CORNWALL INSIGHT

CREATING CLARITY

Addressing the cost of electrification

A 2024 update on decarbonising heat for energy intensive sectors

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Getting to grips with the intricacies embedded in energy and water markets can be a daunting task. There is a wealth of information online to help you keep up-to-date with the latest developments, but finding what you are looking for and understanding the impact for your business can be tough. That's where Cornwall Insight comes in, providing independent and objective expertise. You can ensure your business stays ahead of the game by taking advantage of our:

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Addressing the cost of electrification

1 Executive summary

This report outlines the challenges that energy intensive industries (EIIs) face in decarbonising their heat supply, typically natural gas-powered, when seeking to switch to grid-supplied electricity. This report has been prepared by Cornwall Insight on behalf of CPI. It provides a refreshed perspective on an earlier *2022 report* of the same name, reflecting updated market and policy positions that influence the commercial dynamics of electrification. While this report hones in on the experiences of the paper industry, many of the challenges highlighted here are common to other EIIs.

The key challenge remains the UK's reliance on relatively cheap and readily available natural gas to heat homes, power processes, and generate power. The construction and deployment of specialised storage, international pipelines, long-distance shipping and gasification facilities has led to gas becoming a truly international commodity. However, the consequences of Russian aggression in Ukraine have revealed how dramatically the supply picture can shift. This has led to much greater price volatility compared to the situation when conducting previous analysis. Even though prices have fallen from 2022's record highs, it's no longer possible to assume that gas is always a low cost option. Additionally, unabated consumption is, in the long-term, incompatible with Net Zero.

Notwithstanding these issues, commercially viable options for decarbonising heat remain limited. Hydrogen is years away from widespread availability and adoption, with continued questions over long term costs without revenue support. Electrically-powered heating, which can provide decarbonised heat as the carbon intensity of grid electricity decreases, still faces considerable cost challenges, not least because of the link between the cost of electricity and the cost of gas. The cost-benefit case remains unresolved. The rationale for industrial electrification is improving, though a cost disparity still remains.

This report is addressed to policymakers, highlighting potential policy measures to make industrial decarbonisation by electrification more likely.

1.1 Shifting market backdrop

In a similar trend to that seen in the previous report, Great Britain (GB) has the highest delivered electricity prices in Europe for large consumers, while gas prices remain broadly in line with other major economies in the European Union. This electricity cost discrepancy is largely driven by the allocation of non-commodity costs to the electricity bill, together with the GB-only carbon price floor designed to increase the cost of fossil-based generation. As gas-fired generation is generally still the marginal source of GB generated electricity – and the marginal source sets the market price – then this policy serves to drive up the market price of all grid supplied electricity.

Since the previous report, GB power prices have roughly doubled and delivered gas prices have tripled, though the relative levels continue to fluctuate. This means power prices are currently around four times greater than gas prices per kWh, an improvement in the comparative differential that was six to seven times in the previous report. However, this is largely driven by an overall substantial increase in energy costs, of detriment to Energy Intensive manufacturing where energy is a major production cost.

Wholesale power and gas costs are now easing from all-time highs, and *forecasts now show falls* throughout the rest of the decade, driven by high gas stocks and a mild winter 2023-24 in the short term and continuing renewables buildout in the longer term. However, forecast prices remain substantially higher than historic averages due to an ongoing reliance across Europe on international Liquified Natural Gas (LNG) shipments.

If direct electrical boilers were to be used to replace heat from gas boilers, a significant reduction in the cost of electricity would be required for operating costs to stay the same, despite the slightly higher efficiency of an electric boiler – generally around 95%, compared to around 81% for a gas boiler.

Alternatively, technological improvements mean that heat pumps are increasingly a realistic option to economically decarbonise heat. The best coefficients of performance to create the level of heat required in paper processes[1] are understood to be around 2.3, though this is likely to improve over time. These coefficients mean the price differential between gas and electricity still needs to be substantially closed for heat pumps to be commercially viable in all but the most advantageous situations. Additionally, upfront capex and site layout changes (to integrate heat pumps into site infrastructure) also need to be financed.

1.2 The evolving policy landscape

A particular challenge for this analysis is that Energy Intensive Industries are not always clearly defined, with sectors treated differently across different policies. This confusion gets even worse because several policies also impose additional eligibility criteria meaning that coverage is not even within a sector. The result is that the following analysis is broad brush meaning that the position could well differ between companies even in the same sector.

Several policy developments have progressed since the previous paper, some complete and some newly emerged, including:

- The February 2023 announcement of the *British Industry Supercharger* (the Supercharger) and the November 2023 announcement of *six-year Climate Change Agreements* (CCAs), which offer significant CCL taxation discount on electricity bills for some installations, including most Energy Intensive Installations (EII)
    - For eligible consumers, the Supercharger (DESNZ guidance here). is potentially game-changing development in terms of enabling electrified heating via heat pumps, as discussed in section 4
- Further commitment to the rebalancing of levy costs between electricity and gas in the *Powering Up Britain Energy Security Plan*, committing to a clear approach to gas and electricity rebalancing
- Decisions and implementation of network connection and charging reform through the *Targeted Charging Review Significant Code Review*, though further work is underway through *DUoS SCR* and *TNUoS Task Forces*
- Far-reaching change through the *Review of the Electricity Market Arrangements* (REMA), a root and branch review of the GB wholesale energy market

These changes have marginally improved the environment for the electrification of heat. However, they do not move the dial, with the best-case scenario marginally supporting deployment of heat pumps for installations benefiting from Supercharger support, and all others suggesting gas remains

[1] Broadly speaking circa 200°C and 3-4 bar pressure for steam used in drying rollers, and hot air for drying hoods.

the cheapest energy source. In high capital, risk averse manufacturing exposed to imports, it remains likely that alternatives to gas are still not viable without additional support.

The situation is more nuanced for some EIIs as some sites already receive significant exemptions from policy costs and taxes across electricity and gas. These are only partial and limited in the number of sectors eligible, with inconsistent eligibility even within sectors due to the imposition of business-level cost impact thresholds based on fiscal data drawn from company accounts, rather than a specific product being manufactured. Additionally, a re-application for continued support is required every 5-years – a major barrier for long-term investment projects.

1.3 Further reform

Further reform is required to reduce the cost of electricity. Policy makers must ensure that the switch to electric heating is an economic option alongside the clear environmental benefits if EIIs are to pursue widespread adoption.

Reform which shifts levies funding low carbon investment away from delivered cost of electricity is the clearest policy lever available to supporting business cases for switching. With re-allocation, the annual cost of energy following a switch to heat pumps could be cheaper and this would support a business case for electrification. The Supercharger has made significant progress in this area, but DESNZ expect that only around 300 companies will benefit, with their share of the costs being reallocated to non-Supercharger consumers. Widening Supercharger eligibility, and removing additional costs from other consumers would mitigate a potential unintended consequence the policy in incentivising some companies to electrify, while at the same time discouraging others.

This is not the only option, however. Alternative routes for reform to support switching could be effective, such as targeted capex support, tax breaks and a reform of Climate Change Agreements (CCAs) to incentivise EII consumers to electrify. Alternatively, policy could take a wider view and provide incentives for all business consumers to switch to electricity and not target EII consumers exclusively.

All options for reform which feature increased or new subsidies to support the financial case to switch come with the caveat of increasing cost to the UK Treasury (or additional cost for non-supported consumers if the costs were to be recovered from within the supply industry) adding a level of unattractiveness from a policy perspective. Many of the potential reforms propose to increase the attractiveness of electrification by increasing delivered gas cost, through the levelling of electricity and gas. This is again likely to be unattractive from a policymaker perspective, depending on how an increased cost in gas would impact wider society, especially the domestic supply market and energy bills.

The key measures we suggest policy-makers explore are:

- Direct financial support in making capital outlay for electrified heat, to bridge the gap between the capital cost of conventional and new low-carbon assets
- Tax breaks on equipment for electrification, to facilitate the investment in capital assets
- Interlinkage with existing schemes, such as Climate Change Agreements and UK Emissions Trading Scheme exemptions
- Prioritising access to network connections for users who are seeking additional capacity to enable electrification of carbon-intensive processes like heating
- Subsidy support for low-carbon heat, perhaps on a Contract for Difference basis versus the cost of the current gas technologies
- Widening access to the British Industry Supercharger for installations which decarbonise their heating

Section 5 provides more details and an analysis of these policy measures.

2 Introduction by CPI | Steve Freeman

With electrification being one of the key decarbonisation technologies for UK industry, CPI (the Confederation of Paper Industries) is pleased to sponsor this update to the 2022 Cornwall Insight research paper that refreshes the policy background and re-considers the operational cost impact of switching to grid supplied electricity from gas. The report analyses barriers and suggests resolutions to issues that need to be solved if decarbonisation by switching to low-carbon grid supplied electricity is to become a viable strategy.

At the time of the 2022 report, most policy attention was focused on decarbonisation by switching to hydrogen or carbon capture, with electrification being comparatively neglected. Thankfully this situation has changed with considerable political attention now being paid to the challenges highlighted in both the original Cornwall Insight report and our sister report (by Fichtner Engineers) looking at grid connection issues. While the CPI sponsored report focused on site connection to the grid issues, considerable policy attention is now being directed to address the wider grid infrastructure changes required to take increasing amounts of electricity from new (and often remote) low-carbon generation sites to distant areas of demand.

If the national strategy (and binding legal target) to transform the UK economy to a Net Zero economy by 2050 (with challenging interim targets at 2030 and 2035) is to be delivered, then industry needs to be decarbonised. For the Foundation Industries – installations providing 75% of the materials that underpin manufacturing and construction supply chains – this is a particular challenge.

These sectors (chemicals, cement, ceramics, glass, metals and paper) are characterised by the energy intensive nature of their manufacturing processes. They jointly emit around 10% of total UK emissions of carbon dioxide.

