RESEARCH NOTE

By Jack Richardson

Summary

The UK needs a secure supply of low carbon hydrogen. It will improve energy security by storing intermittent renewable energy and reducing the need for imported gas. It can make British industry more competitive by removing pollution costs through decarbonisation and helping them to access markets that are placing a premium on greenness. And it can create new jobs in deindustrialised parts of the country that have nascent hydrogen clusters, like Teesside and Humberside.

The Government understands the value of hydrogen and has set a target of 10 gigawatts (GW) of low carbon hydrogen production by 2030. The early hydrogen industry will be supported through the UK's new hydrogen production business model, which will provide revenue support to hydrogen producers to overcome the cost gap between low carbon hydrogen and high carbon fuels. The hydrogen industry will need £3.5 billion in support per year from 2030, based on government illustrative figures for strike prices.

The current route to raising the necessary revenue is through a new hydrogen levy that the Energy Bill provides powers to the government to establish. If the levy is placed on domestic and commercial gas bills in line with the Government's policy of rebalancing policy costs, we estimate the levy would raise bills by around £118 by 2030, a 10% rise for dual fuel bills.

The Treasury is attempting to avoid the direct costs of supporting a hydrogen industry. This is understandable in a tight fiscal environment. But placing another green levy on consumers is unfair when the majority of domestic households and businesses will not likely benefit from hydrogen directly. Applying a flat rate across energy consumers, regardless of their financial means, is the wrong way to raise the required capital. It risks undermining the public's support for hydrogen and net zero more widely. Onward's polling found that 43% of the general public would not be willing to pay a hydrogen levy on their energy bills; a quarter of people would pay up to £10 whereafter support falls sharply.

Asking Members of Parliament to vote for bill rises during the current cost of living crisis endangers political support for hydrogen. Labour has already defeated the Government in the House of Lords, securing an amendment that shifts the hydrogen levy from household bills to the Treasury and gas companies. There have been reports of brewing rebellions in the House of Commons over this amendment during the passage of the Energy Bill. Even if the economic case for the levy stacks up, the political and moral case is weak.

There is an alternative. By implementing a carbon border adjustment mechanism (CBAM), the Government can phase out free allowances for carbon pricing under the UK Emissions Trading System (ETS) from 2026. Onward modelling shows that, in a range of different scenarios, the additional revenue from phasing out free allowances raises more than enough to pay for the 10GW – or at least reduces the size of the financial burden so as to render a levy unnecessary. The savings from phasing out free allowances have not been baked into Treasury forecasts, meaning they can be utilised without increasing borrowing. This option was by far the most popular method of funding from our polling (44% support), decisively beating a new levy (12% support).

To reduce the burden as much as possible, the Government needs to ensure the investment environment is conducive to lowering strike prices. This means more generous capital allowances for the infrastructure that is needed to reach our energy security and net zero targets, such as wind and solar farms, electrolysers, and power transmission lines. And it means permitting the blending of hydrogen into the gas network to support the development of the market while ensuring selling hydrogen to the grid really is a last resort for producers.

The Government is right to set ambitious targets for hydrogen. But they cannot put the costs on bill payers. Funding the hydrogen levy through revenues raised by phasing out free allowances from the ETS typifies the approach needed to reach the UK's net zero targets – fair, practical, and strategic.

What is hydrogen?

Hydrogen is a carbon and methane-free gas. It is currently used for applications like fertiliser production and oil refining. It is seen as a viable, cleaner replacement for some applications of fossil gas like heat and industrial processes despite its lower energy density.

It is the most abundant element in the universe, but it is not found naturally like natural gas. It needs to be produced, which is where hydrogen "colours" come in. Almost all hydrogen that is currently consumed is grey hydrogen. This is produced through a process called steam methane reforming, where methane is heated with steam to produce a mixture of carbon monoxide and hydrogen. Blue hydrogen is the same process, but with the carbon captured and buried using carbon capture and storage (CCS) technology, making it low-carbon.

Green hydrogen, also known as zero carbon or electrolytic hydrogen, is where an electric current is passed through water to separate hydrogen from oxygen (the "H_2" from the "O"). It is zero carbon if the electricity used in the process is from a renewable source or a nuclear power station.

The future role of hydrogen in a net zero economy is not yet clear. Hydrogen is different to fossil gas and might not always be a suitable replacement: it takes up more space and would require upgrades to the pipelines that carry gas up and down the country to make sure it does not leak.[1]

The CCS and hydrogen sectors both have a long way to maturity. The Government has a target for the UK to have 10 gigawatts (GW) of low carbon hydrogen production capacity by 2030, which in gigawatt hours (GWh) terms would be around 6.7% of today's energy mix. At least 5GW will be green hydrogen.

The Government announced the first round of projects and plans to have 1GW of blue and green hydrogen in operation or in construction by the end 2025 (2GW total). The Energy Bill legislates for financial support mechanisms and regulatory frameworks for these new industries, including the hydrogen levy, regulatory frameworks, and business models.

Developing a hydrogen industry and the hydrogen levy

Why does the UK need hydrogen?

Hydrogen has several benefits that mean it will be an important part of the future economy and the route to decarbonisation:

- Hydrogen can boost our energy system's resilience and lower the structural costs imposed by intermittency. Rather than paying wind and solar farms to switch off, which raises retail energy bills, green hydrogen electrolysers can maximise the value of abundant but intermittent renewable resources by providing long term storage for renewable energy. This would lower curtailment costs, cutting household energy bills.

