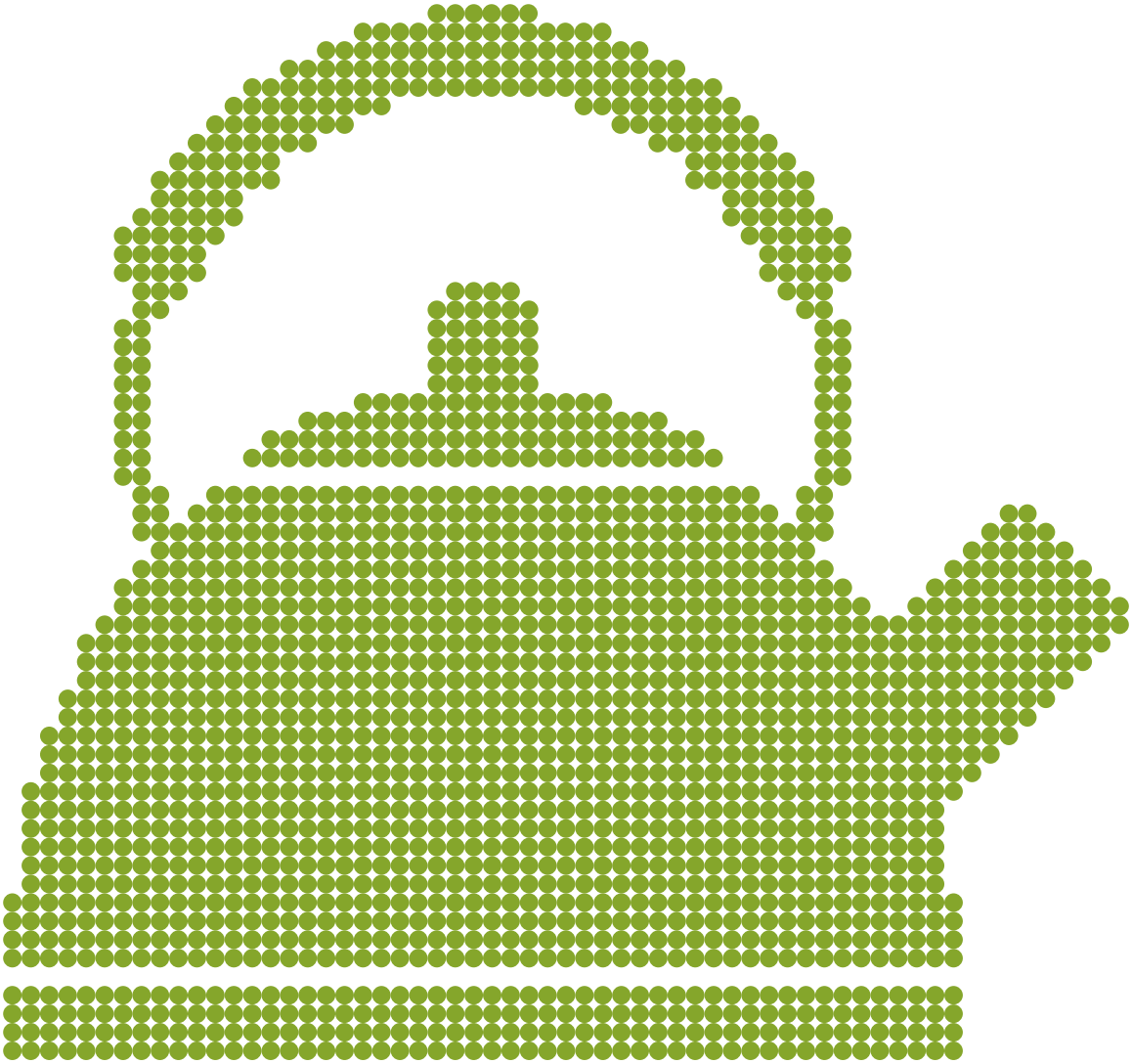
The Case for a Social Tariff: Reducing Bills and Emissions, and Delivering for the Fuel Poor



ALDERSGATE GROUP
LEADERS FOR A SUSTAINABLE ECONOMY

UCL

Contents

SEPETEMBER 2023

LIST OF FIGURES

AUTHORS

PHIL MCNALLY, CLAUDIA BROWN, SERGUEY MAXIMOV, MICHAEL GRUBB

Aldersgate Group

The Aldersgate Group is a politically impartial, multi-stakeholder alliance championing a competitive and environmentally sustainable economy.

The Aldersgate Group is an alliance of major businesses, academic institutions, professional institutes, and civil society organisations driving action for a sustainable and competitive economy. Our members believe that ambitious and stable low carbon and environmental policies make clear economic sense for the UK. Our policy proposals are formed collaboratively and benefit from the expertise of our members who span a wide range of industry sectors and public interests. Our breadth and collegiate approach allows us to formulate progressive policy positions to benefit all organisations and individuals.

ORGANISATION MEMBERS

Recommendations made in this report cannot be attributed to any single organisation and the Aldersgate Group takes full responsibility for the views expressed.

Executive Summary

Inflation and household bills are finally falling but **households across the UK still face a cost-of-living crisis.** While energy bills are expected to be lower this winter compared with last, the recently announced Price Cap level for October to December 2023 still has bills at 78% higher than the pre-crisis 5-year average. On top of that, **bill payers are entering winter in a worse financial position owing to the debt accumulated over winter 2022/23 and the scaling back of government support.**

The analysis in this report suggests that **energy bills are likely to remain significantly above pre-crisis levels to the end of the decade.** This will make grim reading for the millions of households that were forced into fuel poverty last winter and is bad news for the growing consumer debt crisis in the energy sector and beyond.[1] We have seen the acute impact of unaffordable energy bills in creating a perfect storm of increased prices across the economy and reduced household disposable income. So while emergency, short-term interventions were required last year, **government now has an opportunity to introduce an enduring solution to retail energy prices to ensure the long-term health of the energy sector, the broader economy, and households across the country.**

This paper explores the various ways in which government can ensure affordable bills while maintaining incentives to reduce and decarbonise energy usage. **We present six key recommendations that will help enable deep decarbonisation of the UK's housing stock and deliver affordable energy bills** in both the near- and long-term.

Recommendation 1: Bring forward the government's strategic decision on the roles of hydrogen and electrification in home heating to the end of 2023, showing preference for electrification.

This decision is currently set for 2026, creating a significant barrier to the important near-term development of both hydrogen boilers and heat pumps, and creating uncertainty in other sectors as regards the future availability of low carbon hydrogen (including in some sectors for whom electrification is not an option). There are strong indications that hydrogen could only play, at best, a marginal role in relation to home heating and therefore we recommend that a clear preference for electrification is set out to remove uncertainty. For further information on the importance of bringing forward the decision on hydrogen, see the *Aldersgate Group's Espresso Briefing, Powering Britain Affordably.*

1: (Broome, Handscomb and Try, 2023)

Recommendation 2:
Extend the role of long-run marginal cost pricing, in the form of fixed-price contracts, for suitable technologies.

In previous work conducted by UCL in collaboration with the Aldersgate Group, a dual market approach coined the 'Green Power Pool' (GPP) was proposed, separating electricity generators into markets based on the most suitable type of marginal cost pricing – either short-run or long-run. In principle, such an approach would allow consumers to access increasingly cheap renewable energy, based on the average cost of generation rather than a short-run-marginal-cost-pricing-on-all model, which typically results in gas setting the price for all technologies (apart from those on CfDs).

Our analysis shows that such a move could reduce bills for all – by as much as £1287 per household per year at peak crisis prices – as well as reducing the cost of further support required to ensure affordable energy for all. We are therefore pleased to see that government is still actively exploring the role of marginal pricing in its Review of Electricity Market Arrangements.

Recommendation 3:
Introduce a targeted social tariff for the fuel poor.

A social tariff offering an automatic discount on the unit rate of both gas and electricity for vulnerable homes would significantly alleviate fuel poverty; a discount of 30% would strike a reasonable balance of consumer protection and fiscal affordability. In our "New Normal" scenario, which looks at projected energy prices in 2027, this social tariff design would deliver savings of around £450 to each of the 6 million households who would still be in fuel poverty, reducing bills to around pre-crisis levels, at a cost to HM Treasury of £2.7bn.

We recommend that the social tariff is targeted at fuel poor homes, adopting the National Energy Action (NEA) definition, i.e., defined as those that spend more than 10% of their income on energy. The number of households in receipt would therefore increase or decrease automatically in response to higher or lower energy prices. To accurately track households that fall under this definition, we believe government and suppliers should work together to combine energy usage data, which is held by suppliers, with income data, which is held by government.

The social tariff should also be delivered as an automatic discount on bills, rather than a cash payment. This would ensure that support is applied directly where it is needed and is received immediately rather than after the fact; it would also temper the impact of high energy prices on headline inflation, and in particular, inflation as experienced by the poorest households. This would work in a similar way to the Energy Price Guarantee or the Energy Bill Support Scheme, both of which delivered an automatic discount on bills, but with the crucial difference of targeting, taking account of actual recent energy consumption levels. Legislation would be required but the schemes mentioned provide the framework for this, and government has shown, with the Energy Act 2022, that such legislation can be implemented quickly in the delivery of those schemes.

The social tariff should be funded by HMT to ensure progressive recovery of costs; avoid raising bills for remaining billpayers, thereby protecting capital for decarbonisation; and maintain an important incentive on government to provide investment support for demand reduction measures, particularly in lower income households, to reduce the overall cost of the scheme.

Recommendation 4:
Move policy cost recovery from energy bills to general taxation.

Policy costs applied to household energy bills for closed and social schemes should be moved to general taxation to immediately lower bills and ensure progressive recovery of 'public good' costs. The saving per household is relatively modest at £151 per year in our "New Normal" Scenario, however, government has proved that this could be implemented quickly having effectively already done this via the Energy Price Guarantee in October 2022.

Reducing policy costs this way, rather than rebalancing them across electricity and gas, avoids penalising those reliant on gas for heating who currently do not have the capacity to switch to a low-carbon heating technology. Having said that, rebalancing is preferable to the status quo and thus should be seen as a backup option if general taxation is rejected.

Recommendation 5:
Lay the foundations for market wide Time of Use Tariffs (TOUs) in future.

Electricity TOUs will be crucial in enabling a flexible future energy system, enabling the integration of high proportions of variable renewables, and limiting excess capacity buildout. However, the benefit of TOUs will accrue mostly to households with electric heating (including heat pumps) and cars, a smart meter and the ability and knowledge to manage their energy use carefully. In negative cases, TOUs can result in increased bills as ill-prepared consumers fail to shift usage from high-priced periods.

TOUs should therefore not be seen as an immediate solution to affordable energy bills for all. They should be available for households that desire them – this is important for incentivising the switch to electric cars and heating. But the main government focus should be on laying the foundations for TOUs in future, namely completing the rollout of smart meters, delivering market-wide half hourly settlement as soon as possible, and working with consumers and suppliers on TOU design and consumer protection regulation.

Recommendation 6:
Urgently address standing charges on Pre-Payment Meter (PPM) customers.

While we recognise the attraction of the proposal, we have concerns with calls to remove standing charges due to issues with distributional fairness and economic efficiency. As such, we recommend that government currently avoids interfering with standing charges, recognising the important role they play in covering many of the fixed costs in the system (and the fact that fixed charges are an economically efficient way of recovering fixed network costs).