With energy being one of the top three costs for energy intensive installations, then decarbonisation polices that drive these costs higher in the UK inevitably make these sites less internationally competitive. Driving up their costs cascades throughout whole supply chains. With such sites being capital intensive, a progressive loss of competitiveness means losing out on new investment and eventually closure. If replacement plant is outside the UK, then domestic manufacturing is replaced by imports. Rather than delivering real carbon savings, the closure of domestic manufacturing means that emissions are simply moved to other countries – almost all with less ambitious climate change polices than the UK.

A major part of the Government strategy is to support the decarbonisation of UK manufacturing sites by process improvements, technological innovation and changing the energy sources to reduce their carbon intensity.

For UK papermaking, these routes are built around:

- Increased resource efficiency
- Electrification to switch to low-carbon grid supplied electricity
- Decarbonising natural gas by blending biomethane and/or hydrogen into the distribution network or at the point of use
- Switching from natural gas to hydrogen
- Linking into zero-carbon energy networks such as those potentially served by new Small Modular Nuclear units
- Further developing on-site renewables and battery storage

In reality sector decarbonisation will be achieved through a combination of these ideas – often on the same site.

However, this report is focused on the option to switch from natural gas to grid supplied electricity, on the assumption that the electricity provided by the grid is progressively decarbonised as the proportion of low carbon generation continues to increase. Assuming grid supplied electricity continues to decarbonise, then at some stage it saves carbon by replacing installation's use of gas with electricity – firstly in gas boilers, but also potentially also replacing heat and power from gas-fired Combined Heat & Power plant.

The proposal to substantially increase the use of grid supplied electricity by industry comes with a number of technical challenges including adding to total national electrical demand, increasing the peak electricity levels, grid reinforcement needs and site connection reinforcement, the requirement for new equipment and the loss of flexible industrial generation in balancing the grid.

While acknowledging these technical issues, this paper is focused on one specific question – can industry afford to swap from gas to grid supplied power and stay competitive? Can gas bills be swapped for electricity bills and energy intensive sites stay in business?

Since the first report, Government has acted to address high electricity costs for a sub-set of energy intensive industrial sites through the 'British Industry Supercharger' programme. It's debatable if this programme is sufficiently wide enough in scope and depth to close the cost gap with other countries, and it is certainly not sufficient to close the cost-gap between gas and electricity. Additionally, recent market supply issues have caused real problems and price spikes, meaning that the current use of grid-supplied electricity to generate heat is insignificant.

Historic high costs for grid supplied electricity have resulted in a number of industrial sectors (with both an electrical and heat requirement (such as paper, chemicals and food & drink) investing heavily in on-site Combined Heat & Power plant. Indeed, for several sectors, regulatory guidance (the technical Best Available Techniques Reference (BREF) documents that underpin the legally required site operating permits) continue to state that on-site CHP should be the default position. With the long-term use of such gas-fired plant now being questioned on carbon efficiency grounds, policymakers also need to consider the issues this will raise over the economic use of UK plant that comprises a significant regulatory driven investment for a number of companies.

Heat Pumps – a key electrification technology

A heat pump works by transferring thermal energy from one location to another, using a refrigeration/compression cycle to increase the heat temperature at the delivery location. Heat Pumps are already widely deployed for space heating. A smaller temperature differential between the heat source and the heat destination results in a more energy efficient process. Efficiency is quoted in terms of Coefficient of Performance (COP), with a domestic system generally expected to operate at a COP between 2.0 and 4.0, depending on the season. For every unit of electricity that goes into the heat pump, 2.0–4.0 units of heat are delivered. Using electricity directly for heat, a COP of 1.0 would the best that could be achieved.

This COP is central to the economics of Heat Pumps, where expensive electricity is being substituted for gas. Assuming a gas boiler is operated at 71% efficiency and a Heat Pump at a COP of 3.0, then 100 kWh of gas would deliver 71 kWh of heat, while 24 kWh of electricity would deliver 72 kWh of heat. In this simple example, if the cost differential between gas and electricity is below 3, then operating a Heat Pump becomes an economically viable option – above 3 and it is not.

Until recently, the realistic maximum temperature that could be achieved was around 100°C, but technological developments are increasing this to closer to the 200°C required in the paper industry – when combined with mechanical vapour recompression (MVR) – meaning that heat pumps are now seen as an exciting way to decarbonise heat, especially when the heat source makes use of the large volumes of low temperature heat currently not fully utilised at mills. It follows that the deliverable COP will vary from site to site depending on the starting temperature of the heat source and the temperature required from the delivered heat.

It should be stressed that unlike exchanging a gas boiler for an electric boiler, installing a heat pump also requires major changes to the paper machine – likely requiring new drying section pipework, valves and controls, and possibly a new hood. To operate a heat pump efficiently (delivering the highest COP), it is best to use waste heat sources at their highest temperature, necessitating installation of better insulation, and to use the produced heat at lower temperatures.

Evidence from the projects being developed suggests that the cost of the replacement heat pump is outweighed by the cost of the changes required to the drying section and associated energy systems. Essentially, heat management for operating and controlling the steam supply with a heat pump is completely different from steam control with an existing boiler or CHP. For a paper mill, this means managing heat differently in pressurising up to the level required using MVR only where necessary (rather than the traditional approach of pressurising down), seeking to operate at lower temperatures, and focusing on recovery of lower temperature heat.

3 Context and the status quo

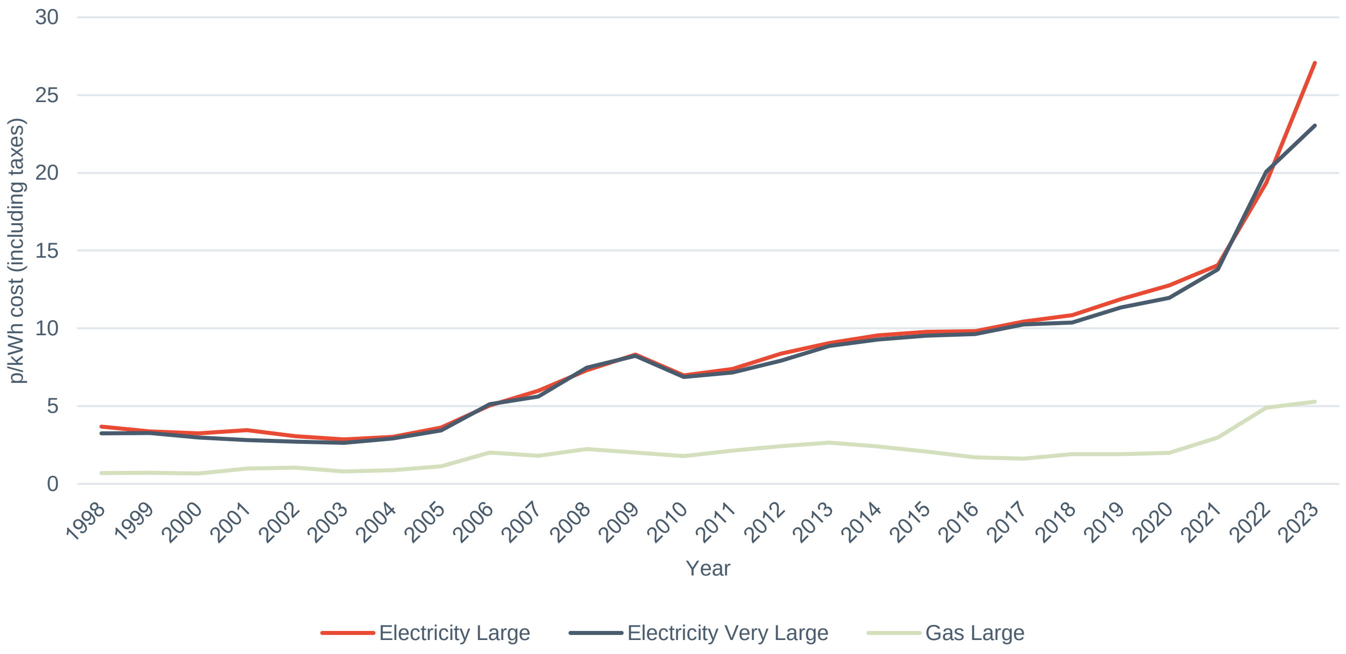
3.1 Introduction

This section provides an overview of the current energy market context and environment. Since the previous report in January 2022, we have seen extremely volatile energy prices, driven predominantly by the Russian invasion of Ukraine launched in February 2022 and knock-on impacts in regional energy flows. During 2022, prices rapidly increased, but have generally been more benign in 2023 despite remaining elevated against historic norms. The Israeli war on Hamas has disrupted gas flows in the eastern Mediterranean leading into winter 2023-24, once again increasing price volatility albeit not yet to the same scale as the early stages of the Ukraine war. However, as summer 2024 approaches, gas storage is well above seasonal norms as supply patterns have adjusted to bring alternative supplies to Europe meaning that prices are settling at more benign levels – though still twice what they were in 2019.

