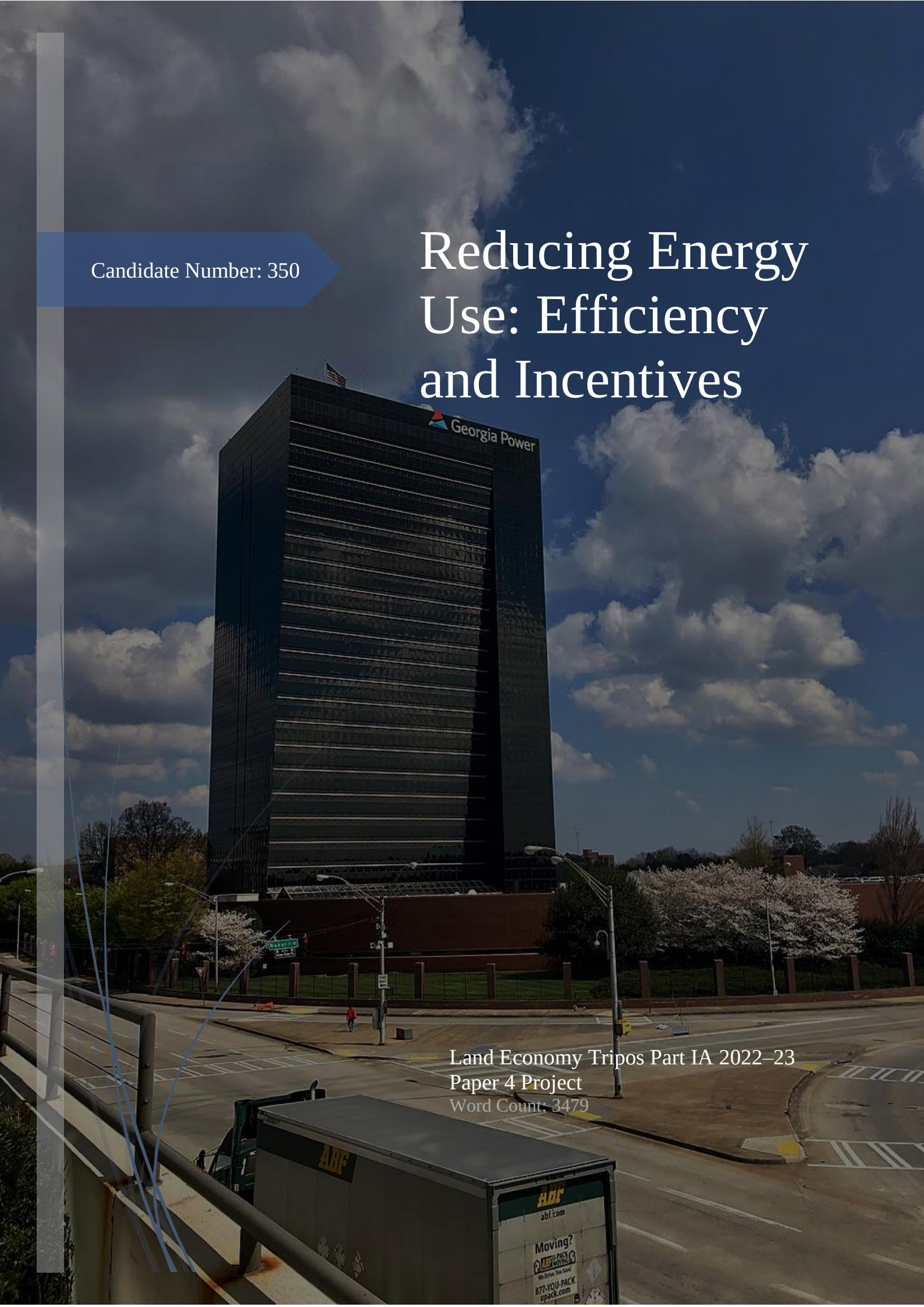
Candidate Number: 350

Reducing Energy Use: Efficiency and Incentives



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Contents

Executive Summary

Pre-existing pressure on energy markets catalysed by the invasion of Ukraine by Russia has led natural gas prices to rise to unprecedented levels. With persistently high inflation, firms are at risk of shutting down and households are struggling to keep up with rising energy payments.

This policy brief aims to support the town's residents throughout the energy crisis. It involves using a nudge-based approach towards a local information campaign encouraging all households and firms to employ energy-efficient improvements and energy-saving practices. It is reinforced with an automatic rebate on energy bills for those who successfully reduce their consumption below a baseline quantity that reflects their average consumption level.