However, the relationship between standing charges and PPMs is worrying. Government must act to avoid the situation where access to the energy system is effectively blocked for those customers who have self-disconnected and are unable to reconnect as they cannot afford to clear debt that has accrued due to standing charges. Suppliers should be mandated to install smart PPMs in households that that have difficulties with disconnection; clear debts; and develop payment plans with these customers. The cost of this support should fall on HM Treasury to ensure the incentive remains with central government to eradicate fuel poverty.

1 Introduction

The global energy crisis has placed increasing energy price pressures on households across the UK, with the regulated cap on **typical domestic energy prices rising from £1,138 to £4,279 between April 2021 and January 2023.**[2] This dramatic increase forced the UK Government to intervene across October 2022 to March 2023 with the Energy Price Guarantee (EPG), which capped household bills at £2,500 (at a cost to HM Treasury of £21bn), and the Energy Bill Support Scheme, which gave every household a £400 discount on their energy bills (at a cost to HM Treasury of £12bn).[3] **As a result, over winter 2022–23 we saw energy expenditure for the typical household increase to more than double the pre-crisis 10-year average, and HM Treasury spend £33 billion covering around half of household bills.**

The consequences of this crisis have been felt in the wider economy with the UK recording its highest inflation rates for 40 years and millions of homes forced into fuel poverty. Estimates from government – using the National Energy Action (NEA) definition of fuel poverty – suggest that **the sharp increase in energy bills forced an additional 7.7 million households into fuel poverty** over the last 2 years, with 12 million UK households (41%), now estimated to be in fuel poverty.[4]

In recent months, the decline in international gas prices has been followed by the first decline in energy bills since 2020. However, **most households will still be paying at least double the pre-crisis average and all households remain vulnerable to any future increase in gas and energy prices.**

Ultimately, **there are two key routes to protecting households from excessively volatile energy prices in the long run: (1) reducing dependency on gas by accelerating home and grid decarbonisation, and (2) reforming electricity market and tariff design to ensure consumers have direct access to increasingly cheap renewable power at stable prices.**

There are two key routes to protecting households from excessively volatile energy prices in the long run: (1) reducing dependency on gas by accelerating home and grid decarbonisation, and (2) reforming electricity market and tariff design to ensure consumers have direct access to increasingly cheap renewable power at stable prices.

Our previous report in this series looked at grid decarbonisation in detail and set out six priority recommendations for government.[5]

2: (Norton, 2023)

3: (DESNZ and The Rt Hon Grant Shapps MP, 2023)

4: (DESNZ, 2023a) – Note the NEA use a different definition of fuel poverty to the UK Government, however, energy price is less influential in the UK Government definition and thus the NEA definition is deemed more appropriate in these times of high prices. Indeed, the UK Government also reported on the NEA definition in its latest report.

5: (Grubb et al., 2023)

This paper will cover home decarbonisation pathways and technology options at a high-level, recognising the extensive existing literature in this space, before focusing on tariff reform options and their relationship with live proposals for electricity market reform. Several options for tariff reform have been championed over the past year, but there has been limited detailed comparative assessment of the different options.[6] **Furthermore, we see a clear gap in the literature in assessing the relationship between electricity market reform and tariff offerings.**

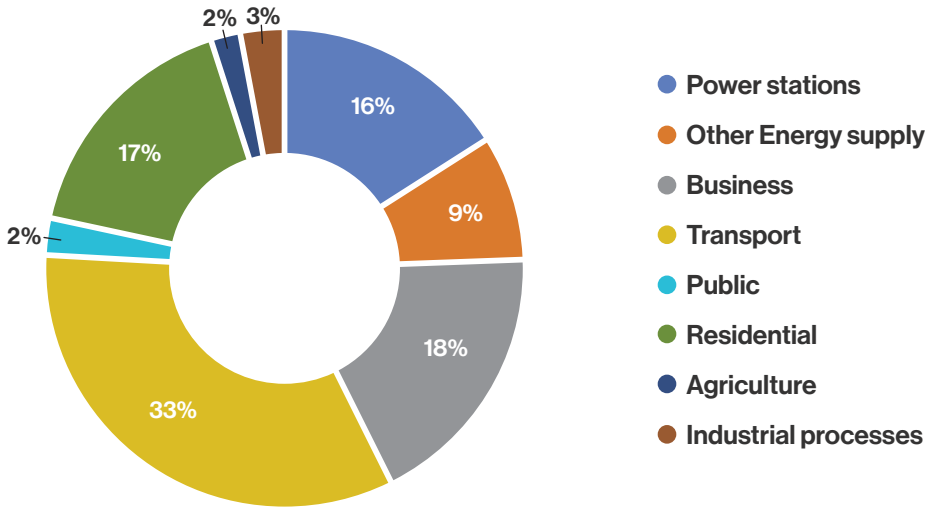
1.1 DOMESTIC DECARBONISATION

1.1.1 Emissions

Targets to reduce carbon dioxide emissions, enshrined in UK law, include the reduction of emissions by 68% by 2030 and 78% by 2035 relative to 1990 levels. Such stringent targets will undoubtedly require the transformation of current technologies, systems, and behaviours across the entire economy.

Figure 1: shows the breakdown of UK territorial emissions in 2022 by sector. Given major reductions in power generation over the past decade, Transport (113 $MtCO_2e$) is the most polluting sector by some margin with Business (62 $MtCO_2e$) and Residential (56$MtCO_2e$) contributing similar amounts in second and third position.

Figure 1: UK Territorial greenhouse gas emissions 2021 by sector



Source: *DESNZ 2022 UK greenhouse gas emissions, provisional figures – data tables*[7]

The Residential sector is seen as one of the most challenging areas of decarbonisation, partly due to the glacial progress in reducing emissions to date **(Figure 2)**, and partly due to the decentralised and potentially disruptive nature of the transition required with energy efficiency upgrades and heating system replacements needed in most of the 29 million homes across the UK.[8]

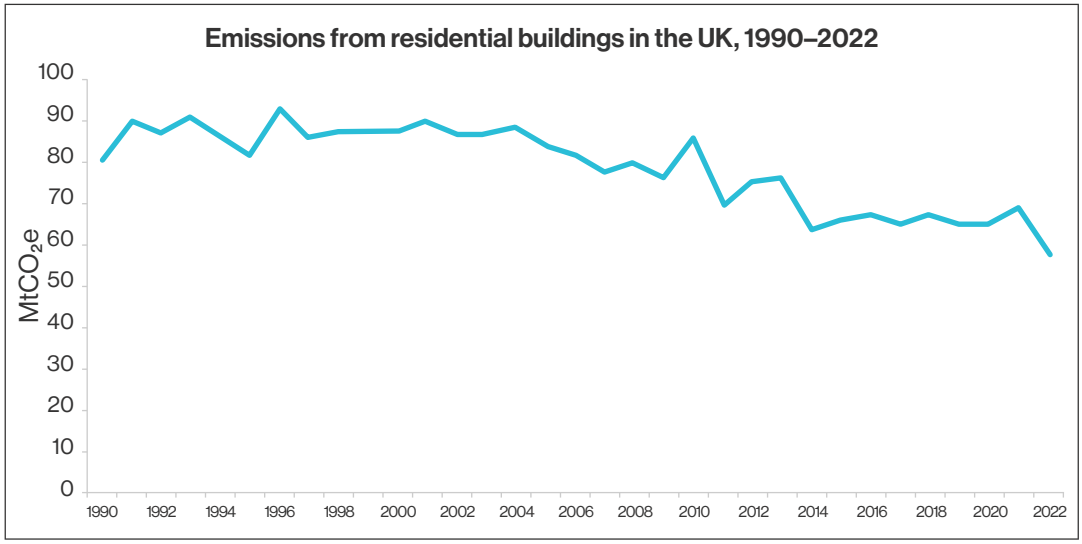
6: A joint report from Social Market Foundation and Public First in a project with Citizens Advice did explore various options – (Norman et al., 2023)

7: (DESNZ and BEIS, 2023)

8: (CCC, 2019b, 2020c; BEIS, 2021a).

overwhelmingly due to a mild winter and lower household demand in response to higher bills. **Temperature adjusted data shows that over the past decade there has been little progress in residential decarbonisation,** and the Climate Change Committee's recent Progress Report to Parliament identified government as 'off-track' on the majority of the key indicators for building decarbonisation.[9]

Figure 2: Emissions from residential buildings in the UK 1990–2022



Source: *CCC Sixth Carbon Budget.10 Original data from National Atmospheric Emissions Inventory (2020) Breakdown of UK GHG emissions by source and greenhouse gas.*

To meet our targets, **the next three decades must see domestic emissions reduce three times faster than the average observed during the preceding three decades**.[11] While this presents a major step change in the progress needed, analysis by the CCC demonstrated that **the achievement of very low emissions in residential buildings is indeed feasible**.[12]

1.1.2 Energy bills

The slow progress in residential decarbonisation to date is not only jeopardising the UK's climate targets, but also **leaving households dependent on gas and vulnerable to current and future energy bill shocks.** Indeed, natural gas remains responsible for the vast majority of domestic heating, with around 85% of UK households using the fuel for central heating.[13]

On the electricity side, natural gas is also the dominant force in setting electricity prices, as detailed in Working Paper 1 from our series on Navigating the Energy-Climate Crisis.[14] In fact, **gas set the electricity price for 98% of the time in 2021, despite accounting for only 40% of electricity generation .** Households across the country are therefore **highly exposed to changes in gas prices, and suffered when prices rose to record highs in 2022.**

9: (CCC, 2023)

10: (CCC, 2020a)

11: (BEIS, 2022b)

12: (CCC, 2019a, 2020b)

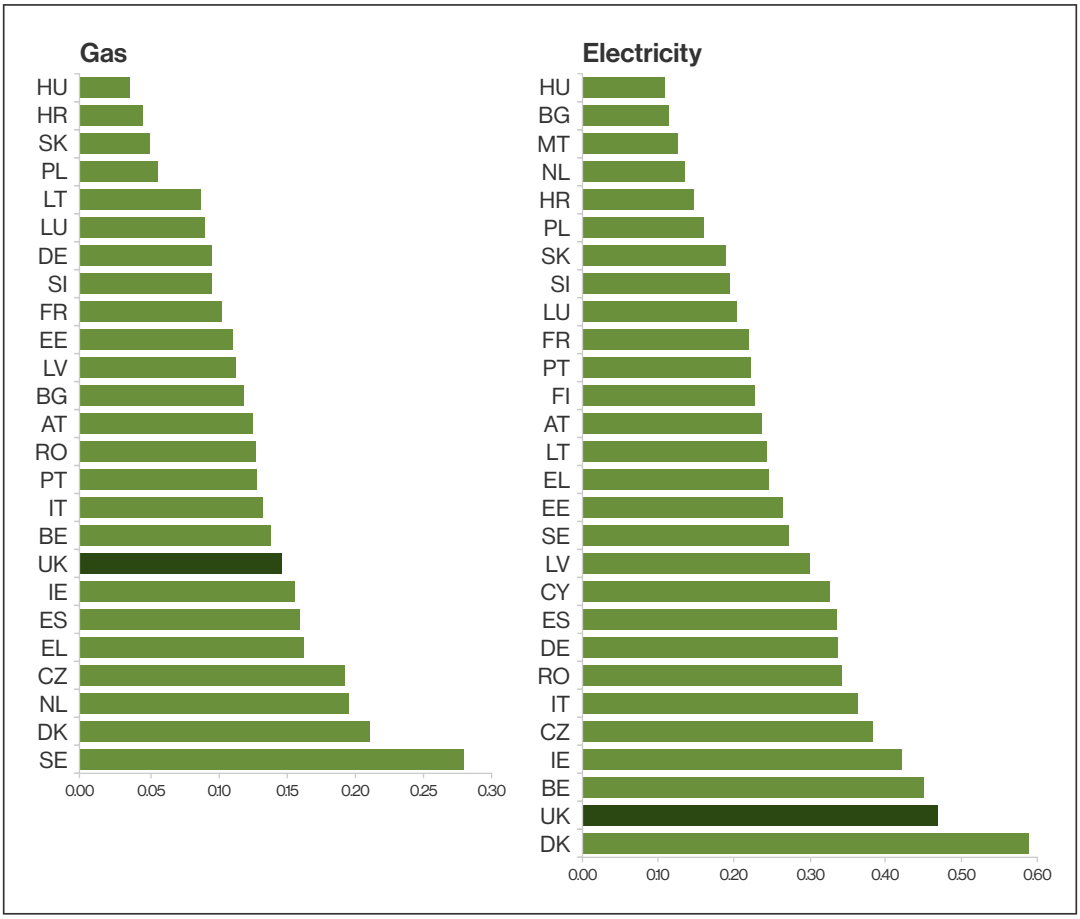
13: (BEIS, 2018, 2021a)

14: (Zakeri et al., 2022)

Over the second half of 2022, this resulted in **UK domestic consumers facing higher than average gas prices and the second highest electricity prices across the EU (Figure 3).** The latest data for July 2023 shows that UK domestic electricity prices remain the second highest across Europe, surpassed only marginally by prices in Ireland.[15,16]

Figure 3: Comparing UK and EU gas and electricity prices for domestic customers for the second half of 2022. (€/kWh for medium users including taxes and levies)

> The slow progress in residential decarbonisation to date is not only jeopardising the UK's climate targets, but also leaving households dependent on gas and vulnerable to current and future energy bill shocks.