Figure 1 summarises how large energy consumer prices have changed between 1998 and 2023 on an annual basis. The significant increase in power and gas prices in 2022 and 2023 is evident, with large consumer electricity costs increasing an average of around 80% and large gas consumer prices rising over 77%, compared to 2023. This is based on DESNZ data, which includes the following assumptions:

- Large electricity customers consume 20,000 to 69,999MWh per annum
- Very large electricity customers consume 70,000 to 150,000MWh per annum
- Large gas customers consume 27,778 to 277,777MWh per annum (100,000-1mn therms/year)

Figure 1: Large consumer energy costs (including taxes, but excluding VAT)



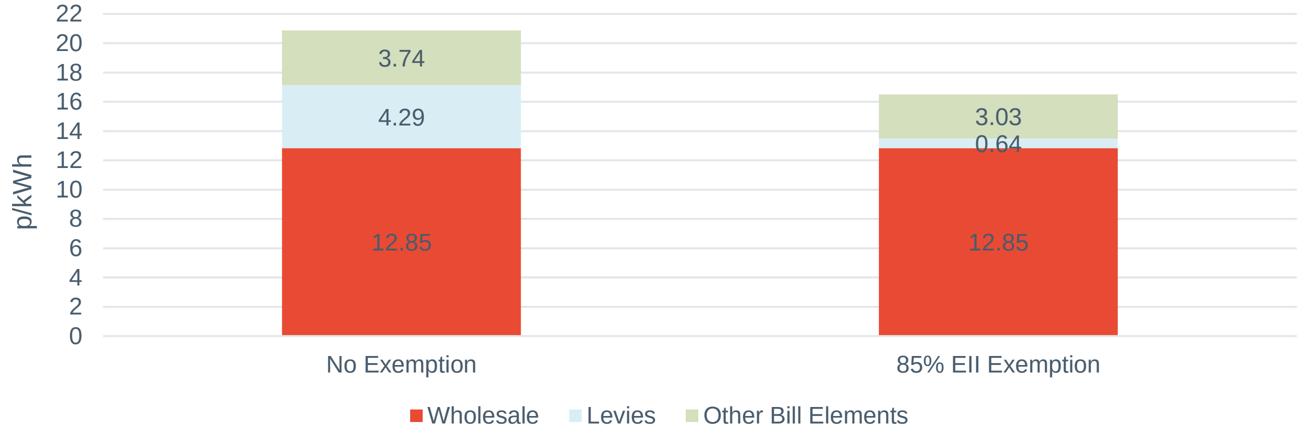
Source: DESNZ energy price statistics, arithmetic mean of seasonal prices for each year

Despite the substantial movements in electricity and gas prices over recent years, electricity costs for large users have been at least 4 times those of gas since 2015. For large users, this multiplier peaked at 6.3x the cost of gas in 2017, and has since fallen to 4.4x in 2023. The two prices are interlinked, as gas-fired generation is typically the marginal (or price-setting) fuel in the electricity industry. The falling difference between gas and electricity costs is supportive for electrification of heat, however it needs to fall much further (and be stable over the long term) to support commercial decisions to electrify processes.

3.2 Retail breakdown of electricity and gas

Electricity retail costs continue to be characterised by a significant non-commodity component, which includes network charges and policy costs both to support renewable energy deployment and ensure stable supply meeting peak demand. Figure 2 shows a breakdown of costs into wholesale price, levies relating to policy: Renewable Obligation (RO), Feed in Tariff (FiT), Capacity Mechanism (CM), Contracts-for-Difference (CfD), and other bill elements including network charges, Climate Change Levy (CCL), and other supplier costs. With no exemptions on these costs, electricity is delivered at a cost of 20.9p/kWh.

Figure 2: Comparative breakdown of electricity bill components, with and without EII exemptions

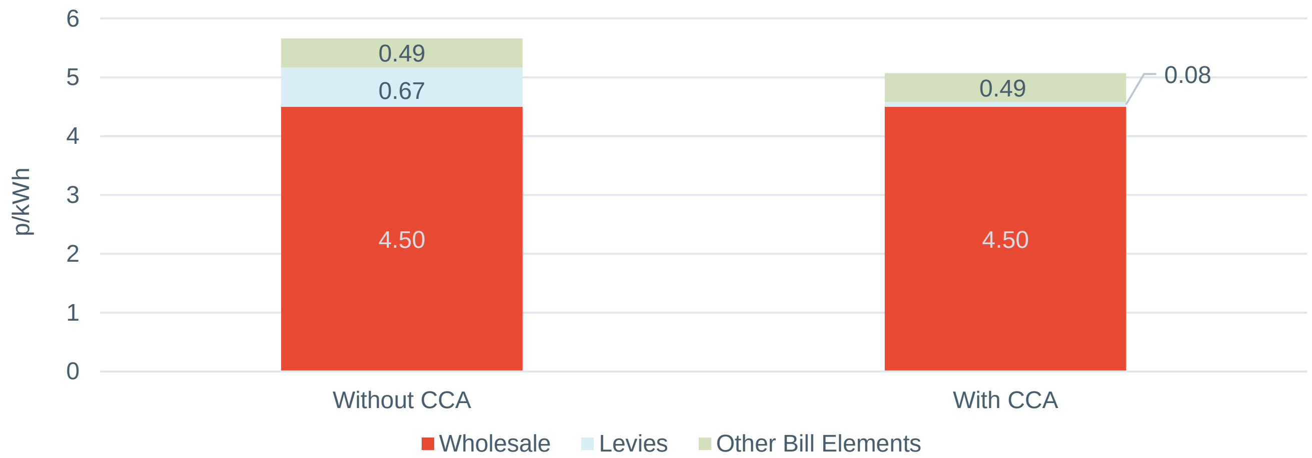


Source: Cornwall Insight analysis, 2023-24 prices for a Very Large electricity consumer with a High to Extra High Voltage connection

With the historic 85% Energy Intensive Industry (EII) exemption on policy levies[2], this cost is reduced to 16.5p/kWh due to the reduction on RO, FiT and CfD charges, as well as the CCL discount arising from the CCA scheme[3].

Figure 3 shows the breakdown of delivered gas cost with and without a Climate Change Agreement (CCA). CCAs allow for EIIs to receive a discount (89% for gas, 92% for electricity)) on the CCL in exchange for meeting energy efficiency targets. The total delivered cost for a large gas consumer with a CCA is 5.1p/kWh compared to 5.7p/kWh without a CCA (Figure 3).

Figure 3: Comparative breakdown of gas bill components – with (left) and without (right) CCAs



Source: Cornwall Insight analysis, 2023-24 prices for a Large Gas consumer

The effective multiplier of cost of gas to cost of electricity is, therefore, around 3.7 times for a typical large user which is paying all costs, or 3.25 times for a user which is benefiting from exemptions. This is significant, as it highlights the efficiency required from a heat pump, if it is to deliver an equal or lower operational cost of heat production.

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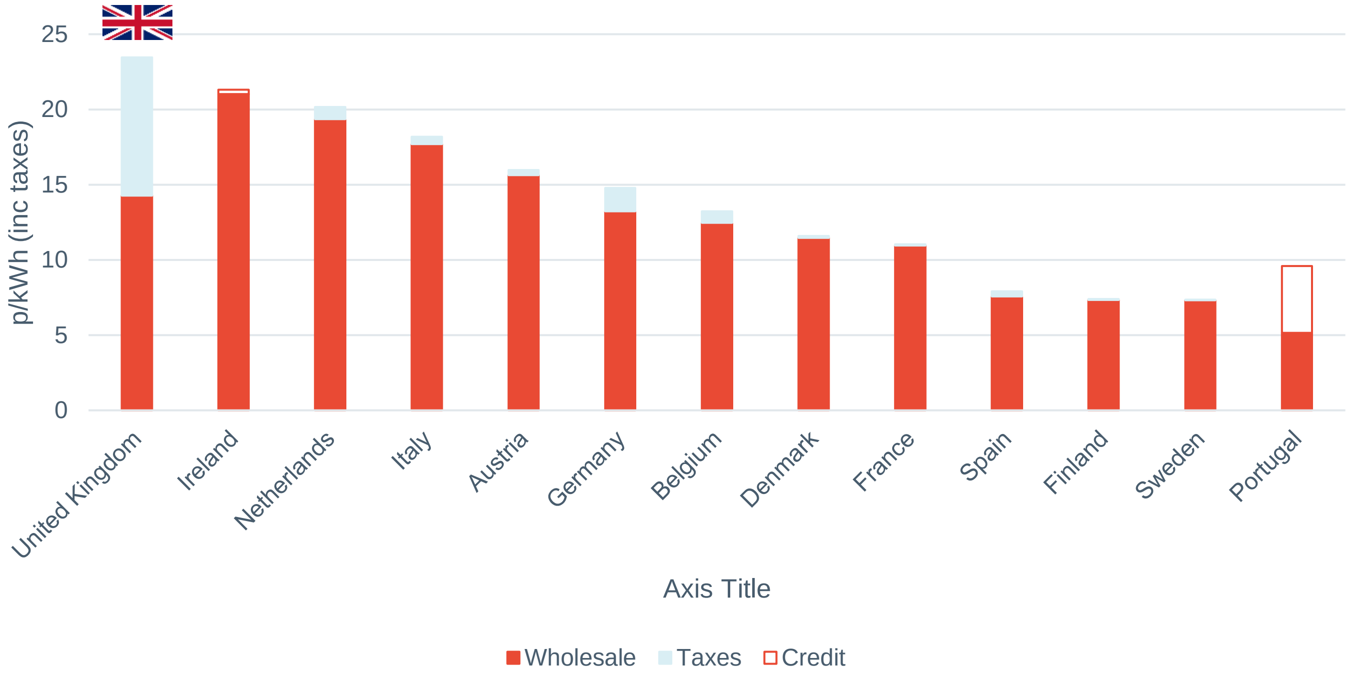
[2] From 1 April 2024, this is discount increased to 100%, and a 100% CM discount was introduced. This is discussed further in section 4.1.

[3] We assume that EII exemption and Supercharger consumers also have a Climate Change Agreement

3.3 International comparison

From an international perspective, GB's electricity prices were higher than the EU14's in H1 2023. GB's position as the highest is largely due to a combination of the Carbon Price Floor and environmental levies applied to bills.