The policies take advantage of the high energy prices by creating strong financial incentives to reduce energy consumption. Retrofitting can take only six to eight years to break even. Cheap energy-saving appliances and habits can save £465 annually, or £930 with the rebate. Although our goal is to reduce energy consumption by at least 20% over the year, the most successful rebate programme saw a 60% reduction in electricity consumed. Energy efficiency also reduces pressure on energy production, which has significant social benefits by reducing negative production externalities. The flexibility of energy-reducing methods makes this policy more effective and accessible than the alternatives because all residents and firms can be made better off.

Context

The contemporary energy crisis involves a surge in the prices of oil, natural gas, coal and electricity starting in late 2021.[1]

Background

The rapid post-pandemic economic rebound saw both households and firms worldwide demand more energy. A longer- and colder-than-average Northern Hemisphere winter in 2021 eroded pre-existing natural gas stores.

This situation was exacerbated by Russia's invasion of Ukraine in February 2022, whereby Russia increasingly withdrew their natural gas exports. Subsequently, the price of natural gas has increased the most in this crisis.[2] This is a particular issue for Europe as Russia provided around 45% of the European Union's total gas imports in 2021 (International Energy Agency [IEA], 2022). The UK is also vulnerable due to its dependence on gas for heating and cooking; in 2021, gas accounted for 39.8% of the total electricity generated (Department for Business, Energy & Industrial Strategy [BEIS], 2022).

These countries partially substituted Russian gas and oil with coal and liquified natural gas, but this has only placed upwards pressure on their respective prices, alongside increasing carbon emissions (IEA, 2022). A lack of investment in both renewable and non-renewable energy sources alongside maintenance work following COVID-19 has meant that supply in these industries could not match or offset the increased demand quickly enough.

In addition, unfavourable weather conditions in 2021 saw reduced solar, hydro and, most of all, wind output in the UK, reducing primary electricity by 1.9 million tonnes of oil equivalent despite increased capacity (BEIS, 2022).

The unfortunate combination of and interaction between these demand- and supply-side shocks over the course of several months has resulted in today's energy crisis.

Implications

Energy is one of the most widely used and important inputs into our economy; it powers homes, industry and transportation. Being price inelastic in demand means that most consumers will have no choice but to absorb the higher cost.

For firms, profits are reduced by higher costs of production and lower demand by consumers cutting back on consumption, forcing them to raise prices or shut down. The rise in prices of important intermediate goods such as steel and fertiliser has led to even more inflation across other industries (IEA, 2022). Coupled with pre-existing supply chain shortages in the aftermath of COVID-19, the net effect has been stagflation: low growth

[1] We will use the term "energy" in this policy brief as a catch-all for these commodities.
[2] To get a sense of magnitudes and to support our arguments, we have included two graphs in the appendix to help visualise the course of the crisis and its effects on 1) energy prices and 2) the cost of living.

despite high inflation. In response, central banks have raised the base rate, but this increases the burden of interest repayments on loans under variable rates for consumers and firms.

Consequently, all households face higher energy bills in addition to inflation. Low-income households will be impacted the most because they spend a larger proportion of their income on energy: the richest 10% in the UK spend 6.1% of their income on energy, and the poorest 10% spend 17.8% (Ari et al., 2022). With declining real wages, the resulting cost-of-living crisis means that the poorest households may find themselves having to make a trade-off between food and heating: both posing health-related risks.

Given the extremity of inflation levels and its significant impacts, immediate policy action is urgently needed.

Policy Recommendation

We preface the policy recommendation with the UK national government's main policies.

Energy Price Guarantee (EPG)	Automatic cap on the unit price of energy, limiting the typical household's energy bill to £2500 a year until April 2023, saving the average household around £1100 since its inception in October (BEIS, 2023). The cap has been extended to £3000 by April 2024.
Energy Bills Support Scheme (EBSS)	All households automatically receive a £400 energy bill discount in six instalments (GOV.UK, n.d.).
Energy Bill Relief Scheme	Automatically provides non-domestic customers with discounted rates; it will be replaced by the Energy Bills Discount Scheme from April 2023 onwards (Department for Energy Security and Net Zero [DESNZ]; BEIS, 2023).

Against this backdrop, our policy proposal is a two-fold strategy to reduce the town's consumption of energy. The first is to encourage the implementation of energy-efficient upgrades and practices. The second involves providing a rebate to households and firms who reduce their energy use below a baseline quantity.