Source: *House of Commons Library – Domestic energy prices.*

In light of this, domestic decarbonisation – through reduced dependence on natural gas – should be seen as a key priority in both reducing emissions in line with government legislation and delivering long-term energy bill stability (and the associated macroeconomic benefits that come with this).

15: (Household Energy Price Index, 2023)

16: (Bolton and Stewart, 2023)

1.1.3 Technology pathways to domestic decarbonisation

Levers of domestic decarbonisation
There are three key levers available to decarbonise residential heating:

1. **Behaviour change (to reduce or shift energy demand)**
2. **Energy efficiency (to reduce demand)**
3. **Deployment of low carbon technologies**

It is widely acknowledged that a combination of all three levers will be required to drive the deep domestic decarbonisation needed in the UK; **we will struggle to deliver sufficient low carbon energy to homes without first reducing the total energy required to heat each household.**

That being said, the CCC's 'Balanced Net Zero Pathway for Buildings' shows that by 2050, behaviour change, energy efficiency and low carbon heat must account for 2, 5, and 61 $MtCO_2$ of residential emissions reductions, respectively.[17] Household behaviour change, such as shifting and reducing energy demand, will be discussed in relation to various tariff reform options and the impact on energy bills. Energy efficiency is not within the scope of this report, however, an overview of the topic is provided in the *Aldersgate Group's Espresso Briefing, Warming Britain Affordably.*

An overview of low-carbon heating technology options, pathways and supporting policies is provided in Annex 1. Given the commercial availability and lower cost of heat pumps compared to blue and green hydrogen options, the widespread electrification of domestic heating offers the most obvious route to the decarbonisation of homes across the UK. Further, **the potential for immediate and significant emissions reductions arising from heat pump deployment could accelerate what has so far been a slow journey to domestic decarbonisation.**

To capture the clear benefits of electrified heating, we recommend that Government bring forward the strategic decision on the roles of hydrogen and electrification to the end of 2023. This decision is currently set for 2026, creating a significant barrier to the important near-term development of both hydrogen boilers and heat pumps, and creating uncertainty in other sectors as regards the future availability of low carbon hydrogen (including in some sectors for whom electrification is not an option). For further information on the importance of bringing forward the decision on hydrogen, see the *Aldersgate Group's Espresso Briefing, Powering Britain Affordably.*

In the context of heat pump development, bringing forward the decision sends early investment signals. Early adoption then enables a process of learning by doing through one or two natural replacement cycles prior to 2050, creating economies of scale and supporting the development of domestic manufacturing capacity, and installation training, all of which would encourage further innovation in heat pump technology and bring down costs.

Recommendation 1:
We recommend that Government bring forward the strategic decision on the roles of hydrogen and electrification to the end of 2023.

17: (CCC, 2020a)

2 Energy Bills and Reform Options

2.1 THE ENERGY BILL

Household energy bills are significantly more complex than simply the price of electricity or gas on wholesale markets. The consumer bill also includes policy costs, for various social and environmental subsidy schemes; network costs, for maintaining and developing transmission and distribution grid infrastructure; energy retailer operating costs and profits margins; and VAT. Since January 2019, Ofgem – following the direction of government – has administered the Default Tariff Cap (also known as the Price Cap) to protect customers from being overcharged by suppliers.

The Default Tariff Cap (DTC) works by capping the unit rate that retailers can charge for electricity and gas consumption to consumers on standard variable tariffs, default tariffs and standing charges. Prior to the unprecedented rise in international gas prices, the DTC acted as a ceiling for energy prices in the market, with consumers able to shop around for cheaper deals. **But following the significant rise in prices since October 2021, and associated collapse of over 30 retailers, the DTC has effectively became a floor price in the market, with no retailer offering a tariff under the DTC until recently.**[18]

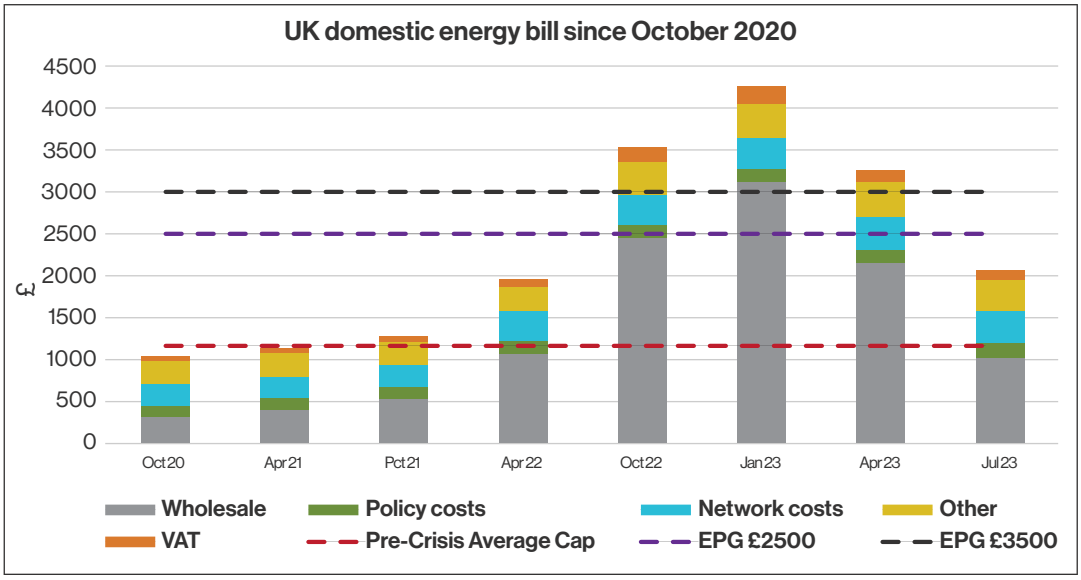
Figure 4 shows the evolution of the cap on a dual-fuel (gas and electricity) bill over the last three years. **The average pre-crisis cap, shown by the red dashed line, was £1154. This almost doubled to £1971 in April 2022, before peaking at almost four times the average in January 2023.** From October 2022, consumers were protected by the government's Energy Price Guarantee (EPG) which capped the typical household bill at £2500 (green dashed line). The EPG was then raised to £3000 from July 2023 as the DTC fell back to around £2000 and now acts as a protection against potential future price spikes .

Figure 4: **Dual fuel default tariff cap for the typical household over the last three years.** Due to increased volatility in energy prices, Ofgem moved from updating the cap every 6 months to every three months to ensure the cap was more reflective of recent prices.

The main driver of the increase in energy bills since October 2021 is the wholesale element of the bill, which increased almost ten-fold between October 2020 and January 2023.

18: The DTC has acted as a floor primarily due to the time lag between wholesale price rises and increases in the DTC level. When wholesale prices rise, the DTC level is slow to respond (although this has been improved by the switch from 6-monthly updates to 3-monthly) and thus the DTC level is cheaper than real prices.

Figure 4 clearly shows that **the main driver of the increase in energy bills since October 2021 is the wholesale element of the bill, which increased almost ten-fold between October 2020 and January 2023 .** Other elements of the bill have also increased for various reasons, and this is summarised in Table 2 below.



At one level, this dramatic increase in energy prices was unavoidable as **the unprecedented increase in international gas prices was passed onto consumers.** However, as we go onto illustrate below, **electricity consumers have significantly overpaid relative to the true cost of generating electricity due to the current design of electricity markets.**

2.2 THE ROLE OF WHOLESALE MARKET REFORM IN DELIVERING AFFORDABLE, PREDICTABLE CONSUMER BILLS

The key takeaway from **Figure 4** is the dramatic effect that wholesale costs can have on bill prices. Table 1 shows the evolution of wholesale costs as a proportion of gas and electricity bills over the past three years. **Clearly, wholesale costs were the driving force behind the domestic energy affordability crisis in the UK,** and thus a review of the drivers of these costs and reform options is necessary.

Table 1: Wholesale costs as a proportion of gas and electricity bills

	Wholesale % of gas bill	Wholesale % of electricity bill
Oct 2020 – Mar 2021	32%	30%
Apr 2021 – Sep 2021	38%	33%
Oct 2021 – Mar 2022	47%	38%
Apr 2022 – Sep 2022	60%	49%
Oct 2022 – Dec 2022	73%	65%
Jan 2023 – Mar 2023	76%	71%
Apr 2023 – Jun 2023	70%	62%
Apr 2023 – Jun 2023	57%	44%

Source: *Ofgem Default Tariff Cap Model.*[19]

Wholesale costs account for the greatest portion of total energy bills, and represent the total price paid by energy suppliers in the wholesale market to purchase the electricity delivered to consumers (aside from the modest role of CfD payments and repayments). The UK wholesale market currently functions on a marginal cost basis – **the price of wholesale electricity at any given moment is set by the marginal cost of operating the last and most expensive power plant brought online to meet demand. Given that the marginal cost of electricity from gas is significantly higher than the near-zero marginal cost of operating renewables,** the wholesale electricity price is broadly driven by the cost of gas. As mentioned above, **in 2021, gas set the price of electricity 98% of the time, despite only accounting for 40% of generation.**[20]

With the wholesale price of gas almost four times higher in January 2022 than in early 2021,[21] the cost of electricity skyrocketed, regardless of its source. Analysis in our recent paper found **that the revenues of GB generators increased by almost £30bn relative to pre-COVID levels,** [22] which saw millions plunged into fuel poverty. Indeed, the impact of the energy crisis in the UK has been devastating, in spite of around 40% of electricity originating from far cheaper renewables – their price obscured by the marginal-on-all pricing system, which seems increasingly inappropriate as the volume of renewables increases.[23]

As expected, revenues acquired by gas generators followed substantial increases in the cost of natural gas – revenues are estimated to have risen by around £13bn. However, a review of **recent spark spreads suggests that gas generator revenues far exceeded the absolute rise in costs, leading to substantial profits.**[24]

19: (Norton, 2023)

20: (Zakeri et al., 2022)

21: (Office for National Statistics (ONS), 2023)

22: (Maximov et al., 2023)

23: (Grubb et al., 2022)

24: (Ofgem, 2023b)

In the case of renewable electricity generators, there has been no similar increase in fuel costs as the fuels are cost-free by nature.[25] Hence, it can be assumed that the vast majority of increased revenue was acquired as profit for those with wholesale market revenues. Estimates show that **generators with renewables obligation certificates (ROCs), accounting for the majority of renewables output in 2022, acquired total revenue £7.7bn higher than the pre-Covid average.**

For generators operating on contracts for difference (CfDs), no additional revenue was acquired during the crisis due to the nature of the contract always requiring reconciliation of wholesale revenues against a fixed strike price. In fact, **over the course of October 2021 to April 2023, payments were in fact flowing from CfD generators back to suppliers to the tune of £660 million.**[26] However, this figure pales into insignificance when compared with the additional revenues generated by renewables on ROCs.