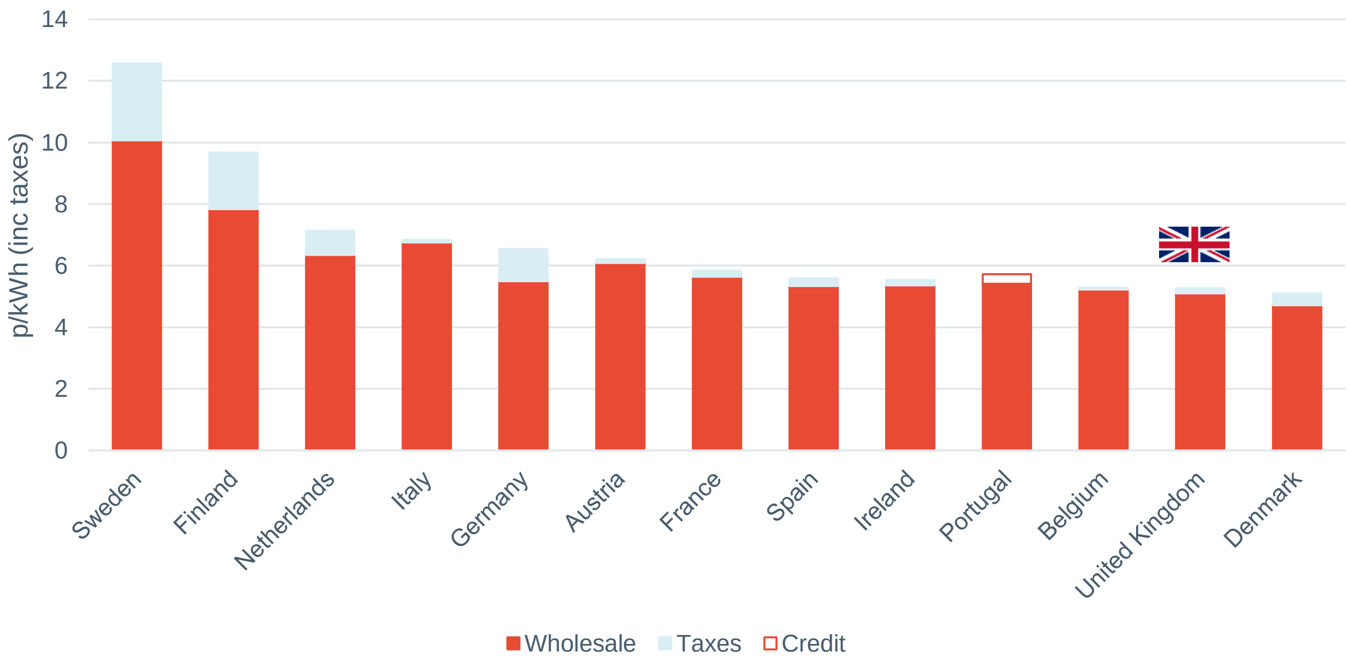
Figure 4: EU14 comparison of very large electricity consumers costs H1 2023



Source: DESNZ international industrial energy prices, arithmetic mean of 2022 seasonal prices

In comparison, the UK had the second cheapest delivered gas costs for large consumers in 2023.

Figure 5: EU14 comparison of large gas consumers costs H1 2023



Source: DESNZ international industrial energy prices, arithmetic mean of 2022 seasonal prices

3.4 Recent trends

3.4.1 Wholesale power prices

Since the second half of 2021, the market has seen elevated and volatile wholesale gas and subsequently electricity prices, driven by:

- Global economic recovery leading to increased gas demand, butting up against low investment levels in gas production assets during the Covid 19 pandemic
- Disruption to gas supply and transport routes, including the Nordstream and Nordstream2 pipelines between the EU and Russia, as well as disruption at an American LNG export terminal
- The Russian invasion of Ukraine and subsequent sanctions from a number of EU member states and international peers
- New EU rules and new forms of long-term, fixed price LNG contracts, which have resulted in more stable gas prices over winter 2023-24

Figure 6 outlines seasonal forward wholesale power prices, from August 2021 to March 2024. While these products differ in price points, the trends are very clear in a significant price rise through the second half of 2022, impacts of which continue to be felt throughout 2023 and into 2024. Though prices have fallen, these remain in the range of £70-80/MWh, over 50% higher than the historic trend pre-Covid.

Figure 6: Seasonal wholesale power prices – GB August 2021 to March 2024

Source: Marex Spectrum

3.4.2 Network charging

The network charging baseline has also changed since the previous report. Ofgem's Targeted Charging Review Significant Code Review (TCR SCR) and Access SCR have enacted a number of changes to ongoing use of system charges and the charges for new or upgraded connections.

In summary, the TCR has reallocated the residual costs of the network. Ofgem has decided that these charges should not send signals to users and should be unavoidable – therefore, these charges are now allocated to users depending on their type, size and location in a fixed p/day standing charge fashion. This has had the effect of lowering unit rates and increasing standing charges for most electricity consumers, with a notable cost increase for sites with auto-generation.

The Access SCR investigated how users pay for access to the network, both in terms of up-front connection costs and in terms of "firmness" of connection – whether connection capacity can be reduced by the network operator. As part of the reforms Ofgem decided to reduce the overall connection charge faced by those connecting to the distribution network such that they now only pay for extension assets rather than network reinforcement assets, reducing the cost of obtaining or upgrading a network connection for most users.

3.4.3 CfD Allocation Rounds

Renewable generation technologies are now the lowest marginal cost source of power on the GB system, and increasing the amount of renewable generation is a key policy aim of the GB government, both to decrease emissions and to help stabilise and reduce power prices. However, the cost impact of increasing the amount of intermittent generation to the network can be underestimated by policymakers, with these increased system operation costs getting passed through to consumers.

The recent CfD Allocation Round 5 (AR5), held in September 2023, did not deliver the level of success seen in previous auctions, with the proposed guaranteed contract prices viewed as too low by potential investors, particularly in offshore wind.

The auction delivered just under 3.7GW of capacity, with no offshore wind. This was considerably below the levels in previous auctions – for example, AR4, in 2022, delivered just under 10.8GW, including 7GW of offshore wind, and AR3 in 2018 delivered 5.8GW including 5.5GW of offshore wind.

The rules of the CfD auctions have been changed to address underlying structural issues for AR6, due in 2024, and this auction is expected to be more successful, though at a higher cost to consumers. The delay will create disruption and forecasts of the increase in renewable generation capacity, and consequential falls in electricity prices, are now further in the future than before AR5.

However, while renewable generation has become the lowest marginal cost source of power, particularly solar and wind, it remains an intermittent source of power which requires often expensive back-up during periods of low output. Further, the often-remote locations with the best wind potential need extensive and expensive network investments. These indirectly increase the total costs of renewable power (e.g. through higher network charges) and make electrification less attractive to industry.

3.5 Summary

Overall, across the past two years we have seen a challenging environment for GB industry, irrespective of the need to decarbonise, with energy costs at unprecedented levels and major global supply-chain disruption. Reforms such as the Supercharger programme are intended to ease the cost of electricity for the most electro-intensive sites but the coverage is tight, with Government estimates that only 300 companies will benefit. Even with this support, the cost of electricity remains too far above the cost of gas to permit fuel-switching on an economic basis, with the economics much worse for the majority of firms that don't benefit from the support package. It follows that large scale electrification will require additional support or market reforms.

4 Reallocation impacts under recent and sign-posted change

There are a number of reforms and signposted likely changes that are currently being progressed by government. We explore these in more detail below and comment on their likely implementation dates.

4.1 The British Industry Supercharger

On 23 February 2023, the government announced the *British Industry Supercharger* (Supercharger). This was implemented from 1 April 2024. It includes a range of measures to make Britain's EII's more competitive when compared with European neighbours and tackle carbon leakage. This included three core areas:

- Increases to the existing EII Renewable Levy Exemption from 85% to 100% – change from April 2024
- A new exemption to 100% of Capacity Market charge recovery – in place from October 2024
- A 60% relief on electricity network charges through the EII Network Charging Compensation Scheme (NCC) – in place from April 2024, but paid in arrears from April 2025

Government is working with the scheme administrator to understand whether quarterly compensation payments are the most appropriate or whether a more regular cycle of monthly levy collection is more feasible. Regardless, eligible companies will be required to provide evidence of network costs on a quarterly basis, and (once fully established) companies should expected their first compensation payment to be made quarterly in arrears.

Our analysis indicates this is likely to significantly impact the annual cost of electricity for eligible companies. Network costs are expected to decrease from around 2.5p/kWh to 1.0p/kWh for a typical eligible consumer. Combined with the increased levy exemption, this results in electricity being a potentially more attractive fuel option than gas.

DESNZ also specifically ruled out the implementation of NCC for gas network charges, though an exemption may be considered in future if electricity policy levies are applied to gas bills.

As discussed later in this section, the Supercharger reduces electricity costs for eligible companies to roughly the levels required for high-temperature heat production via heat pumps to be economically viable, on an operational basis. A 2.5x cost multiplier from gas to electricity suggests that the most efficient heat pumps may be able to deliver heat at a viable price, from an operational point of view.

While the Supercharge scheme provides significant support to eligible businesses, most British industry – including parts of the British paper industry – will not benefit from these exemptions due to the *business-specific criteria* in EII exemption rules. These restrict support to defined eligible activities, rather than to the traditional EII industries (paper, metals, ceramics, glass, chemicals) as a whole. Instead, these non-eligible parties will face modestly increased costs from the scheme, of around £1/MWh, to cover the avoided costs arising from supported companies.

4.2 Electricity levy rebalancing and reallocation

The attribution of electricity environmental levies on electricity bills may be appropriate from the perspective of user pays and to drive energy efficiency improvements, but in isolation it may hamper the system-wide transition to net zero by driving up the relative costs of what is now, for many uses, the least carbon-intensive fuel. Reallocation of levy costs, either to general taxation or counterfactual fuels, could be appropriate.

The *MISSION ZERO: Independent Review of Net Zero* final report was published on 13 January 2023. The report noted that ensuring electricity is cheaper than oil or gas is essential to incentivising people to switch to low carbon technologies such as electric vehicles and heat pumps. It stated that government should deliver the Review of Electricity Market Arrangements (REMA) promised in the British Energy Security Strategy and rebalance environmental levy costs, and that government should ensure there is a clear price signal in favour of technologies that use electricity rather than fossil fuels.

Government's 30 March 2023 *Powering Up Britain: Energy Security Plan* accepted that a clear approach to gas and electricity rebalancing should be made by the end of 2023-24. It stated that the government will set out plans during 2023-24 to rebalance gas and electricity costs with the aim of making electricity bills cheaper and speeding up electrification for households and businesses. Government also accepted that it should make significant progress affecting relative prices by the end of 2024.