Improving Energy Efficiency

The UK housing stock is among the oldest and most poorly insulated in Europe (Piddington et al., 2020). Therefore local households are strongly urged to employ energy-efficient technology. This includes replacing gas boilers with heat pumps and upgrading homes with thicker insulation and insulated windows. These efficiencies enable residents to lead a business-as-usual lifestyle at a lower cost. Survey data shows that those unwilling to install specific low-carbon heating systems and insulation cited the cost as their main concern (BEIS et al., 2023). However, there are a wide variety of methods that are not necessarily costly. Low-cost home improvements such as switching to LED lightbulbs can save up to £55 a year and no cost actions such as turning appliances off at the socket can save another £70; the aggregate savings advertised by the Help for Households campaign from low- and no-cost actions alone exceed £350 and £155 per year respectively (GOV.UK, n.d.).

Because UK housing is so thermally inefficient, this policy offers the greatest returns. By reducing energy usage by 30%, the aggregate cost savings across the UK is estimated to be worth £10 billion per year at an upfront cost of £60 billion (Fetzer et al., 2023). The cost savings from using energy more efficiently do not reflect the social benefits of reducing energy production; the IEA (2019) relates it to 12 different benefits relating to the economy, environment and health. Thus, the positive externalities are a strong case for using this policy because it promotes economic efficiency.

As energy-efficiency upgrades last for decades, this will be a long-term solution to reducing energy bills that will extend far beyond the current crisis. Since higher energy prices increase the return on energy-efficient projects and practices, it automatically incentivises informed households and firms to act. At 2021 gas prices, a cavity wall insulation broke even after about 14 years, with the increased prices, the investment now pays back in under eight years (Kommenda et al., 2022). Evidence also suggests that the investment will likely increase the market and rental value of the building (Eichholtz et al., 2011; Hyland et al., 2013; Jensen et al., 2016). Split incentives constrain upgrades for rented housing because only the tenant benefits from the investment paid by the landlord. The resulting increase in asset value should therefore also incentive landlords and developers to retrofit.

Despite the long-term benefits, people tend to place too little value on future decisions, and not everyone has perfect access to information. By distributing information on all the possible ways of saving energy, the search costs for residents and firms will fall, encouraging participation. Specifically, the financial benefits of saving energy and the exact steps taken to achieve these savings must be widely advertised across the town.

Many different nudges can be used. Since agents react more to losses than gains (Kahneman & Tversky, 1979), we can frame the advertisement by telling consumers how much money they are losing per year (or the total amount forgone over the investment's lifetime) by not implementing the practices today. With enhanced active choices, we can further stress the cost of not making a choice (Keller et al., 2011); for example, by ignoring energy-saving habits, households are, in effect, choosing to waste hundreds of pounds a year. By using specific words such as "future" and "long-term", we can prime the audience to focus on long-term rewards (Sheffer, et al., 2016). For higher-cost upgrades, we can frame the cost over time to make it seem less expensive (Gourville, 1998).

Providing Information and Incentives

We propose a second incentive: consumers who reduce their energy consumption below a baseline quantity will receive a rebate. The baseline quantity reflects each household's monthly average energy consumption over the past year and is fixed over the programme's duration. The rebate will be worth the present market value of the quantity reduced below the baseline and is automatically applied and paid for by the local government. Under constant energy prices, the rebate doubles the savings earned by reducing energy use.

Smart meters complement this policy by enabling consumers to accurately track their real-time energy usage and price. The information tells them how much energy — and money — they have saved and can be compared against their baseline. At the end of 2022, only 55% of all meters in Great Britain were smart (DESNZ et al., 2023). Given that they are free to install, they will be advertised in the campaign.

These policies take advantage of high energy prices and incentives. Both high prices and the rebate increase the return on investment and encourages substituting away from energy. When people contemplate on upgrading or changing a habit, they will compare the cost today with the future savings plus the rebate. Crucially, it does not punish inaction so that those unable to reduce their consumption will not suffer, but it heavily incentivises anyone who can reduce their energy consumption, even by a marginal amount, to do so.

This policy is inspired by the extremely successful voluntary real time pricing programme used by Georgia Power in response to excessive demand for electricity during the summer in California. The programme was able to reduce demand by 750 megawatts on high-price days by inducing customers to cut their demand by as much as 60% in 1999; the policy works well despite the price inelasticity of demand because the rebate compensates energy reduction with more money to spend elsewhere — increasing choice and welfare (Varian, 2014).