Renewable generators on ROCs argue that periods of high revenue are necessary to recover their comparatively high capital costs, justifying the jump in profit. While this may be true, **the energy crisis has highlighted the flaws in the current wholesale market, in which volatile fossil fuel prices suddenly leave millions unable to heat their homes, despite an ever-growing supply of electricity generated by renewables at a reliably low cost.**

Table 2 shows the evolution of different elements of the electricity DTC relative to the last cap deemed to be unaffected by the international gas crisis. The most recent DTC level (for the period July 1st to September 30th, 2023) exhibits a significant fall in prices relative to the peak, however, **customers are still facing electricity bills that are 66% higher than April 2021** and that is primarily driven by the wholesale cost of electricity, which is 123% higher than April 2021.

Table 2: Increases in the cap on electricity bills relative to pre-crisis prices

Bill Element	**April 2021** (Last price cap unaffected by crisis)	**Jan 2023** (Peak crisis / highest price cap) Increase relative to Apr 2021	**Jul 2023** (Most recent price cap / new normal?) Increase relative to Apr 2021
Wholesale	£207.12	+621%	+123%
Policy	£113.24	+4%	+15%
Network	£143.27	+35%	+52%
Other	£140.77	+48%	+38%
VAT	£30.22	+233%	+66%
Total	**£634.62**	**+233%**	**+66%**

Source: *Ofgem Default Tariff Cap Model.*[27]

25: However, renewables developers are facing other increased costs (inflation and increases in material and supply chain costs), which are particularly damaging for new projects and those in construction. In an extreme case, this has led to a hiatus in construction for the Norfolk Boreas site owned by Vattenfall: (BBC News, 2023)

26: (Energy & Climate Intelligence Unit, 2023)

27: (Norton, 2023)

Given this evidence of the influence that gas prices can have on electricity bills, attention must turn to longer-term options to protect customers from sustained higher costs and future price spikes – especially the vulnerable and fuel poor.

2.2.1 Reforming electricity markets to minimise costs to consumers

> Customers are still facing electricity bills that are 66% higher than April 2021.

In previous work conducted by UCL in collaboration with the Aldersgate Group, a dual market approach coined the 'Green Power Pool' (GPP) was proposed, separating electricity generators into markets based on the most suitable type of marginal cost pricing – either short-run or long-run. **In principle, such an approach would allow consumers to access increasingly cheap renewable energy, based on the average cost of generation rather than a short-run-marginal-cost-pricing-on-all model, which typically results in gas setting the price for all technologies (apart from those on CfDs).**

We have covered in detail the rationale for separating electricity from gas prices and design options for a GPP – currently under consideration as part of the Review of Electricity Market Arrangements (REMA) consultation in the UK – in our series of working papers on *Navigating the Energy-Climate Crises.*[28] The key aspect of relevance to this paper is the potential financial impact of enabling consumers to access the average cost of generation rather than the current model of short-run-marginal-cost-pricing-on-all; we introduce 3 scenarios to test this impact below. There are several other potential co-benefits and considerations for consumers in implementing a GPP – we recommend Working Paper 4 for those wishing to explore the design options in further detail.[29]

2.2.2 Marginal cost pricing vs average cost pricing – which delivers cheaper energy bills?

Given the volatile nature of gas prices, it is impossible to accurately predict the potential energy bill impact of switching from a wholesale market design based on short-run-marginal-cost-pricing-on-all to one based on the average cost of generation. Instead, we define three scenarios against which the two approaches can be tested.

1. **Scenario 1:** 'Pre-crisis' – we use average energy prices for the 5 years preceding the 2022 energy crisis.

2. **Scenario 2:** 'Peak-crisis' – we use the highest DTC level during the crisis, covering the period January to April 2023.

3. **Scenario 3:** 'New normal' – we project energy bills out to 2027 using Cornwall Insight projections and forward contract prices. We choose 2027 as this is that latest delivery year for current CfD contract holders – all contracted capacity should be online by this date. It allows a time for recovery and market stabilisation post energy crisis.

28: (UCL ISR, 2023)

29: (Grubb, Drummond and Maximov, 2022)

For simplicity, we refer to two methods of pricing – 'marginal pricing' and 'average pricing'. By 'marginal pricing', we mean the current market design based on short-run-marginal-cost-pricing-on-all. By average pricing we mean a potential future market design where all renewable and nuclear generation sell their energy, for example to a Green Power Pool Operator, at the fixed price set out in their contract. Non-renewable and nuclear generation would continue to operate in the wholesale market, as today.

Figure 5 shows the potential impact of shifting to average pricing under our three scenarios with the final bill savings summarised in Table 3. All the savings accrue to electricity bills, however, we show the impact for dual fuel customers given this represents the vast majority of households. For methodology, see Annex 2.

For Scenario 1, our analysis shows a discount of £71 on the annual bill for the average pricing approach – a £1.9bn saving across the 27.3 million households in Great Britain. The cost of electricity is in fact higher with average pricing, as the weighted average cost of the contracts is higher than the wholesale price under the marginal pricing approach. However, RO policy costs and the CfD allowance would no longer apply under average pricing as these generators would be remunerated directly via the fixed price contract, therefore these costs can be removed from the final bill.

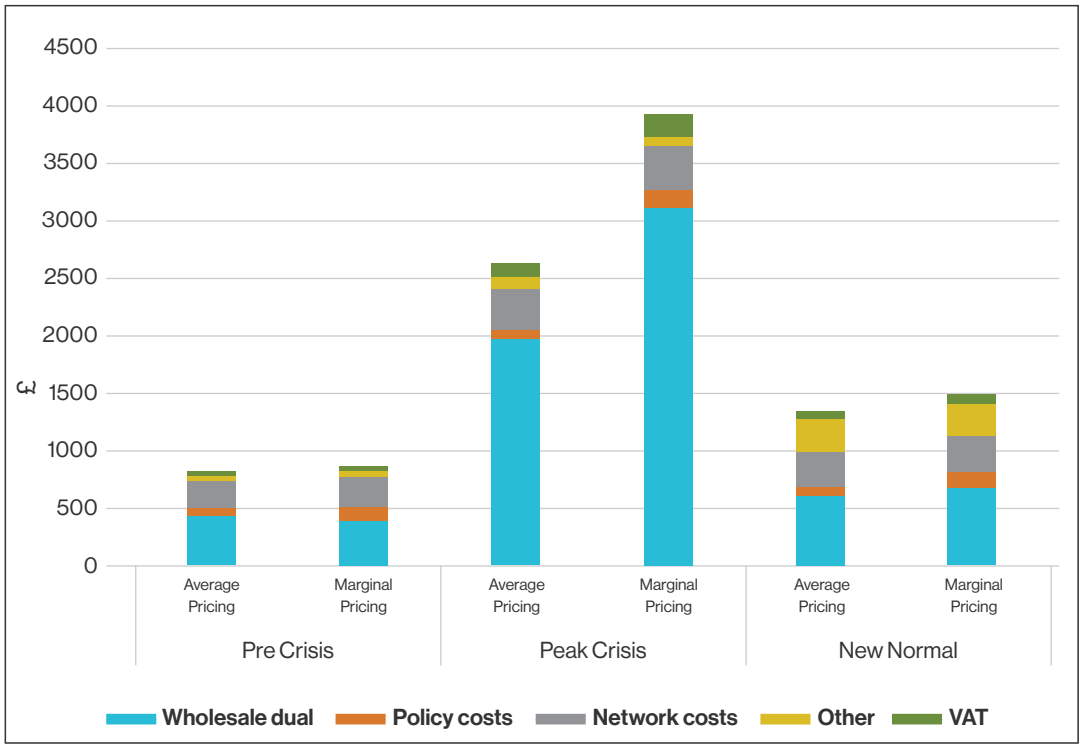


Figure 5: Assessing the impact of average pricing vs marginal pricing on the final bill to consumers under three scenarios *(for methodology, see Annex 2).*

For Scenario 2, our analysis shows a significant saving at both the household (£1287/yr) and national level (£35.1bn/yr). This is a result of average pricing removing the opportunity for windfall profits for those generators on fixed price contracts. As above, RO policy costs and the CfD allowance would no longer apply. However, with the final annual bill still reaching £3000, consumers would require additional support – we explore options for this support in more detail in Section 4.

Finally, Scenario 3 exhibits an annual saving of £160 for the typical household, which equates to a £4.4bn total saving across GB. This is due to wholesale price forecasts remaining above pre-crisis levels out to 2027 and beyond. As a result, the opportunity for windfall profits remains in the system and average pricing removes this possibility for those generators on fixed price contracts, creating a saving for the end-consumer. Generators would be willing to sign contracts at a price below wholesale market forecasts due to the increased revenue certainty those contracts would deliver, however, the specific price level they would be willing to accept is unknown and would vary on a project-by-project basis. Once again, RO policy costs and the CfD allowance do not apply under average pricing.

Table 3: Potential savings from moving to average pricing under three scenarios of energy prices

	Scenario 1: Pre Crisis		**Scenario 2: Peak Crisis**		**Scenario 3: New Normal**	
	Average	Marginal	Average	Marginal	Average	Marginal
Final Bill (annual)	£1012	£1083	£2992	£4279	£1338	£1497
Saving per Household (annual)	£71	£0	£1287	£0	£160	£0
Savings across GB (annual)	£1.9bn	£0	£35.1bn	£0	£4.4bn	£0
Cost to HMT (annual)	£0	£0	£0	£0	£0	£0

In summary, a shift to average pricing would deliver savings to consumers in all scenarios. It would be most effective in dampening the impact of potential future energy price shocks by limiting the potential windfall profits in the system. As mentioned previously, **HM Treasury spent £33bn covering around half of household energy bills between October 2022 and March 2023; this analysis shows that bill could have been reduced substantially if average pricing was in place.** Furthermore, with current wholesale forecasts showing electricity and gas prices remaining at least 50% above the pre-crisis average out to 2030, average pricing is all the more important for revealing the true cost of power to consumers.

Clearly, average pricing alone will not be enough to end fuel poverty, but it will reduce bills for all, and it will reduce the cost of further support required to ensure affordable energy for all. We are therefore pleased to see that government is still actively exploring the role of marginal pricing in its Review of Electricity Market Arrangements and we recommend extending the role of long-run marginal cost pricing, in the form of fixed-price contracts, for suitable technologies.

Recommendation 2:
We recommend extending the role of long-run marginal cost pricing, in the form of fixed-price contracts, for suitable technologies.