While the target of end-2024 for implementation of a number of reforms is promised, the legislation required to implement this reform could take some time to deliver as the reforms impact a swathe of green energy policies. In an election year, such legislative reform will be challenging to deliver. The extent to which rebalancing is likely to impact the relative costs of electricity and gas is highly uncertain – "significant progress affecting relative prices" provides no clarity.

Within the broader societal and economic landscape, the effects of any reallocation will likely need to be closely assessed and monitored, with the very poorest domestic customers potentially requiring further help with their energy bills. Given this stricture, "significant progress" could imply a 10-25% rebalancing by end 2024 if the government is fully committed to the timeline recommended by the Independent Review of Net Zero.

Fundamentally, this reform is likely to be the most effective policy measure to support fuel switching without any other significant reform on the horizon. Our analysis suggests that it, alongside additional support for a sub-set of installations through the Supercharger programme together with the Network Charging Compensation noted in the previous section, can support eligible installations in making the decision to switch. Under this scenario, enabling early adopters to switch has a knock-in impact of increasing the cost for those who have not yet switched, further improving the business case for switching. However, for those users who cannot switch due to technical and/or operational challenges, the cost of energy is likely to materially increase as others switch, making this an imperfect solution at best for British industry.

4.3 Analysis of impact on the relative attractiveness of fuels

4.3.1 Methodology: Pricing Scenarios and Assumptions

Our analysis for this report follows a similar methodology to that of our 2022 report. We modelled four scenarios to contrast with the current allocation of policy levy costs (Figure 7 and Figure 8 show the breakdown of levies added to delivered cost for electricity and gas for each scenario and over the range of exemptions. Reallocation of levies from electricity to gas increases the price of gas less than it reduces the price of electricity, as much more gas than electricity is consumed in GB.

Figure 7), though the value of this measure is now removed for a sub-set of sites by the impact of the Supercharger) policy (see section 4.1). The following are the main assumptions underpinning our modelling:

- The policy levies our analysis is based on are: Renewable Obligation (RO), Feed in Tariff (FiT), Capacity Mechanism (CM) and Contracts-for-Difference (CfD)
- The scenarios we have modelled are based on potential reallocation which would shift those levies away from delivered electricity cost:
  - Scenario 1 (control): No change to levies applied to delivered energy costs
  - Scenario 2: 50% of levies reallocated from delivered electricity cost to delivered gas cost
  - Scenario 3: 100% of levies reallocated from delivered electricity cost to delivered gas cost
  - Scenario 4: 100% of levies reallocated from delivered electricity cost to general taxation; note that this is only presented in Figure 13, annual costs, as results are similar to Scenario 3
- We have assumed that there will be no EII discount on these levies if they are reallocated to the delivered gas cost (though this is not certain), which increases the impact of reallocation substantially
  - This is based on government's position from the NCC, which suggested that this would not be supported from a policy position
- We have considered prices for non-Combined Heat and Power (CHP) stations, unless specified, and any assertions on the attractiveness of electricity as a fuel source will be through the utilisation of heat-pumps. This is because there appears no prospect of direct electrification becoming economically viable for most process heating energy due the huge price disparity between gas and electricity. As a result of

focus on heat pumps, heat pump efficiency is a key factor in the economic feasibility of switching to electricity

- Analysis is present for three example consumers – not eligible for EII discounts on import electricity costs; eligible for the previous, less generous version of the EII scheme; and eligible for the new Supercharger discounts

4.3.2 Unit rate reallocation impacts

Firstly, we discuss the results of our analysis on a unit rate (p/kWh) basis, breaking down how costs are allocated and how a change in allocation of levies will impact delivered energy cost from a micro-perspective. Currently, the unit rate (p/kWh) levies on delivered electricity cost are subject to a 100% discount for eligible EII consumers through the new Supercharger scheme. The CCA exemption for Climate Change Levy cost is applied separately for electricity and gas and therefore is not impacted by any levy reallocation, though Treasury is part way through a process to increase the CCL rate for gas and reduce for electricity.

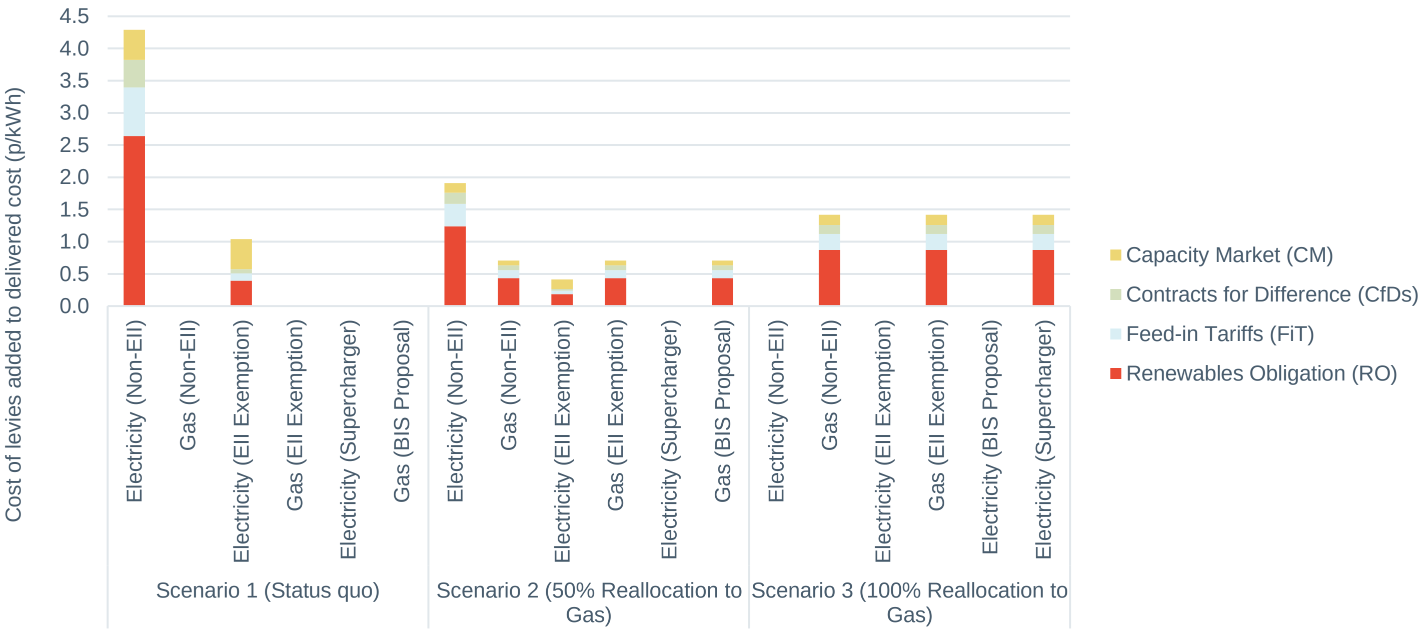
Figure 7 and Figure 8 show the breakdown of levies added to delivered cost for electricity and gas for each scenario and over the range of exemptions. Reallocation of levies from electricity to gas increases the price of gas less than it reduces the price of electricity, as much more gas than electricity is consumed in GB.

Figure 7: Cost of levies added to delivered energy cost

p/kWh	Non-EII		Old EII scheme		Supercharger	
Scenario	**Electricity**	**Gas**	**Electricity**	**Gas**	**Electricity**	**Gas**
1 (status quo)	4.39	0.00	1.04	0.00	0.00	0.00
2 (50% re-allocation to gas)	1.91	0.71	0.41	0.71	0.00	0.71
3 (100% re-allocation to gas)	0.00	1.42	0.00	1.42	0.00	1.42
4 (100% re-allocation to tax)	0.00	0.00	0.00	0.00	0.00	0.00

Source: Cornwall Insight

Figure 8: Cost of levies added to delivered energy cost



Source: Cornwall Insight

The reallocation of policy levies to gas adds just over 0.7p/kWh in Scenario 2, or +14% to the total cost of gas, and 1.4p/kWh in Scenario 3, or +28%. This is the case in both the EII exemption and Supercharger proposal results, as gas is not expected to benefit from the same exemptions.

Figure 9 below shows the total cost of importing different energy types for Scenario 1, the status quo position. This shows that even with full exemption from the relevant levies and the additional discount on network charges under the Supercharger, there is still a large disparity between delivered electricity and delivered gas cost. Electricity would need to produce 2.82kWh of heat for every kWh purchased to be a competitively attractive fuel alternative for a non-EII site.

This uplift in efficiency is within the range of domestic-type heat pumps, which provide useful heat around 60-70ºC. It is currently beyond the reach of heat pumps which produce high-temperature heat in the form of steam, as is required by the paper industry (circa 200°C).