Policy Steps

Following the discussion, this is how we recommend the town to execute the policy:

1) **Set up the policy.**

   Make a guide on all the possible energy-efficient housing upgrades of varying prices and energy-saving practices and their expected annual savings — including the benefits of smart meters and how to freely obtain them. Require utility firms to calculate the baseline quantity for each customer and distribute information on the rebate programme using letters and emails. To combat hyperbolic discounting, the money lost from inaction should be stressed using the nudges discussed earlier. Example headlines include:

   "By not implementing energy-saving habits, you are choosing to lose over £155 a year." and "Loft insulation costs less than £1 a day, but will save you over £10,000 in the long-term.".

2) **Advertise.**

   To limit information failure, the guides should be physically distributed to all residents and advertised online. With each monthly reminder, it inserts a decision point for each person to act. Local information stands should also be set up to further spread awareness.

   The town's population should be involved in the process by using surveys and conducting interviews using random sampling to understand their thoughts and concerns about the policy.

3) **Monitor and evaluate.**

   The main quantitative metric of success is the change in the monthly energy bills across households and firms following the policy's enactment. Though different targets can be used, given that electricity prices are around 60% higher than the previous year (Office for National Statistics [ONS], 2023), a 20% reduction in energy use from the baseline plus the rebate would set energy bills back to the pre-crisis level.

   The cost of the policy should be constantly monitored to prevent exceeding the national-level funding. To reduce costs, the rebate can be reduced or restricted to certain income levels for example.

It is important to continue gaining feedback from residents on its effects on disposable income and wellbeing to see the direct effects of the policy, and areas of fault should be rectified.

The plan is for the policy programme to run until natural gas and electricity prices return to their pre-crisis levels. This expected to be in late-2023 (Markovitz, 2023).

Limitations

Whilst we try to optimise the policy to support all residents through the crisis, certain limitations exist.

The rebate programme disproportionately benefits the wealthier, who are generally more able to reduce their energy consumption. However, this is still not necessarily a disadvantage because it alleviates local energy demand and prices.

We also ignored the important fact that low-income households are unlikely to be able to afford more expensive upgrades, even if returns are high, when they are focussing on fulfilling basic needs. Between 10% to 25% of potential savings in low-income households cannot be exploited without policies removing split incentives, information failure and a lack of capital (Ugarte, et al., 2016). Therefore, there are grounds for local provision under efficiency (with positive externalities) and equity. Using the UK definition of a low-income household, households with an annual income under £20,000 would receive a grant towards any energy upgrade (ONS, 2023). The size of the grant can be determined by the expected amount of funding left over in the budget after the rebate programme and campaign costs. This will support their ability to further utilise the rebate programme in addition to the low- and no-cost actions. Having said that, income-related benefits never have a full take-up (Department for Work & Pensions, 2022). This is why we use nudges and rebates to encourage actors to take the initiative in installing upgrades and breaking habits.

Whilst difficult to predict, there may be unintended consequences. For example, it is possible that the rebate encourages excessive reductions in energy consumption to a point where the number damp homes significantly rise. Having said that, these are unlikely and can be rectified ad hoc using survey and interview data.

Alternative Policies

This section outlines two possible alternative policies to consider. However given their own disadvantages, we will argue why they fall short of our main proposals.

Conditional Energy Payment

An alternative policy involves an automatic one-off payment exclusively targeted towards energy, and conditional on income. Using the same income threshold of £20,000 from earlier and assuming that households reach the cap under the EPG (£2500), with the EBSS (£400), Warm Home Discount Scheme (£150) plus a local conditional energy payment worth £750, the final annual energy bill will be £1200, or 6% of income — the same proportion spent by the richest 10%.

This policy is fair because it helps those worst affected by increased energy prices by enabling them to spend the money on other necessities. It is the most effective form of immediate relief that directly addresses the main concern of the crisis. Past emergency transfers such as the US stimulus check during COVID-19 were successfully able to reduce financial and mental hardship (Cooney & Shaefer, 2021). Unlike cash transfers, an energy payment cannot be saved. Automatically providing the transfer using existing data on income levels and benefits means that all eligible residents will participate by default.

However, this policy does nothing to support middle-income residents and firms struggling with rising costs. One must make a value judgement on who is eligible and the payment's size (and if it should vary with income). Those just above the cut-off level will certainly feel unfairly excluded.