3 Tariff Reform Options

Alongside wholesale market reform to address volatile and elevated electricity prices, changes to tariff structures could also be implemented to deliver more affordable and equitable bills for consumers. This section compares tariff reform options currently under consideration, evaluating the ability of each to support decarbonisation and deliver more affordable electricity to both vulnerable and typical consumer groups. We explore the potential impact of a social tariff, rising block tariffs, and changes to policy cost recovery as options for implementation in the near-term, conducting analysis using our three wholesale price scenarios to quantify the impact of each on bills.

3.1 SOCIAL TARIFF

A social tariff is effectively a supplementary price cap, lower than the DTC, applied to the energy bills of specific target groups to discount the price paid per unit of energy consumed. Consumers supported by a social tariff would vary according to design, but could include those on means tested benefits, disability benefits and those receiving carers allowances. Crucially, **a social tariff should also look to cover households *outside* target groups assisted by the welfare system, but who still consistently struggle to pay energy bills;** NEA estimates that a third of households in fuel poverty are not supported by the UK welfare system.

A combination of household income and electricity consumption or payment data, held by HMRC and energy suppliers respectively, could provide the appropriate information to pinpoint households in need of support. Some suggest compensating the supplier costs of a social tariff by increasing bills for remaining consumers. However, higher bills would hinder the transition to decarbonised homes by lowering the capital availability of households for investment in low-carbon heating systems. Alternatively, **to avoid stalling the transition, the preferred option is for costs to be covered by general taxation.**

Vulnerable consumers often reside in dwellings with low efficiency ratings and do not have the capital to invest in retrofitting, exacerbating fuel poverty through energy wastage. Therefore, there have been calls to couple social tariffs with support for the installation of basic efficiency measures such as cavity wall and loft insulation. Initiatives of the sort would accelerate the upgrade of the UK housing stock, help to reduce energy demand, and work to reduce fuel poverty. **Additionally, if the cost of funding a social tariff scheme was covered by HMT, this would create an incentive on government to provide investment support for demand reduction measures to reduce the overall cost of the scheme** (this is true if the social tariff is implemented as a proportional bill discount – it would not apply if it is a fixed discount like the Warm Home Discount, for example).

Citizen's Advice advocates for a social tariff in the form of a cash payment to over twelve million of the lowest income households across the UK, with the degree of support varying according to household needs.[30] On the other hand, the UK fuel poverty charity, National Energy Action, campaigns for an automatically applied social tariff, providing a substantially discounted standing charge and unit rate to the eight million vulnerable consumers it estimates need aid. The charity highlights that an automatically applied discount better supports households on prepayment meters, who are disadvantaged by the current system in which support vouchers are often left unclaimed.[31]

Table 4: Design advocated for by proponents of a social tariff

Organisation	Proposed design	How it would work
Citizens Advice[32]	Cash payments to target group.	Formula-based lump sum payment up to £1,500 for 12.3 million targeted households, varying with household income and energy use. The scheme would cost £6.5bn. Funded by general taxation.
NEA, Fair by Design	Bespoke price cap for low income and vulnerable consumers.	New legislation saving targeted households hundreds per year. Funded by general taxation or cross-subsidy across the energy market.
Age UK[33] **(SCOPE are also proponents**[34]**)**	Bespoke price cap for low income and vulnerable consumers.	New legislation saving targeted households hundreds per year. Funded by general taxation or cross-subsidy across the energy market.

3.1.1 Scenario Analysis: Social Tariff

Several proposals exist for the scale and type of discount a social tariff should offer, and the number of households it should target. For analysis against our three scenarios, we choose a 30% tariff discount targeted at a changing number of households according to the prevailing wholesale electricity price. We use government figures for fuel poverty based on the NEA definition,[35] taking the 5-year pre-crisis average (4.2m) and the 2023 estimate (12m). We then project the 2027 figure (6m) using the ratio of fuel poverty statistics to wholesale electricity price. Such a mechanism would result in final bill reductions and costs to HM Treasury set out in Table 5.

30: (Citizens Advice, 2023)

31: (Miller et al., 2023)

32: (Citizens Advice, 2023; Norman et al., 2023)

33: (Karania, 2022; Age UK, 2023a, 2023b)

34: (Leigh, 2023)

35: (DESNZ, 2023a)

Table 5: Impact of a Social Tariff under three scenarios of energy prices

	Scenario 1: Pre Crisis	Scenario 2: Peak Crisis	Scenario 3: New Normal
Final Bill w/o intervention (annual)	£1083	£4279	£1497
Final Bill with intervention (annual)	£758	£2995	£1048
Saving per Household (annual)	£325	£1284	£449
Cost to HMT (annual)	£1.4bn 4.2 million households	£15.4bn 12 million households	£2.7bn 6 million households

In Scenarios 1 and 3 this social tariff design would contribute significantly to alleviating fuel poverty. **Targeting is the crucial element of this tariff design to ensure support is delivered to households in need and taxpayer money is used efficiently** (targeting is discussed in more detail in Section 4.6). Our proposal to link social tariff recipients to the NEA's fuel poverty definition results in efficient targeting and a clear incentive on government to support the installation of energy efficiency measures in fuel poor homes. In Scenario 2, this design would deliver some respite from high energy bills but further fiscal support – similar in nature to the Energy Price Guarantee though ideally targeted – would be required.

The benefits of such an intervention include significant and predictable bill discounts for households in need, and immediate and direct relief if applied as an automatic bill discount rather than as a cash payment. The drawbacks include the usual challenges with targeting, and the need for further support in the event of future energy price shocks, however, these issues are common across other reform options. Significant reductions to energy prices, without other interventions, may also incentivise greater energy usage to the detriment of the wider system (further detail on benefits and drawbacks is provided in Table 11).

3.2 RISING BLOCK TARIFF (RBT)

This option would provide all customers across the market with progressively rising tariffs based on their electricity consumption. The more electricity used, the higher the rate at which customers will be charged per unit used. The first block of electricity would cover essential daily activities and would be provided at either low or no cost. Proponents of a RBT argue that a rising block tariff drives decarbonisation by encouraging demand reduction and the uptake of efficiency measures, while remaining progressive due to the low or no cost block, significantly reducing the rate of self-disconnection from the grid. Further, a rising block tariff system could be leveraged to respond to fuel poverty through the provision of free blocks of energy to the most vulnerable consumers.

However, **many vulnerable consumer groups are left unaccounted for by this reform option – those consuming a high volume of energy due to fixed circumstances, who therefore cannot adapt to reduce their demand.** Such consumer groups include households running high usage medical equipment, those with several children, and those with one or more disabled members who must reside in warmer homes to avoid exacerbating illness. This option would also disadvantage those living in energy inefficient buildings who do not have the capital

to install insulation – typically renters, as well as 1.8 million electricity-only households who would inevitably require electricity from more expensive 'blocks' for basic needs.[36]

New Economics Foundation suggests combining a rising block tariff system with social tariffs or cash support to ensure the incentive to reduce demand is better targeted.[37]

Similarly to Time of Use tariffs (TOUs), discussed below, a rising block tariff would require the rapid roll out of smart meters. **This use of smart meters would encourage a reduction in total demand, rather than targeted reduction of peak demand, although this would likely reduce accordingly.** While reducing demand will be an important enabler of widespread domestic decarbonisation, penalising consumers for increasing their electricity consumption, during a period in which the switch from traditional gas boilers to heat pumps will be encouraged, may be counterintuitive.

Table 6: RBT design options

Organisation	Proposed design	How it would work
New Economics Foundation[36]	Two tier RBT	Block 1: 0-2,100 kWh electricity, 0-5,400 kWh gas, -50% reduction relative to 2021. Block 2: 2,101+ kWh electricity, 5,401+ kWh has, +20% above 2021 prices.
	Three tier RBT	Block 1: <1,050 kWh electricity, <2,700 kWh gas free. Block 2: 1,051-2,900 kWh electricity, 2,701 – 12,000 kWh gas, equal to 2021 prices. Block 3: 2,901+ kWh electricity, 12,001+ kWh gas, +30% above 2021 prices.
	Both	Ensure a 50% cut in the price of 'essential energy' for the average household, compared with 2021 Q4 prices, and cost in the region of £2.4bn.

3.2.1 Scenario Analysis: Rising Block Tariff

For analysis against our three scenarios, we choose to focus on a two-tier RBT in the interests of simplicity. We follow the usage boundaries set out by New Economics Foundation in their two-tier RBT (Table 6), but we introduce new price levels. We analyse RBTs with Block 1 at the 5-year, pre-crisis average and Block 2 at the prevailing market price of the moment, respectively to both electricity and gas consumption. To align with proponents, the RBT is be applied across all households. Such a design would lead to the final bill reductions and costs to HMT set out in Table 7.

36: (Simakov et al., 2022)

37: (Chapman and Kumar, 2023)

Table 7: Impact of a Rising Block Tariff under three scenarios of energy prices

	Scenario 1: Pre Crisis	Scenario 2: Peak Crisis	Scenario 3: New Normal
Final Bill w/o intervention (annual)	£1083	£4279	£1497
Final Bill with intervention (annual)	£1083	£2459	£1313
Saving per Household (annual)	£0	£1820	£184
Cost to HMT (annual)	£0	£53bn	£5.3bn

By nature of the design of this RBT, there would be no change to the final bill in Scenario 1. Consequently, the 3–4 million households living in fuel poverty pre-crisis would require additional support. In Scenario 2, this design would provide significant savings to all households, delivering a similar outcome to the initial Energy Price Guarantee which capped bills at £2500, however, at £53bn, the cost to HM Treasury is clearly unsustainable in the event of future energy price crises (as significant further fiscal support would be required for vulnerable households). This reveals the Achilles Heel of RBTs – the lack of targeting and thus inefficient use of taxpayer money. Modest savings would be delivered in Scenario 3 resulting in a clear requirement for further support to vulnerable households.

The benefits of this design option include delivering the average household's minimum electricity and gas needs (as defined by New Economics Foundation) at pre-crisis prices. Therefore, consumers who could cut back to this minimum level could see annual savings in excess of those set out in Table 7 (as these savings are based on Ofgem's typical consumption levels). However, there are several drawbacks with this design, specifically fairness concerns, such as penalising vulnerable high energy users and poor compatibility for households without smart meters; the exceptionally high cost to HM Treasury during crises; and the low saving to cost ratio as a result of the lack of targeting.

3.3 REFORMING POLICY COSTS

A less radical option for reducing bills and incentivising decarbonisation is reducing or rebalancing the policy cost element of the bill. Reducing policy costs would simply involve transferring the recovery of some policy costs (breakdown below) to general taxation. Rebalancing policy costs would involve shifting recovery of some policy costs from electricity bills to gas bills to 'level the playing field' across the two fuels. At present, policy costs are recovered primarily from electricity bills rather than gas bills, at a ratio of around 80:20 respectively. This means electricity bills are artificially inflated relative to gas bills by a factor outside of wholesale, network and other charges. Ultimately, this disincentivises consumers from moving away from gas at a time when this needs to be accelerated to improve energy security and reduce emissions.

Each year, government applies an additional £160 to average household bills as 'policy costs', to cover energy levies, subsidies and schemes which support our electricity markets. A full breakdown of costs is presented in Table 8, below.