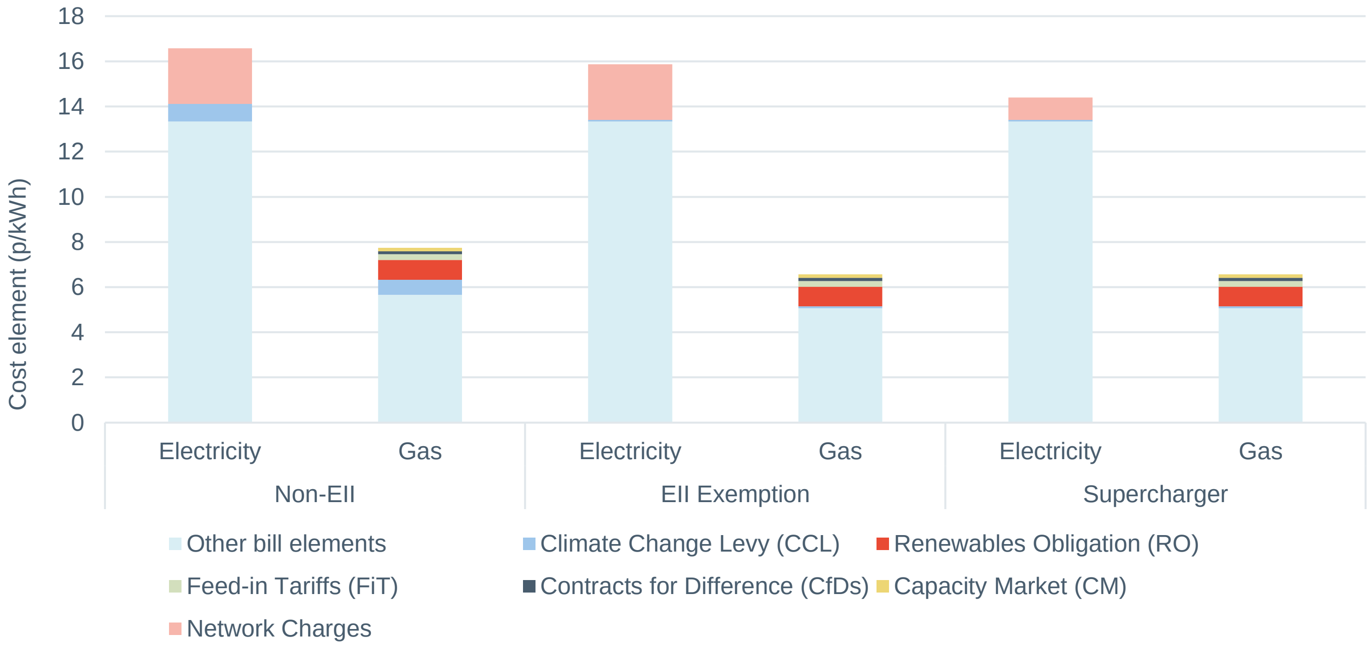
Figure 9: Delivered energy cost and required heat pump efficiency for electricity to breakeven for Scenario 1

	Electricity DEC (p/kWh)	Gas DEC (p/kWh)	Required Efficiency[4]
Non-Supercharger supported	20.9	6.3	282%
Old EII scheme	16.9	5.1	282%
Supercharger scheme	14.4	5.1	240%

Source: Cornwall Insight

Figure 10 shows the full breakdown of delivered energy costs in Scenario 3, the maximum reallocation. Electricity and gas are still not balanced on unit price, though the multiplier from gas to electricity costs is much lower. Figure 11 shows total delivered energy costs under Scenarios 2 and 3. The cost multiplier from electricity to gas is between 1.73 and 1.96 times for Scenario 3, which may be within the potential of high temperature heat pumps. Therefore, heat pump efficiency is a key factor in the economic attractiveness of switching.

Figure 10: Breakdown of scenario 3 (100% reallocation to gas) delivered energy cost for electricity and gas, for a non-EII consumer (left), a EII consumer with historic 85% exemptions (central), and a EII consumer under the Supercharger Scheme (right)



Source: Cornwall Insight

[4] Note that this calculation includes an assumption of 85% efficient gas-to-useful-heat conversion

Figure 11: Delivered energy cost and required heat pump efficiency for electricity to breakeven for Scenarios 2 & 3

Scenario	Electricity cost (p/kWh)	Gas cost (p/kWh)	Required efficiency[5]
2: Non-EII	18.5	6.3	250%
2: EII Exemption	16.3	5.7	243%
2: Supercharger scheme	14.4	5.8	211%
3: Non-EII	16.6	7.7	183%
3: EII Exemption	15.9	6.6	205%
3: Supercharger scheme	14.4	6.6	185%

Source: Cornwall Insight

Scenario 4 reduces the cost of electricity but does not rebalance any cost to gas. This result is no different to the Supercharger proposal in providing a 100% exemption to electricity levies while not adding any costs to gas consumption, but would provide this more broadly to all electricity users. However, it does not present a competitive case for switching to electricity on a unit rate basis due to the lack of uplift on gas cost and, therefore, a high multiplier from gas cost to electricity cost. On the other hand, it does not "punish" those parties who continue to consume gas.

This section has shown that, even with a full reallocation of electricity policy levies and applying the maximum proposed exemptions, there would remain a large disparity between the delivered costs of electricity and gas. Therefore, to fully balance industrial spending on fuels, further sums would need to be recovered from gas consumers to subsidise the wholesale cost of electricity.

4.3.3 Impact on annual energy cost

On unit rates alone, electrification does not appear to present a viable business case. It would require more than a full reallocation of the modelled levies to breakeven on unit prices.

A key technology in making the switch to electricity is heat pumps, which are able to produce heat energy at a far greater efficiency of output than gas boilers, meaning that switching to heat pumps reduces the amount of energy needed to conduct operations which, combined with a cheaper baseline electricity for power, could result in a lower annual cost following the switch to electricity only.

Heat pumps have historically been considered unsuitable for most industrial processes, producing an insufficient temperature and also lacking the necessary scale. To date we are not aware of any successful higher temperature industrial implementations in GB. However, technological development continues and we believe that some new-to-market and forthcoming assets may be suitable for applications in the paper industry and therefore we have considered the costs of operating with a heat pump.

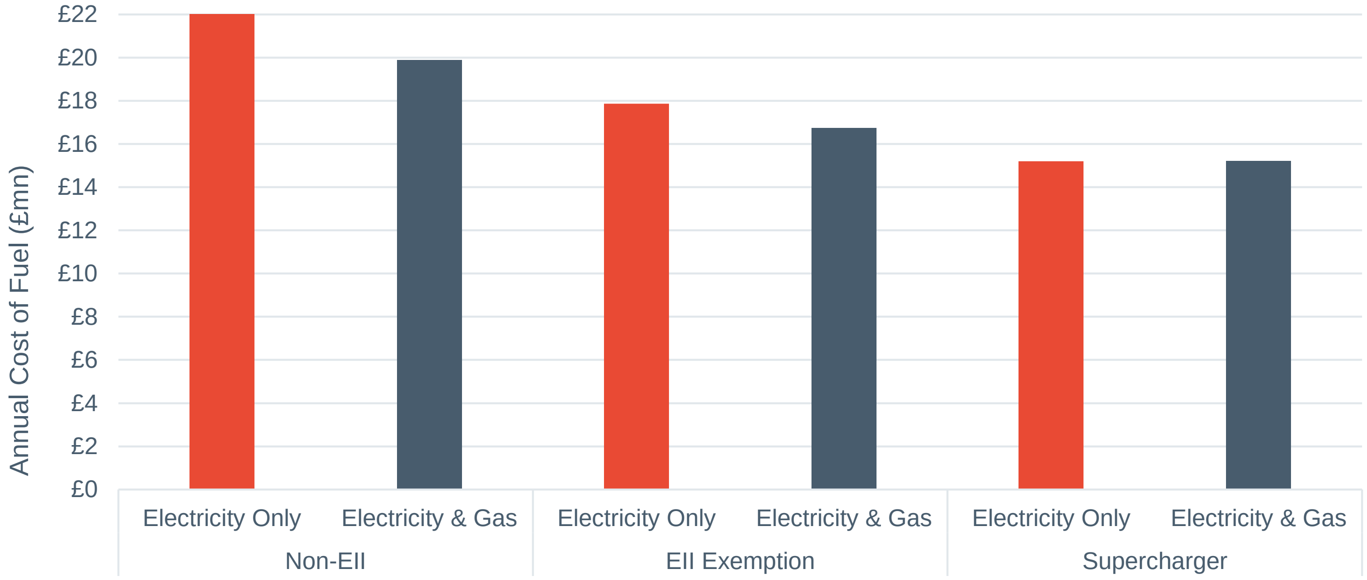
We have modelled a site which operated under the following parameters:

- A base electricity (power) demand of 60,000MWh
- A gas for heat demand of 130,000MWh
- A heat requirement of 105,000MWh
  - This assumes a gas boiler efficiency of 81%
- A heat pump co-efficient of performance (CoP) of 230%
- Reallocation Scenarios and exemption schemes as dependent variables as described in the previous section

[5] Note that this calculation includes an assumption of 85% efficient gas-to-useful-heat conversion

Figure 12 shows annual fuel costs under Scenario 1 (status quo) showing that electricity becomes essentially equalised in annual cost under the Supercharger scheme, without additional reallocation of levies.

Figure 12: Annual delivered energy cost for electricity and gas (status quo) vs electricity only (post switch), for a non-EII consumer (left), a EII consumer with current exemptions (central), and a EII consumer under the Supercharger Scheme (right), for a CoP of 230%



Source: Cornwall Insight

Figure 13 shows the aggregate annual cost of heating fuels in the four scenarios under the different exemption rules. In Scenario 2 and 3, the annual cost of fuel after switching to electricity is significantly lower than gas for Supercharger supported EIIs. For non-supported EIIs (and other users), Scenario 2 sees the cost of process heat from electricity brought broadly into line with gas-fired, at less than 2% more expensive.

The greatest disparity is seen in Scenario 3, which sees annual cost after switching to electricity at a saving per annum of £1.63mn, £1.18mn, and £1.86mn, under no exemptions, the EII exemption, and the Supercharger proposal, respectively. This would make switching to electricity a very attractive proposal. Scenario 2 also sees small savings for electricity compared to gas. Scenario 4 offers little competitive advantage to industry.

Crucially here, we are examining an industrial site which consumes a significant amount of electrical power – around half as much as gas – and which does not have an onsite CHP producing heat and power. If the electricity imports of the site were lower, then the economic case for levy rebalancing would be weaker as the saving on this side of the equation would also be weaker.