Providing relief is ineffective in reducing long-term energy consumption; all residents will continue to face high energy bills. If the energy crisis is expected to last until late 2023, more subsidies would have to be provided; using our example, the subsidy would have to be £1800 to reach 6% in 2023 if only the EPG remains. The cost-benefit ratio is unlikely to be greater than that of the main policy.

Therefore despite its appeal, it is not for the local government to execute such an expensive solution. This policy is better suited for the national government instead because of their ability to finance it by issuing bonds.

Utilising Solar Energy

Another alternative policy is to encourage local solar power deployment by highlighting the future financial and environmental benefits. They can reduce annual energy bills by £329 and increase a home's sale price from £1891 to £2722 (Ramsay, et al., 2021) at an average cost of £1876 per kW, for 0–4 kW instillations in 2021–22 (Department for Business, Energy & Industrial Strategy, 2022).

This policy strongly parallels the energy efficiency policy and can be advertised and executed in the same manner. They share similar benefits by offering long-term financial and

social benefits and some independence from energy markets. The cost depends on the type and amount of panels used and the dwelling itself, yet the annual returns also vary depending on the roof's aspect and weather conditions. The main barrier preventing uptake is also the cost (BEIS et al., 2023), thus the local government can offer subsidises, but a value judgement must be made again with regards to eligibility and the size.

The main difference lies in the barriers to participation. With solar power, energy bills can only be reduced by paying the large upfront cost of solar panels. Whilst retrofitting can be expensive, energy efficiency can easily be achieved at a cheaper cost and through more mediums. Because increasing energy efficiency is far more flexible than using solar energy to reduce energy use, all residents, regardless of income, would experience gains.

Concluding Remarks

One of the main difficulties of policymaking involves transitioning the theory to practice because there will always be uncertainties, and resource constraints forces policymakers to be selective. By implementing a local awareness campaign on energy-reducing methods and a rebate programme to accentuate incentives until late 2023, we hope that all residents and firms will be able to reduce their energy consumption by at least 20% over the year. This way, the policy package enables them to be as well-off compared to before the energy crisis, and far better off than in the policy's absence.

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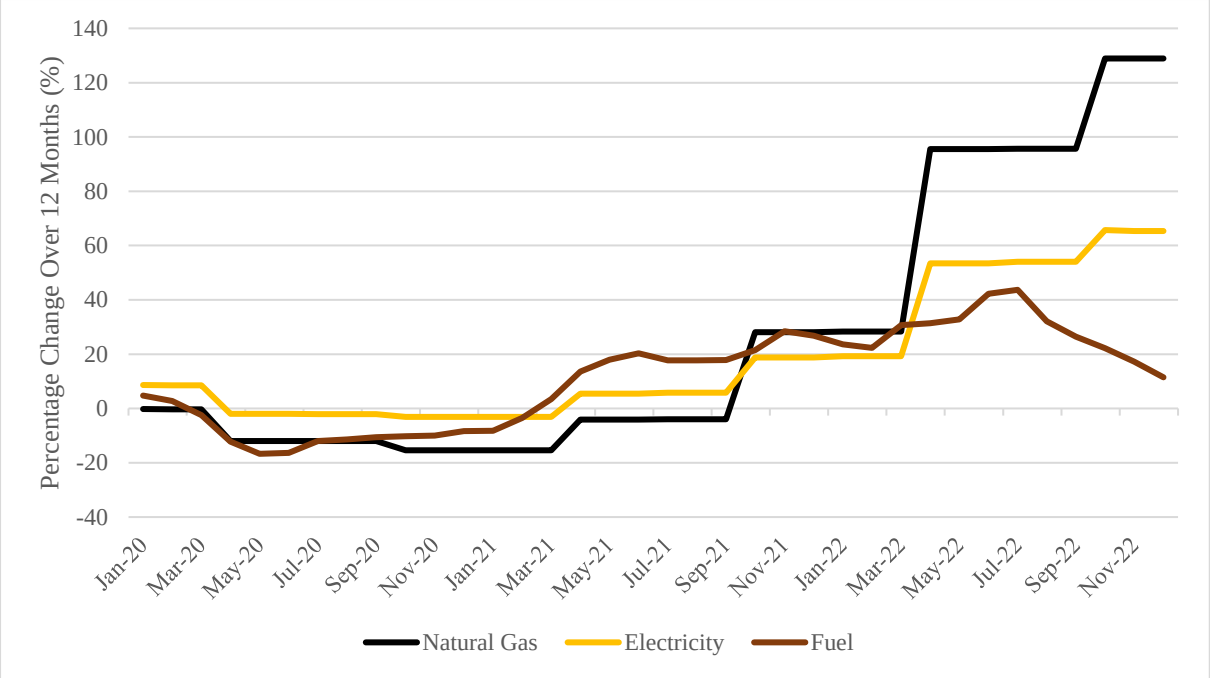
Front cover photo of the Georgia Power Company Corporate Headquarters in Atlanta, Georgia taken by Warren LeMay from Cincinnati, OH, United States, CC0. The floors have a passive solar design: each floor on the south-facing side extends 15 inches beyond the one below. This innovative design utilises the Sun's changing position throughout the year; the windows are partially shaded during the summer and sunlight shines through the window during the winter. This in turn reduces their demand for heating.