Table 8: Breakdown of policy costs on energy bills (as of Oct–Dec 2023 price cap)

	Status	Type	Purpose	£/year
Electricity bill				
Renewable Obligations	Closed	Green	Legacy renewable energy subsidies	80.26
Feed in tariffs	Closed	Green	Legacy renewable energy subsidies	20.41
Energy Company Obligation	Open	Mixed	Fuel poverty / energy-efficiency scheme	20.66
Warm Homes Discount	Open	Social	Financial support for households	10.30
Assistance for Areas with High Distribution Costs	Open	Social	Support for high-cost distribution areas	1.32
CfD	Open	Green	Current renewable energy contracts	16.27
Gas bill				
Energy Company Obligation	Open	Mixed	Fuel poverty/energy-efficiency scheme	23.21
Warm Homes Discount	Open	Social	Financial support for households	10.30
Green Gas Levy	Open	Green	Low-carbon gas subsidy	0.45

Source: *Author analysis of Ofgem Default Tariff Cap Model.*[38]

Over 55% of all policy costs contribute towards policies that have been closed for years (i.e., payments based on historical contracts of schemes now discontinued), 35% towards policies supporting fuel poor households, and less than 9% of policy costs cover green policies currently in operation . In total, £149 (82%) are added to electricity bills, while only £34 (around 18%) are added to gas bills.

38: (Ofgem, 2023a)

Summarising the two key solutions:

- **Shifting policy costs from household bills to general taxation. This could be justified given that policy costs are mostly comprised of legacy policies, which can now be considered a 'public good'.** This solution would arguably have the greatest impact on fuel poverty rates in the UK, reducing the cost of heating bills which typically account for higher proportions of household expenditure of vulnerable customers. Further, **it is a progressive option as the poorest would repay a far smaller share of policy costs through general taxation.**

  In the case of shifting policy costs to general taxation, **we would recommend that all but open, green schemes should be removed from bills.** It makes sense for the CfD scheme to remain on electricity bills due to the two-way nature of the mechanism, meaning customers would receive payments (i.e. policy costs would effectively be negative) during periods of high electricity prices. The Green Gas Levy is trivial and as noted, the prospects for 'green gas' for home heating seem very limited.

- **Redistributing policy costs evenly across gas and electricity bills.** This would involve evening what is currently an 80:20 split of policy costs on electricity and gas bills, respectively, **thereby levelling the playing field but avoiding favouring electricity over gas.** This would **reduce the cost of electricity bills relative to gas, encouraging consumers to switch to electrified heating.** If applied in conjunction with a Green Power Pool, rebalancing policy costs would further expose consumers to a more accurate representation of the disparity in the costs of producing electricity from gas and renewables.

  However, such rebalancing **would increase the cost of heating bills for the 85% of UK homes which still use gas boilers.** This is an important incentive for those in a position to afford the switch to a lower-carbon heating system. However, this is a **significant risk for the millions currently not in this position, and especially the fuel poor, for whom heating bills hit hardest.** Government would therefore need to **combine rebalancing with either direct fiscal support to these households, or subsidies to install measures to reduce heat demand and switch to a low-carbon heating system.**

3.3.1 Scenario Analysis: Reforming Policy Cost Recovery

The final reform options included in our analysis are the reduction and rebalancing of policy costs. We model the potential savings and cost to HMT of both options, applying the changes across all households. **Table 9** shows the results of shifting to recovery of policy costs (all except the CfD) from general taxation. The saving across all scenarios is similar due to the relatively fixed nature of policy costs, of course the extent of the saving would change in line with the expansion/removal of schemes. The cost to HMT is relatively modest – less than 0.5% of forecast public sector spending for 2023/24 – and predictable.[39]

39: (Office for Budget Responsibility, 2023)

Table 9: Impact of moving to policy cost recovery via general taxation under three scenarios of energy prices

	Scenario 1: Pre Crisis	Scenario 2: Peak Crisis	Scenario 3: New Normal
Final Bill w/o intervention (annual)	£1083	£4279	£1497
Final Bill with intervention (annual)	£955	£4120	£1346
Saving per Household (annual)	£128	£159	£151
Cost to HMT (annual)	£3.7bn	£4.6bn	£4.4bn

Table 10 shows the impact of rebalancing policy costs across electricity and gas bills, addressing the current recovery 80:20 ratio of recovery. Some call for a majority or even all of policy costs to be recovered via gas bills with the aim of maximising the incentive for electrification. We choose to model a 50:50 recovery to limit the impact on gas users and ensure a level playing field across the two fuels. An underlying economic rationale is that the costs were incurred to support investment in technologies that meet the general need to decarbonise energy (including through electrification of heat), not just existing electricity uses, so should be charged across the competing energy sources (in this case, gas).

In Scenario 1 this approach is effective in making electricity cheaper than gas at typical consumption levels, thus delivering a strong incentive to switch to heat pumps. The relative impact of the policy in Scenario 2 is limited due to high prices, whereas Scenario 3 sees a 14% swing in the relative price of electricity and gas. The key attraction of this option is the lack of any cost to government, but that means continuing with the current regressive approach of recovering costs through energy bills.

Table 10: Impact of a policy cost rebalancing under three scenarios of energy prices

	Scenario 1: Pre Crisis		Scenario 2: Peak Crisis		Scenario 3: New Normal	
	Elec	Gas	Elec	Gas	Elec	Gas
Final Bill w/o intervention (annual)	£573	£510	£2126	£2153	£950	£547
Final Bill with intervention (annual)	£532	£551	£2100	£2198	£889	£593
% change in bill (annual)	-7%	+8%	-1%	+2%	-6%	+8%
Cost to HMT (annual)	£0	£0	£0	£0	£0	£0

Our preferred recommendation is for legacy and social policy costs to be shifted to general taxation to ensure progressive recovery of 'public good' costs. This would also reduce the burden on energy bill payers as much as possible, which is crucial in the context of near-term prices, but also offers resilience to future potential price increases. Furthermore, it avoids penalising those who are reliant on gas for heating and who do not have the capacity to switch to a low-carbon heat technology – an outcome which would require an additional layer of government intervention, increasing complexity.

3.4 TIME-OF-USE TARIFFS

Currently offered by some suppliers, TOUs work similarly to a rising block tariff in that smart meters are used to offer lower rates to households in exchange for adapting consumption. There are two broad categories of TOU: a static TOU, which offers two or more fixed rates during set times of the day; and a dynamic TOU, which exposes customers to real-time pricing allowing them (or a smart system) to shift demand according to changes in price. Both options encourage households to avoid consumption at peak times and thus present consumers with the ability to access cheaper prices.

In a future electricity system dominated by weather-dependent renewables, there will increasingly be periods of misalignment – when supply exceeds or falls short of demand. Hence, smart meter facilitated TOUs could not only allow consumers to avoid more expensive energy when renewables supply is low, but also to access increasingly cheap energy in times of surplus. **Facilitating consumers to respond to prices in a more variable system could therefore reduce energy bills in the near-term and significantly reduce overall system costs by minimising the amount of electricity generation, network, and storage capacity required – thereby reducing energy bills in the long-term as well.**

While TOUs hold promise in enabling a flexible future energy system, concerns remain around potential impacts for consumers. For example, **some high-usage groups may not be able to shift time of consumption, such as those reliant on medical equipment, and would be unfairly penalised when forced to use their devices during periods of high prices.** Vulnerable consumers are also less likely to benefit from TOUs as they are typically less engaged with their energy usage and do not have access to the capital required to install complementary technologies such as heat pumps, batteries, and EVs.

We see TOUs as a key aspect of the future energy system – in enabling demand side flexibility in response to increasing shares of variable renewable generation – and believe suppliers should eventually be mandated to offer TOUs to their customers as a result. However, in the near-term, TOUs only offer significant reductions in energy bills for households that have electric heating and cars, a smart meter and the ability and knowledge to manage their energy use carefully. In negative cases, TOUs can result in increased bills – a recent UK trial of TOUs, resulted in 25–40% of people facing higher energy bills.[40]

Therefore, TOUs should not be seen as an immediate solution for affordable energy bills for all and, as such, are not included in our analysis. They should be available for households that desire them – this is important for incentivising the switch to electric cars and heating. **But the main government focus should be on laying the foundations for TOUs in future, namely completing the rollout of smart meters, delivering market-wide half hourly settlement as soon as possible, and working with consumers and suppliers on TOU design and consumer protection regulation.**

40: (Hledik et al., 2017)

3.5 STANDING CHARGE REFORM

Standing charges are fixed components of household energy bills, unchanged by the volume of electricity or gas consumed. They cover costs incurred by suppliers on behalf of their customers, including the cost of maintaining networks, the cost of government support schemes (policy costs) and the cost of conducting meter readings. Various arguments have been made for either increasing or decreasing standing charges.

Proponents of a higher standing charge say it would be coupled with appropriate reductions in the unit charge to ensure that the revenue accrued by energy suppliers is unchanged. They suggest restructuring would reduce the volatility of household energy bills brought about by fluctuating wholesale prices. However, given that volatility in energy bills is almost solely a result of wholesale prices, **this would only be true if part of the wholesale element was included in the standing charge.** Further, increasing the standing charge relative to current levels could more reliably recover the costs of major grid development needed to facilitate the transition to net zero.[41]

However, raising standing charges could have serious implications for vulnerable consumers. **This reform option increases the cost of minimum usage, encouraging the fuel poor pre-payment meter (PPM) customers to self-disconnect and live in cold homes when faced with significant debt accruing irrespective of energy consumption.** This is particularly true for customers on pre-payment meters who must clear standing charges prior to consuming energy. As such and given that unit rate volatility would only be reduced by including part of wholesale prices in the standing charge (a move that seems overly complex for the potential benefit), **we recommend that increasing standing charges is avoided.**

Others propose reducing,[42] or even completely removing the standing charge,[43] with arguments centring around the fact that high standing charges result in lower energy users saving proportionately less and less by reducing usage, and the fact that vulnerable consumers can accumulate debt during periods when they have decided to use no energy at all. However, removing the standing charge and increasing the unit rate would result in distributional impacts similar to the RBT by penalising vulnerable high energy users. In addition, such an approach would enable those with the wherewithal to install behind the meter generation to completely avoid paying any system costs despite still utilising the system (i.e. to sell excess power back to the grid). Due to these fairness concerns, we remain unconvinced of any strong case to change the regime around standing charges in either direction. Regardless, targeted relief is needed for the most vulnerable, specifically PPM customers who have disconnected and are unable to use their meter again until they have cleared the debt that has accumulated from standing charges.

41: In Great Britain, around four times as much new transmission network will be needed in the next seven years as was built since 1990 – (Winser, 2023).

42: (Lewis, 2023)

43: (Centrica, 2023; Fuel Poverty Action, 2023)

Table 11: Summary of tariff reform options

	Social Tariff (30% discount)	Rising Block Tariff (RBT)	Policy Costs	TOU	Standing Charge Reform
Targeting	Targeted. Government should adjust coverage according to energy price levels.	Applied to all households	Applied to all households	Applied to all households	Applied to all households
Support for fuel poor/vulnerable	Provides the most targeted support of all tariff reform options. Could create a severe cliff-edge if not targeted appropriately.	Provision of a free block would prevent self-disconnection. Risks plunging groups with fixed high usage into deep fuel poverty.	Moving closed and social policy costs onto general taxation benefits vulnerable consumers the most. Rebalancing policy costs doesn't reduce financial burden for the fuel poor.	Typically benefits wealthier households with the capital to invest in complementary technologies. Provides no targeted support to vulnerable consumers. Could benefit fuel poor in future if smart system can shift usage to lower priced periods.	Increasing standing charge hits vulnerable consumers the hardest. Moving standing charges to unit rate would penalise vulnerable groups with fixed high usage, similar to RBT.
Incentive for electrification	Cheaper electricity increases incentive to electrify, but heats pumps are currently unaffordable for vulnerable consumers. Does not address the fact that electricity is a more expensive fuel than gas.	Penalises electricity consumption beyond the 'essential' cheaper block. This will broadly disincentivise electrification. For those on old electric heating system, it incentivises heat pump installation due to much higher efficiency.	Shifting policy costs to general taxation would make electricity cheaper and result in a bigger decrease in electricity relative to gas (as 80% of policy costs are on electricity) Gas would still be the cheaper fuel per unit rate.	For consumers who can afford complementary technologies, significant savings could be made by shifting electricity consumption, thus incentivising electrification.	Higher standing charges would reduce energy prices for the highest users, thereby creating a small incentive for electrification. Removing standing charges would do the opposite, although it would improve flexibility signals and thus may incentivise electrification for those confident in energy use management
Incentive to reduce total energy usage	Cheaper energy generally leads to higher consumption and thus a weaker incentive to reduce total energy usage.	A RBT incentivises consumers to reduce usage to minimise the impact of higher priced blocks.	Similar to a social tariff, any discount to electricity or gas bills would likely lead to increased total energy usage, depending on prevailing wholesale price levels.	The core focus of a TOU is shifting energy use rather than reducing. However, as TOUs incentivise electrification, and heat pumps and electric cars are more efficient than alternatives, overall consumer energy use would be reduced.	Increasing the standing charge reduces the unit charge, thus encouraging less diligent usage. Decreasing the standing charge would have the opposite effect and incentivise consumers to limit usage.