Figure 13: Annual fuel cost under full range of exemptions for electricity and gas for Scenarios 1-4, for a HPE of 230% (£/year)

	1 – No Reallocation	2 – 50% Reallocation	3 – 100% Reallocation	4 – 100% Reallocation to Tax
Non-EII – Electricity	£22,054,152	£19,788,071	£17,521,990	£17,521,990
Non-EII – Elec & gas	£19,881,280	£19,514,417	£19,147,554	£17,307,460
EII Ex. – Electricity	£17,869,142	£17,318,864	£16,768,585	£16,768,585
EII Ex. – Elec & gas	£16,735,986	£17,343,529	£17,951,071	£16,110,978
Supercharger – Electricity	£15,203,443	£15,203,443	£15,203,443	£15,203,443
Supercharger – Elec & gas	£15,222,132	£16,142,194	£17,062,255	£15,222,132

Source: Cornwall Insight

This analysis also does not consider the considerable capital costs of installation of the heat pump and conversion of systems and processes to enable this, or the costs of obtaining an upgraded electricity network connection to support the additional load of the heat pump. Additionally, capital-intensive manufacturing sites are extremely conservative and only likely to move install heat pumps once they are commercially proven in real world applications.

This report is focused of operational cost implications and does not consider grid operation or investment requirements. However, we note that this is a huge issue with no clear answers. The Network Commissioner (Nick Winser) has *issued a major report* on this issue with the proposals being considered by Government.

We also note that *separate research by CPI* indicates that any UK mill that decided to fully electrify production would need a substantial reinforcement to its existing network connection. Obtaining this in the current environment of long connection lead-times and high costs is likely to be difficult for many sites.

Hence while we have identified potential operational cost reductions from electrification, the magnitude of those savings is unlikely to be sufficient to incentivise switching.

4.3.4 Conclusion

There are multiple options where policy could result in an equalised or even lower annual cost of fuel after switching to electricity, despite the continuing higher cost of electricity over gas. If policy levy costs were fully rebalanced from electricity to gas, under Scenario 3, electricity becomes an attractive option as it presents a saving of over £1mn per annum for our example site, even without EII exemptions.

Maintaining the status quo (Scenario 1) does not present a strong case for switching to electricity as there are little to no savings, even for an EII under the expanded Supercharger exemptions. The £19,000/year saving is highly unlikely to be sufficient to cover the capital cost of switching to heat pumps. This is also a problem for Scenario 2 under the current EII exemption scheme, with costs still higher for electrified heat than the gas status quo. The Supercharger scheme, however, presents a situation where the operational costs of electrified heating are roughly equivalent to gas heating. Scenario 3 would see consistent savings across the board, but only through the increasing cost of gas as levies are reallocated at a full rate, as opposed to at an exempted rate.

As previously stated, there are key variables which would impact results which we have kept fixed in our analysis. Heat pump efficiency and wholesale price, of electricity and gas respectively, have the largest impact on aggregated cost and would significantly change figures above and results if they themselves significantly changed. We also make no allowance for reinforcing grid connections, though in reality this is likely to be a key blockage even if the operational cost issue can be solved. In the next section, we will discuss how our scenarios and analysis results might be translated into workable policy and the considerations therein.

5 Options for reform

This section of the report outlines some potential solutions to resolve or further support capital and ongoing fuel cost issues.

5.1 Updates since the previous report

The previous report outlined the following reforms:

Figure 14: Summaries of reforms in adoption for EIIs

Option	Route to implementation	Support to net zero	Price impacts	Overall
Network charge reform	Requires a restructure to cost allocation for largest consumers	Supports decisions to electrify, but not wider decarbonisation	Reduces the most significant component of the bill bar wholesale costs for EIIs	Provides a sizeable price discount and supports electrification
Reduced or removed subsidy costs	Requires legislative and/ or policy change	Provides marginal support to decision to electrify, but does not fully bridge economic gap	Existing EII discount means little further benefit for some installations	Provides a small price discount, doing little to support electrification

Source: Cornwall Insight

These reforms are being adopted for eligible installations through the Supercharger, discussed in section 4.1, and are expected to be fully in place by April 2025. This significantly improves the position for a number of installations and supports heat pumps in approaching parity vs gas heating from an operational costs perspective, depending on the reallocation of policy costs in the future.

However, ongoing costs are not the only consideration:

- Operational impacts – whether the heat is at a similar grade or can be applied to the medium that requires heating in the same way as gas-fired heating, and whether there are any operational impacts for the company or organisation making the conversion
- Costs of conversion – a natural point at which to switch heating system is when previous heating equipment requires replacement or upgrade. However, as well as the capital costs of the electrified heating system, there are also considerations around upgrades to connection capacity with the electrical network, potential impacts on the profile of consumption and so typical costs, and other associated costs
- The carbon intensity of different fuels – given public concern over climate change and legally binding targets set by UK government, Environmental, Social and Corporate Governance (ESG) goals for businesses are an important consideration in any conversion between fuels. The carbon intensity of importing power from the electricity grid is on average lower than gas-fired heat, although this is not necessarily always the case, and so it typically acts as an incentive to electrify. Regardless, as the grid further decarbonises, this will act as a greater incentive to convert.

Therefore, reaching cost parity is part of the wider decision to convert to electrified heat. With the announced reforms under the Supercharger and levy cost reallocation, Supercharger eligible sites could reach this threshold at 50% policy reallocation. However, non-eligible sites are likely to require further support to make the decision to switch to electrified heating.

At present, eligibility to Supercharger policy support is limited to installations in eligible sectors that also meet an electricity cost impact test based around the impact on profitability. One straightforward policy change would be to remove the eligibility test. Essentially if an installation is making products assessed as electro-intensive enough to potentially require support, then access to the Supercharger programme could be automatic.

Because of the importance of accessing Supercharger policy support to the economics of electrification, the remainder of this section splits into further incentivisation for Supercharger supported sites and wider reform for other consumers.

5.2 Incentivisation for industry

With a marginal commercial case for switching from gas to electrification, further incentivisation may support businesses in making the decision to switch at or before the end of the usable technical life for the existing heating assets. As noted, switching fuels and assets includes capital outlay and may include operational changes. Further incentivisation for industry to electrify heating could include the following:

- Support in making the capital outlay for electrified heat
- Tax breaks on equipment to support electrification
- Operational cost support
- Potential interlinkage with existing schemes, such as CCA approval for those that commit to electrifying over the coming period
- Widening access to the Supercharger scheme

These are explored in greater detail below.

5.2.1 Capex support

Government could provide additional capital support to businesses in making the switch to an electrified heating system. This recognises that the capital outlay for a new system can be prohibitive, potentially requiring a new heat "generator" and extensive alterations to pipework, heating interfaces and control equipment.

A similar approach is taken with domestic and small non-domestic users – the Boiler Upgrade Scheme (BUS) provides a capital grant for switching heating systems to a heat pump or a biomass boiler. Successful applicants receive £7.5k towards an air source or ground source heat pump, or £5.0k towards a biomass boiler (the latter only applies to off gas-grid, rural customers). The BUS is available to non-domestic consumers, but would not provide support of the scale required to make the transition at an industrial scale.

While the costs of installing an electrified heating system may be a higher proportion of total income for households compared to EIIs, the higher costs of electrifying heavily industrialised heating systems can act as a barrier to industries looking to make the switch.

The Industrial Energy Transformation Fund (IETF) is already active in this area, but feedback is that the application process is too complex and the grant support level insufficient to make a major impact. However, some changes to the rules, together with increased levels of funding could tweak the scheme to increase the impact.

5.2.2 Tax breaks for electrification

Treasury could provide tax exemptions or benefits on equipment and material used for electrifying heat. The Autumn Statement 2023 included some announcements that may facilitate investment in new equipment and technology, such as full expensing of capital allowances on a permanent basis. This allows for a company to bring forward its tax shield benefit from capital allowances, leading to the same amount of tax paid over asset life while being able to gain an NPV benefit due to less tax paid in earlier years. This makes the UK's capital allowance regime one of the most generous in the world and should make the decision to invest in electrification easier.

Indeed, part of the Covid-19 industrial recovery was *the temporary provision* of a 'super-deduction' through which 130% of eligible investment costs delivered a capital allowance credit. Ongoing access to a 'green super-deduction' would be a valuable addition to encourage investments delivering decarbonisation.

5.2.4 Climate Change Levy and Agreements

Government could also use interactions with existing policy and tax schemes to support industries in transitioning across to electrified heating. This includes, for example, the CCA mechanism which provides a significant discount on CCL costs. Rather than meeting emissions targets or paying a fee in compensation, allowing a business to commit to electrifying their heating over the two-year budget period may support decision-making in transitioning to decarbonised heat.

Government published a response to its CCA consultation after the Autumn Budget 2023 and *issued a new consultation* on 22 November 2023. This confirmed the principle of a new, six-year CCA with detailed scheme design details to follow.

Treasury may also consider rebalancing the CCL itself. It is expecting to complete the process of equalising electricity and gas levies in April 2024, when both rates will reach £7.75/MWh. By continuing the increasing trajectory of the gas CCL, or decreasing the electricity CCL, government could increase the incentives to switch from gas to electricity. This would to some extent replicate the scheme implemented in the German market, where a new tax on all fossil fuel users (gas, fuel oil, petrol and diesel) has been used to reduce the cost of the "EEG" electricity policy levies on domestic retail electricity bills, incentivising fuel switching.

However, we expect that any moves resulting in an increase in gas bills will be understandably unpopular with industrial users.

5.3 Support for all users, including non-EIIs

While, depending on heat pump technological development, the business case for Supercharger supported EIIs to electrify is reaching commercial parity with the costs of heating from gas, the case for non-Supercharger supported companies remains some way off. Further reform is required to support these users in making the decision to switch. We discuss some potential options for providing this support below.

5.3.1 Priority network access

The GB electricity distribution and transmission networks are becoming increasingly congested, with potential new users looking to connect, and existing users looking to secure larger connections, finding that timelines are longer and costs are higher. Several new user-types are looking for very large connections: data centres, EV charging hubs and electrified heat production are all now competing for limited available network resources, with batteries and hydrogen electrolyser facilities also adding new demand over the remainder of the decade.