Back cover photo of the Crescent Dunes Solar Energy Project taken by Amble, CC BY-SA 4.0. Located in Nevada, US, it concentrates sunlight using 10,347 mirrored heliostats spanning around 1.2 km² towards a 195-metre-tall solar power tower that uses advanced molten salt energy storage technology; it has an installed capacity of 110 megawatts (National Renewable Energy Laboratory, n.d.). Solar energy has experienced the largest decline in production costs out of all energy sources thanks to learning curves following many large-scale projects across multiple countries over time (Ritchie & Roser, 2020). Despite the challenges of renewable energy, projects like these are a large positive step towards a net zero world.

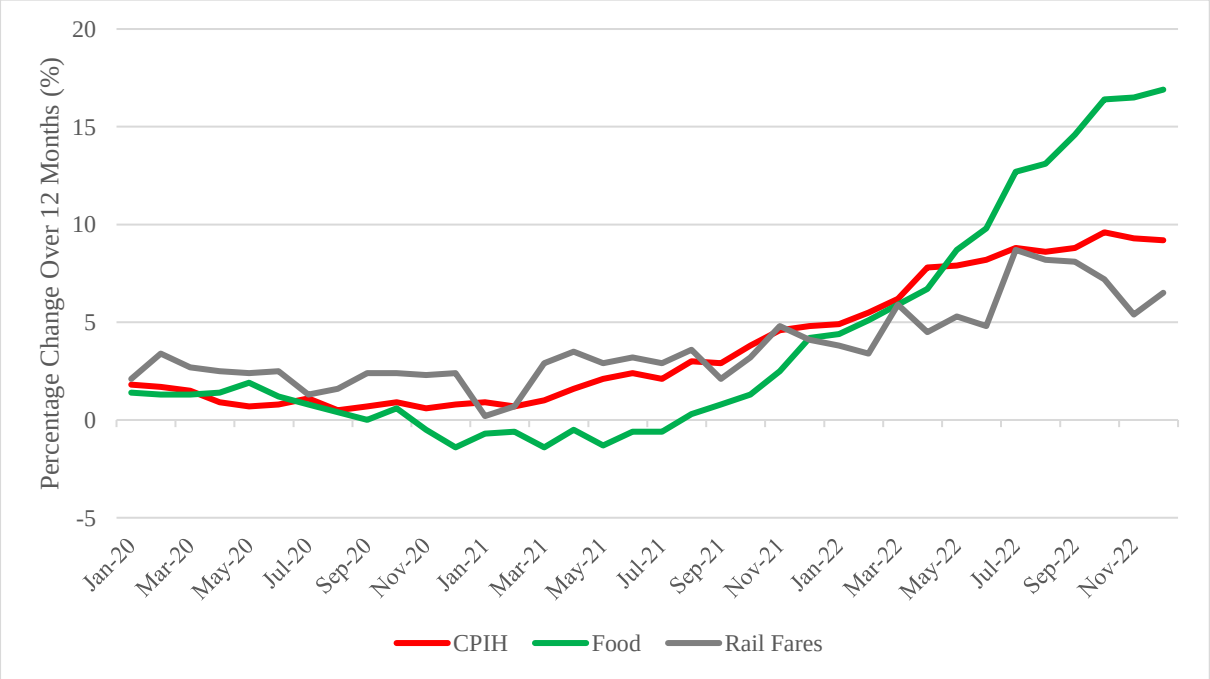
Appendix

Monthly Energy Prices Time Series: 2020–2022



Sources: (ONS, 2023; ONS, 2023).

Monthly Cost of Living Time Series: 2020–2022



Sources: (ONS, 2023; ONS, 2023).