	Social Tariff (30% discount)	Rising Block Tariff (RBT)	Policy Costs	TOU	Standing Charge Reform
Incentive to shift energy usage	No incentive to shift usage.	No incentive to shift usage	No incentive to shift usage	Provides incentive to shift usage, so long as households are educated and have the capacity to change consumption patterns.	No incentive to shift usage
Ease of implementation	Data sharing between HMRC and energy suppliers could play either an enabling or disabling role in the speed and ease of correctly identifying vulnerable consumers. Likely time consuming to set up, requiring substantial regulatory and legislative overhaul.	Implementation could be challenged due to the high likelihood of inequitable outcomes arising from RBT. Likely time consuming to set up, requiring substantial regulatory and legislative overhaul.	Rebalancing and shifting policy costs would theoretically be easy to implement, indeed government committed to funding policy costs via general taxation during winter 2022/23 – however, HM Treasury is likely to oppose a permanent shift to general taxation.	Roll out of smart meters, ensuring consumer protection regulations and sufficient awareness of risks means TOUs are a longer-term option. New legislation would be required alongside a comprehensive regulatory framework. Implementation could be challenged due to the high likelihood of inequitable outcomes arising from TOU tariffs.	Changes to the standing charge would be relatively simple to implement, indeed Ofgem has significantly increased the standing charge in recent months (primarily to recover SoLR costs). There is growing political pressure to reduce or even remove standing charge, thus further increases are unlikely.
Summary	A social tariff is our preferred option for delivering more affordable bills to consumers as it is relatively simple, delivers savings to those in need and thus ensure efficient use of taxpayer money. A social tariff could also be flexible according to consumer needs - the level of discount/ targeted coverage could be adapted to the prevailing wholesale energy prices by linking recipients with the NEA's definition of fuel poverty. The key challenge with this option is getting the targeting right.	A RBT is rejected primarily due to the associated distributional concerns. Other than the incentive to reduce overall consumption, there is no clear benefit relative to a social tariff. The need for significant additional intervention (NEF suggest a social tariff would be needed alongside a RBT) is another weakness. The lack of targeting also results in inefficient use of taxpayer money.	We recommend that closed scheme and social policy costs should be shifted to general taxation to reduce energy bills and ensure more progressive recovery of costs. Such a move could be implemented alongside a social tariff delivering reduced bills for all and further reductions for those targeted by the social tariff. Rebalancing is the backup option if HM Treasury resists responsibility for policy costs, though care must be taken to avoid distributional impacts – we see a 50:50 rebalancing as the fairest route.	TOUs represent the long-term ambition for the electricity sector to enable the demand side to respond to price signals linked to fluctuating generation from variable renewables. We see several barriers to widespread adoption of TOUs in the near-term and instead encourage government to focus on laying the foundations for a market based on TOUs in the future. In the interim, TOUs should be on offer to suitable households to provide learnings ahead of market-wide adoption and provide flexibility to the system.	Standing charge reform is rejected due to distributional concerns that come with shifting charges to the unit rate. However, government should provide support with standing charges to the most vulnerable i.e., PPM customers who have self-disconnected and are unable to reconnect until they have paid off the standing charge debt that has accrued during their period of zero usage.

3.6 SUMMARY OF RECOMMENDATIONS FOR TARIFF REFORM

The need for government intervention in the retail energy market is clear – record numbers of households are now living in fuel poverty and there is no easement on the horizon given current debt levels and forward energy price projections. We put forward four key recommendations for tariff reform that will lower energy bills for all, deliver enhanced savings to those most in need, and incentivise home electrification to support the net zero transition.

Recommendation 3: Introduce a targeted social tariff for the fuel poor.

A social tariff offering an automatic 30% discount on the unit rate for vulnerable homes would go a long way to alleviating fuel poverty. In our "New Normal" scenario, which looks at projected energy prices in 2027, this social tariff design would deliver savings of around £450 per year to households on typical consumption, reducing bills to around pre-crisis levels, and at a cost to HM Treasury of £2.7bn. As our lead recommendation, we go into further detail on the specifics of implementation below, however, it should be noted that further support will still be required for the most vulnerable households.

Recommendation 4: Move policy cost recovery from energy bills to general taxation.

Policy costs applied to household energy bills for closed and social schemes should be moved to general taxation to immediately lower bills and ensure progressive recovery of 'public good' costs. The saving per household is relatively modest at £151 per year (Scenario 3), however, government has proved that this could be implemented quickly, having effectively already done this via the Energy Price Guarantee in October 2022.

Reducing policy costs this way, rather than rebalancing them across electricity and gas, avoids penalising those reliant on gas for heating who currently do not have the capacity to switch to a low-carbon heating technology. Having said that, rebalancing is preferable to the status quo and thus should be seen as a backup option if general taxation is rejected. It is also worth noting that these options should be introduced in conjunction with other reform options, as they will not be sufficient to address the affordability crisis, or act as a standalone enduring solution to affordable energy bills, rather they should be seen as a means of delivering immediate relief to all households.

Recommendation 5: Lay the foundations for market wide TOUs in future.

TOUs will be crucial in enabling a flexible future energy system, enabling the integration of high proportions of variable renewables, and limiting excess capacity buildout. In doing this TOUs will offer consumers the chance to save money, by shifting their usage to lower priced periods, and they will reduce overall system costs by reducing the capital investment requirement. As such, we believe suppliers should eventually be mandated to offer TOUs to their customers.

However, the benefit of TOUs currently falls mostly on affluent households – those that have electric heating and cars, a smart meter and the ability and knowledge to manage their energy use carefully. In negative cases, TOUs can result in increased bills as ill-prepared consumers fail to shift usage from high-priced periods.

TOUs should therefore not be seen as an immediate solution to affordable energy bills for all. They should be available for households that desire them – this is important for incentivising the switch to electric cars and heating. But the main government focus should be on laying the foundations for TOUs in future, namely completing the rollout of smart meters, delivering market-wide half hourly settlement as soon as possible, and working with consumers and suppliers on TOU design and consumer protection regulation.

Recommendation 6: Urgently address standing charges on PPM customers.

While we recognise the attraction of the proposal, we have concerns with calls to remove standing charges due to issues with distributional fairness and economic efficiency. As such, we recommend that government currently avoids interfering with standing charges and we recognise that they play an important role in covering many of the fixed costs in the system (and fixed charges are seen as an economically efficient way of recovering fixed costs).

However, the relationship between standing charges and PPMs is worrying. Government must act to avoid the situation where access to the energy system is effectively blocked for those customers who have self-disconnected and are unable to reconnect as they cannot afford to clear debt that has accrued due to standing charges. Suppliers should be mandated to install smart PPMs in households that that have difficulties with disconnection and to clear debts and develop payment plans with these customers. The cost of this support should fall on HM Treasury to ensure the incentive remains with central government to eradicate fuel poverty.

Implementation of a social tariff

There are two key considerations in the implementation of a social tariff: (1) who is it targeted at, and (2) how it is delivered to households?

Targeting

The most obvious target for recipients of a social tariff is households already on the benefits system, however as noted above, NEA estimates that a third of households in fuel poverty are not supported by this system. We therefore believe that the social tariff should be linked to the NEA's measure of fuel poverty[44] and the number of households in receipt should increase or decrease respectively in response to higher or lower energy prices.

Funding

We indicate three reasons why a social tariff should be funded from general taxation. Firstly, general taxation is the most progressive means of recovering the cost of these interventions which ensure access to a basic need. Second, it aligns with our recommendation to move policy costs recovery to general taxation – it would be counterintuitive to do that and then place the costs of a social tariff on remaining billpayers. Furthermore, increased bills for remaining customers would reduce capacity to invest in low-carbon heating technologies. Finally, it places an important incentive on government to provide investment support for demand reduction measures to reduce the overall cost of the scheme (this is true if the social tariff is implemented as a proportional bill discount – it would not apply if it were a fixed discount like the Warm Home Discount, for example).

44: The definition for fuel poverty that is widely accepted as the most appropriate in times of elevated prices.

Delivery

To accurately track households that fall under the definition above, we believe government and suppliers should work together to combine energy usage data, which is held by suppliers, with income data, which is held by government. There will be some complications, such as suppliers not holding usage data of customers that have recently switched to them, and possible data privacy issues to be addressed, requiring close attention and cooperation between suppliers, government, and Ofgem.

The social tariff should be delivered as an automatic discount on bills, rather than a cash payment to ensure that support is applied directly where it is needed and is received immediately rather than after the fact. This would work in a similar way to the Energy Price Guarantee or the Energy Bill Support Scheme, both of which delivered an automatic discount on bills. Legislation would be required but the schemes mentioned provide the framework for this, and government has shown that such legislation can be implemented quickly in the delivery of those schemes.

4 Reference List

Age UK (2023a) *Keeping the lights on: The case for an energy social tariff.* Available at: www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/reports-and-briefings/safe-at-home/age-uk-energy-public-policy-report-march-2023.pdf (Accessed: 21 August 2023).

Age UK (2023b) *What are social tariffs and why do we need them?, Age UK.* Available at: www.ageuk.org.uk/discover/2023/april/what-are-social-tariffs (Accessed: 21 August 2023).

BBC News (2023) 'Norfolk Boreas: Work on offshore wind farm stops over soaring costs', *BBC News,* 20 July. Available at: www.bbc.com/news/uk-england-norfolk-66263340 (Accessed: 21 August 2023).

BEIS (2018) *Clean Growth – Transforming Heating – Overview of Current Evidence.* Available at: esc-production-2021.s3.eu-west-2.amazonaws.com/2021/08/decarbonising-heating.pdf (Accessed: 26 May 2023).

BEIS (2021a) *Heat and Buildings Strategy.* CP 388. HM Government. Available at: assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1044598/6.7408_BEIS_Clean_Heat_Heat__Buildings_Strategy_Stage_2_v5_WEB.pdf (Accessed: 24 May 2023).

BEIS (2021b) *Net Zero Strategy: Build Back Greener.* HM Government.

BEIS (2022a) *Contracts for difference allocation round 4 results.* Available at: assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1103022/contracts-for-difference-allocation-round-4-results.pdf (Accessed: 4 September 2023).

BEIS (2022b) *Decarbonising heat in homes.* Seventh Report of Session 2021–22. House of Commons. Available at: committees.parliament.uk/publications/8742/documents/88647/default (Accessed: 26 May 2023).