While Ofgem implemented the Access Significant Code Review in April 2023, which reduced the costs of connecting to the distribution networks by socialising up-front costs, connection queues have not been reduced. Ofgem is also seeking to better manage the connection queue by removing projects unlikely to be progressed as they lack critical factors such as fiscal resources or stakeholder permissions. At the time of writing it's unclear how successful this will be in reducing connection time delays for projects ready to be developed.

In a more proactive manner, the regulator may also wish to amend the queue process to prioritise connections to enable decarbonisation linked projects over other user-types – though whether this would put electrification of heat above other technologies like EV chargers is debatable, and would rely on a case-by-case analysis.

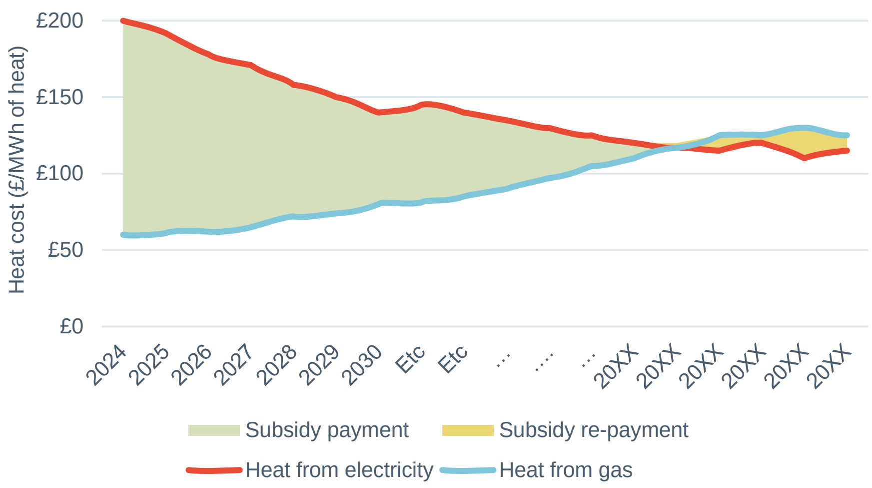
5.3.2 Heat subsidy support

Since the end of the non-domestic Renewable Heat Incentive in March 2021, there has been no direct support for operating large-scale renewable heat production. The scheme was flawed in many ways, particularly the Northern Irish implementation, but did result in large amount of capacity being deployed.

Subsidy mechanisms have evolved since this point, with new subsidy schemes like the CfD regime implementing both an auction process and a fixed price in order to control costs to consumers. CfD-like subsidy mechanisms are under consideration for carbon capture and storage, and for hydrogen production, which would both pin the value of subsidy to a market-based alternative. A similar mechanism for heat, which compensated users based on the cost of the alternative technology – perhaps gas boilers – could remove the economic disincentive to switch to electrified heat by linking the costs to a market which these users understand. Alternatives tied to a known fixed price for heat may be even more attractive to these users.

Figure 15 shows a possible implementation of a CfD mechanism which could be implemented to support heat. This provides support based on the difference in cost in producing this heat from electricity versus the counterfactual gas fuel. In a scenario of falling electricity costs and increasing gas costs, users would pay back costs when the cost of electrified heating fell below the prevailing gas cost; alternatively, these costs could be written off to give additional benefit to early movers in heat electrification.

Figure 15: Diagram of Heat CfD subsidising the gap between gas and electrified heating costs



Source: Cornwall Insight. Note numbers are for demonstration and are not forecasts

An auction mechanism could prioritise support to those offering a lower cost of electrified heating, driven by lower capital costs of installing plant and network connections, or a higher coefficient of performance of heat production equipment such as more efficient heat pump technologies or recovery of waste heat. By recovering the costs of this scheme from the gas bill, an additional incentive to make the clean heat switch would also be created.

5.3.3 Existing scheme interlinkage – widening access to the Supercharger programme

Another option would be to expand the existing carve-out from subsidy costs for electrification of heat, or create a new exemption. This could be similar to the existing EII mechanism and the Supercharger extension of this, granting reductions to the costs of the CfD, FiT, RO and CM for eligible heat production equipment. As shown in section 4.3.2 of this paper, this would deliver cost-reductions of around £40/MWh for large users.

A cost-exemption could be a general broadening of the EII scheme to include more parties. A more targeted approach could provide support only to the volumes of power used to produce heat. The latter would enable parties across the GB economy to benefit, including large and small industries, commercial and domestic users. Implementation would require separate metering for heat equipment, but this is increasingly available and low-cost, both in the context of large industrial-scale metering assets and asset-level meters suitable for smaller applications.

As with the Supercharger proposal to reduce costs to EII users, this proposal would not make the cost of electrifying heat level with the cost of burning gas, but it would deliver a significant cost saving which may make electrification more attractive to parties with strong ESG commitments. The costs of paying for subsidy for non-exempt volumes may, however, make this option unattractive to government.

5.3.4 Extend the UK ETS

The UK Emissions Trading Scheme (UK ETS) essentially implements a tax on emitting carbon for large users. Any sector regulated facility, or an installation with a fossil-fired unit of more than 20MWth capacity is required to purchase certificates to cover the emissions which they produce on an annual basis. Assets under this size, are excluded from these requirements. This is a significant saving at time of writing (Feb-24), of around £30-40/tonne of carbon, or £6-8/MWh of gas burned. Extending the scope of ETS exposes more sites to increased costs associated with fossil fuel and would serve to close the cost differential with grid supplied electricity.

Unlike the EU, the UK Government does not allocate any ETS revenue (raised by the auctioning of allowances) to directly support industrial decarbonisation. A reassessment of this position could provide an enhanced budget to support electrification.

6 Summary

6.1 Purpose of this paper

This paper was commissioned as an update to our previous insight paper on the topic of decarbonising heat generation for industrial consumers through electrification (switching from natural gas to grid supplied electricity), published in February 2022, in which we ultimately concluded electrification of heat was not commercially viable. Both papers have used the UK paper manufacturing industry as a representative example for the challenges industry faces in balancing the need to stay commercially competitive while implementing measures to transition towards net zero, in line with government policy.

The continued interest from the CPI to sponsor an update to the paper showcases the importance of this issue looking ahead, from both a legal and business view, and to highlight how electrification, as a technology, remains the only readily available option to decarbonise EII activities. Hydrogen as a fuel source and Carbon Capture, Utilisation and Storage (CCUS) remain emerging technologies. In addition to this, the substantial energy market volatility which has occurred due to the Russian invasion of Ukraine, beginning only several weeks after our first paper was published, saw unprecedented increases in wholesale power and gas prices, inviting a new appraisal of the situation.

6.2 Updates from our 2022 paper

The most significant change from our 2022 paper has been the volatility in the wholesale power and gas markets globally due to the loss of Russian gas exports, which increased gas prices significantly. Despite this volatility reducing over the course of 2023 and early 2024, prices have not returned to historic baseline levels and show little sign of doing so in the foreseeable future. There have also been several notable policy updates in the form of the Supercharger and Climate Change Agreement (CCA) schemes which will provide further exemptions on energy costs for eligible installations in the aim of supporting the business case for energy efficiency and potentially decarbonisation. Lastly, a commitment to setting out a clear methodology for rebalancing these policy costs between delivered electricity and delivered gas costs was made explicit in the 2023 *Powering Up Britian Energy Security Plan*.

In our analysis, we followed the same methodology in modelling both annual (£/year) and unit cost (£/kWh) for the current allocation of policy costs and three hypothetical rebalancing scenarios (Section 4), However, a critical driver in our analysis has been updated, due to new technological developments delivering a growing capacity of heat pumps to provide the required heat production for manufacturing. This provides a very significant increase in efficiency compared to the electric boilers modelled in our 2022 paper. The potential for heat pumps was noted in our previous paper but, at that time, they could not supply necessary heat.

These changes have the culminative impact of narrowing the divide between the costs of maintaining the current standard dual fuel approach and the cost of using exclusively electricity, though the increased efficiency of heat pumps has not yet provided savings sufficient to deliver overall operational cost reductions.

6.3 Key Takeaways from our analysis

Sections 4 and 5 set out our analytical methodology, baseline scenario (status quo) and results, with the following notable conclusions derived:

- Under the status quo scenario, there is still little-to-no commercial viability for electrification, indicating that further reform is required. However, for the limited number of companies eligible for the British Industry Supercharger which exempts some consumption from levies and network charges, the most efficient high-temperature heat pumps may offer operational costs in the same range as gas heating
    - This disregards the capital costs of implementing an electrified heat solution, which could be considerable, as well as the cost of any operational changes required
- The impact of the macroscopic volatility has caused major disruption over the last two years, making the current business environment highly challenging. This has left many business consumers in a position

where they are unable or unwilling to make substantial long-term investment per se, and (in the context of this debate) investment required to electrify, even if it presented a short-term operational cost saving

- Rebalancing of policy levies away from electricity bills has the potential to provide operational commercial viability for electrification, compared to the natural gas counterfactual. However, this would require re-allocation of at least 50% of levies from electricity to gas retail bills, or full removal of levies from the electricity bill without allocation to gas bills
  - It is important to note that the economic viability of this option is due to the increased costs of gas consumption. This leaves consumers unable to move to electricity-only operation with an annual bill notably greater than the current status quo
  - This is also dependent on the EII exemptions for policy costs not applying to delivered gas costs, as that would significantly reduce the impact of re-allocation and therefore not impact the commercial case for switching fuels
- Continuation of technological development of heat pumps, particularly in terms of output efficiency of heat pump technology, is crucial to improving the commercial viability of electrification

6.4 Next steps

Incentivising the electrification of heat	Enabling electrification of heat	Disincentivising the consumption of gas
Direct capital support for heat electrification via payments or tax breaks	Technological improvements to heat pumps	Expanding the UK ETS to smaller users
Rebalancing policy levies off electricity or creating new levy exemptions	Changes to network connection processes	Rebalancing policy levies onto gas
CCAs and reducing electricity CCLs		Increasing gas CCLs
Heat electrification CfD		

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