Bolton, P. and Stewart, I. (2023) *Domestic Energy Prices.* House of Commons. Available at: researchbriefings.files.parliament.uk/documents/CBP-9491/CBP-9491.pdf (Accessed: 21 August 2023).

Broome, M., Handscomb, K. and Try, L. (2023) *Hoping and coping: How families were faring in March 2023.* Intergenerational Centre, The Health Foundation, Resolution Foundation. Available at: www.resolutionfoundation.org/app/uploads/2023/04/Hoping-and-coping.pdf (Accessed: 22 August 2023).

CCC (2019a) *Net Zero: The UK's contribution to stopping global warming.*

CCC (2019b) *UK housing: Fit for the future?* Available at: www.theccc.org.uk/wp-content/uploads/2019/02/UK-housing-Fit-for-the-future-CCC-2019.pdf (Accessed: 5 June 2023).

CCC (2020a) 'The Sixth Carbon Budget – Charts and data in the report'. Available at: www.theccc.org.uk/publication/sixth-carbon-budget/#supporting-information-charts-and-data (Accessed: 8 June 2023).

CCC (2020b) *The Sixth Carbon Budget: Buildings Sector Summary.* London. Available at: www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Buildings.pdf (Accessed: 24 May 2023).

CCC (2020c) *The Sixth Carbon Budget: The UK's path to Net Zero.* London.

CCC (2023) *2023 Progress Report to Parliament.* Available at: www.theccc.org.uk/publication/2023-progress-report-to-parliament (Accessed: 10 August 2023).

Cebon, D. (2022) *Hydrogen for heating? A comparison with heat pumps (Part 1), Hydrogen Science Coalition.* Available at: h2sciencecoalition.com/blog/hydrogen-for-heating-a-comparison-with-heat-pumps-part-1 (Accessed: 22 August 2023).

Centrica (2023) 'Centrica calls for simpler, more transparent energy sector', *Centrica Plc,* June. Available at: www.centrica.com/media-centre/news/2023/centrica-calls-for-simpler-more-transparent-energy-sector (Accessed: 4 September 2023).

Chapman, A. and Kumar, C. (2023) *The National Energy Guarantee.* New Economics Foundation. Available at: neweconomics.org/uploads/files/national-energy-guarantee.pdf (Accessed: 21 August 2023).

Citizens Advice (2023) *Social tariff now essential in era of high energy bills.* Available at: www.citizensadvice.org.uk/about-us/about-us1/media/press-releases/social-tariff-now-essential-in-era-of-high-energy-bills (Accessed: 21 August 2023).

DESNZ (2023a) *Annual Fuel Poverty Statistics in England, 2023,* p. 77. Available at: assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1139133/annual-fuel-poverty-statistics-lilee-report-2023-2022-data.pdf#page=77 (Accessed: 4 September 2023).

DESNZ (2023b) *UK hydrogen strategy.* Available at: www.gov.uk/government/publications/uk-hydrogen-strategy (Accessed: 22 August 2023).

DESNZ and BEIS (2023) *Provisional UK greenhouse gas emissions national statistics 2022.*

DESNZ and The Rt Hon Grant Shapps MP (2023) *£40 billion spent protecting families and businesses from energy costs, GOV.UK.* Available at: www.gov.uk/government/news/40bn-spent-protecting-families-and-businesses-from-energy-costs (Accessed: 9 August 2023).

Energy & Climate Intelligence Unit (2023) *Offshore wind: All at sea?* Energy & Climate Intelligence Unit. Available at: eciu.net/analysis/reports/2023/offshore-wind-all-at-sea (Accessed: 22 August 2023).

Fuel Poverty Action (2023) 'Standing Charges'. Available at: www.fuelpovertyaction.org.uk/standing-charges (Accessed: 4 September 2023).

Gross, R., MacIver, C. and Blyth, W. (2022) *Pot-Zero: Can renewables and nuclear help keep bills down this winter?* UKERC. Available at: ukerc.ac.uk/publications/can-renewables-help-keep-bills-down (Accessed: 4 September 2023).

Grubb, M., Drummond, P. and Maximov, S. (2022) *Separating electricity from gas prices through Green Power Pools: Design options and evolution.* UCL Institute for Sustainable Resources, Institute for New Economic Thinking Working Paper Series. Available at: doi.org/10.36687/inetwp193.

Grubb, M., Ferguson, T., Musat, A., Maximov, S., Zhang, Z., Price, J. and Drummond, P. (2022) *Navigating the crises in European energy: Price Inflation, Marginal Cost Pricing, and Principles for Electricity Market Redesign in an Era of Low-Carbon Transition.* UCL Institute for Sustainable Resources, Institute for New Economic Thinking Working Paper Series. Available at: doi.org/10.36687/inetwp191.

Grubb, M., McNally, P., Maximov, S., Price, J. and Drummond, P. (2023) *A zero-carbon power grid and the electrification of heavy industry: how to deliver on a twin challenge.* Aldersgate Group and UCL. Available at: www.ucl.ac.uk/bartlett/sustainable/sites/bartlett_sustainable/files/ag-ucl_low_carbon_power_industrial_electrification_report29.pdf (Accessed: 9 August 2023).

Hledik, R., Gorman, W., Irwin, N., Fell, M., Nicolson, M. and Huebner, G. (2017) *The Value of Time of Use Tariffs in Great Britain.* The Brattle Group and UCL. Available at: www.citizensadvice.org.uk/cymraeg/amdanom-ni/our-work/policy/policy-research-topics/energy-policy-research-and-consultation-responses/energy-policy-research/the-value-of-time-of-use-tariffs-in-great-britain (Accessed: 22 August 2023).

Household Energy Price Index (2023) *Monthly Update.* Available at: www.energypriceindex.com/price-data (Accessed: 21 August 2023).

IEA (2021) *Global Hydrogen Review 2021.* Available at: iea.blob.core.windows.net/assets/e57fd1ee-aac7-494d-a351-f2a4024909b4/GlobalHydrogenReview2021.pdf (Accessed: 10 August 2023).

Karania, V.K. (2022) Research Note: *Estimating the cost of a Social Tariff for energy use at home.* Age UK. Available at: www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/reports-and-briefings/safe-at-home/estimating-the-cost-of-a-social-tariff-for-energy-use-at-home-october-2022.pdf (Accessed: 21 August 2023).

Leigh, J. (2023) 'The social tariff on energy explained', SCOPE, January. Available at: www.scope.org.uk/news-and-stories/the-social-tariff-on-energy-explained/#:~:text=A%20social%20tariff%20works%20in,bills%20at%20a%20lower%20level. (Accessed: 18 August 2023).

Lewis, M. (2023) 'Martin Lewis: Why are energy standing charges so high? What can be done?', *MoneySavingExpert.com,* 4 July. Available at: blog.moneysavingexpert.com/2023/07/martin-lewis--why-are-energy-standing-charges-so-high--what-can- (Accessed: 4 September 2023).

Low Carbon Contracts Company (2022) 'CfD Forecast Generation and Avoided GHG – LCCC Data Portal'. Available at: www.lowcarboncontracts.uk/data-portal/dataset/cfd-forecast-generation-and-avoided-ghg (Accessed: 4 September 2023).

Lowe, R. and Oreszczyn, T. (2020) *Building decarbonisation transition pathways: initial reflections.* CREDS. Available at: www.creds.ac.uk/publications/building-decarbonisation-transition-pathways/#:~:text=While%20there%20is%20currently%20much,the%20cheapest%20decarbonisation%20option%20overall. (Accessed: 5 June 2023).

Maximov, S.A., Drummond, P., McNally, P., Grubb, M., and University College London – Institute of Sustainable Resources. (2023) *Where does the money go? An analysis of revenues in the GB power sector during the energy crisis.* UCL Institute for Sustainable Resources, Institute for New Economic Thinking Working Paper Series. Available at: doi.org/10.36687/inetwp207.

Miller, J., Landzaat, W., Johnson, R. and Duke, C. (2023) *Understanding the challenges faced by fuel poor households. Final report for the Committee on Fuel Poverty.* London Economics. Available at: assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1160147/understanding-challenges-faced-by-fuel-poor-households-research.pdf.

National Grid ESO (2023) 'Future Energy Scenarios 2023 Data Workbook'. Available at: www.nationalgrideso.com/document/283061/download (Accessed: 4 September 2023).

Norman, A., Corfe, S., Kirkup, J. and Powell-Chandler, D. (2023) *Fairer, warmer, cheaper.* Soical Market Foundation, Public First, Citizens Advice. Available at: www.smf.co.uk/wp-content/uploads/2023/03/Fairer-warmer-cheaper-March-2023.pdf (Accessed: 21 August 2023).

Norton, D. (2023) 'Default tariff cap level: 1 July 2023 to 30 September 2023'. Available at: www.ofgem.gov.uk/publications/default-tariff-cap-level-1-july-2023-30-september-2023 (Accessed: 21 August 2023).

Office for Budget Responsibility (2023) *A brief guide to the public finances, Office for Budget Responsibility.* Available at: obr.uk/forecasts-in-depth/brief-guides-and-explainers/public-finances (Accessed: 4 September 2023).

Office for National Statistics (ONS) (2023) *Energy prices and their effect on households.* Available at: www.ons.gov.uk/economy/inflationandpriceindices/articles/energypricesandtheireffectonhouseholds/2022-02-01 (Accessed: 10 August 2023).

Ofgem (2021) 'Renewables Obligation Annual Report 2020–21 – Dataset'. Available at: www.ofgem.gov.uk/sites/default/files/2022-03/RO%20Annual%20Report%202020-21%20-%20Dataset.xlsx (Accessed: 4 September 2023).

Ofgem (2023a) *Energy price cap (default tariff): 1 October to 31 December 2023, Ofgem.* Available at: www.ofgem.gov.uk/publications/energy-price-cap-default-tariff-1-october-31-december-2023 (Accessed: 4 September 2023).

Ofgem (2023b) *Wholesale market indicators, Ofgem.* Available at: www.ofgem.gov.uk/energy-data-and-research/data-portal/wholesale-market-indicators (Accessed: 21 August 2023).

Simakov, A., MacDonald, C., Buckland, J., Berry, G., McAleenan, B. and Ellis, H. (2022) *A Plan for Household Energy Bills.* Policy Exchange. Available at: policyexchange.org.uk/wp-content/uploads/2022/09/Halting-Crisis-Tiered-Energy-Relief-Scheme.pdf (Accessed: 22 August 2023).

UCL ISR (2023) *Reforming electricity markets for low-cost and low carbon power, UCL Institute for Sustainable Resources.* Available at: www.ucl.ac.uk/bartlett/sustainable/research-projects/2023/may/reforming-electricity-markets-low-cost-and-low-carbon-power (Accessed: 21 August 2023).

Weidner, T. and Guillén-Gosálbez, G. (2023) 'Planetary boundaries assessment of deep decarbonisation options for building heating in the European Union', *Energy Conversion and Management,* 278, p. 116602. Available at: doi.org/10.1016/j.enconman.2022.116602.

Winser, N. (2023) *Electricity Networks Commissioner report.* Energy Systems Catapult. Available at: es.catapult.org.uk/report/electricity-networks-commissioner-report (Accessed: 22 August 2023).

Zakeri, B., Staffell, I., Dodds, P., Grubb, M., Ekins, P., Jääskeläinen, J., Cross, S., Helin, K. and Castagneto-Gissey, G. (2022) 'Energy Transitions in Europe – Role of Natural Gas in Electricity Prices', *SSRN Electronic Journal* [Preprint]. Available at: doi.org/10.2139/ssrn.4170906.