- Hydrogen is important for energy security. The electrification of heat and transport, powered by British clean energy, is the most cost-efficient way to make the UK more energy independent. But hydrogen will provide a domestic gas resource, displacing foreign fossil fuel gas imports alongside electrification, especially as the "super-mature" North Sea basin dries up.[2]

- A domestic hydrogen industry will boost economic growth. In the Net Zero Growth Plan, the Government estimates its 2030 hydrogen target will leverage "up to £10 billion of private investment and support 12,000 jobs".[3] These jobs will be mostly in our industrial clusters, where demand for hydrogen will be high. Teesside, Humberside, Manchester, Liverpool, Grangemouth, and Aberdeen are industrial clusters which will benefit from the development of a hydrogen industry.

- The Climate Change Committee's (CCC) CEO, Chris Stark, said hydrogen is "crucial" to reaching net zero.[4] It can be used to cut carbon and methane in processes where electrification is not suitable: oil refining, fertiliser production, some energy intensive manufacturing, etc. It could also potentially decarbonise some gas-fired power stations and provide heat for domestic consumption.[5]

How much hydrogen does the UK need?

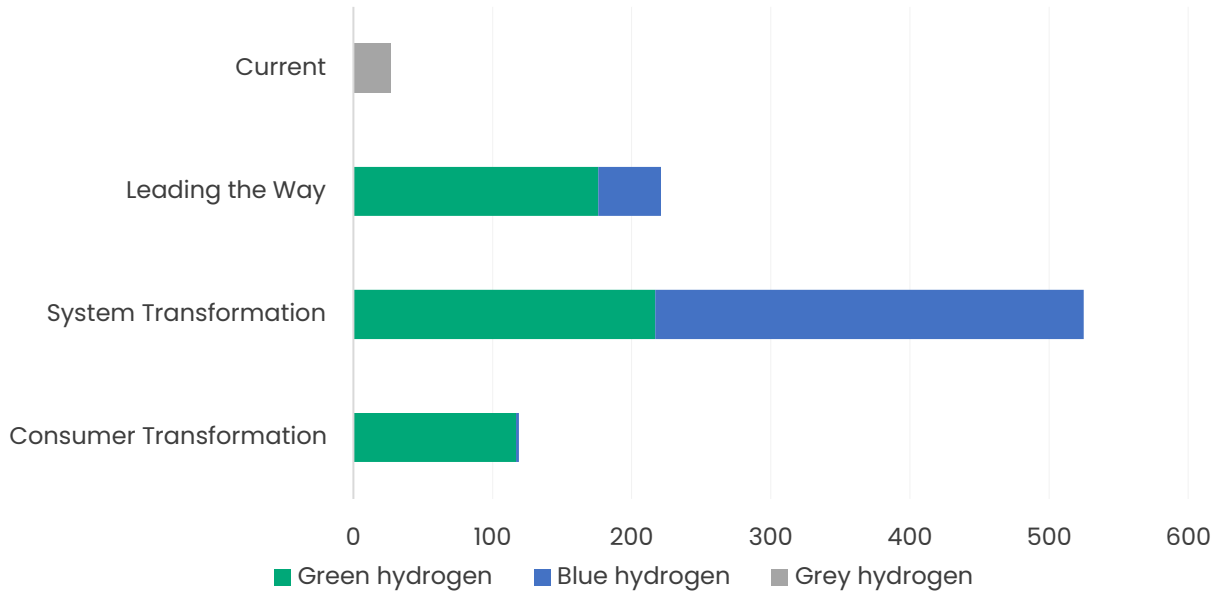
How much hydrogen the UK will need in 2050 is disputed. The Government estimates between 250 and 460TWh of hydrogen could be needed, delivering 20–35% of final energy consumption in the agriculture, industry, residential, services and transport sectors.[6] The UK already uses around 27TWh of hydrogen every year, around 1.35% of the total global hydrogen supply. But it is entirely grey, carbon-intensive hydrogen, so it will need replacing.[7]

The CCC's balanced net zero pathway has up to 90TWh of low carbon hydrogen production being required per year by 2035, nearly a third of the size of the whole power sector in 2020.[8] But in its 'niche hydrogen scenario' from its 2018 *Hydrogen in a Low-carbon Economy* report, which sees hydrogen playing a minimal role, only 13TWh is required by 2030 (less than we use now), and 81TWh by 2050 (which, as discussed below, is approximately what the Government hopes to produce annually from 2030), spread across HGVs, the power sector, and industry.[9]

In the National Grid ESO's *Future Energy Scenarios* 2022, which outlines a range of different ways to decarbonise our energy system for net zero by 2050, hydrogen plays an important role in the UK's energy system by 2050 in all net zero-compliant scenarios. In 'Consumer Transformation', which places a heavy emphasis on electrification, 113TWh of hydrogen is required. In 'System Transformation', which relies more on hydrogen to decarbonise domestic heat especially, 489TWh is required, and in 'Leading the Way' it is 263TWh.

Figure 1: Annual requirement for hydrogen (TWh) in 2050, under different scenarios

Source: National Grid ESO Future Energy Scenarios, 2022



In the 2021 Hydrogen Strategy, the Government announced the "stretching but deliverable" target of 5GW hydrogen production capacity by 2030, which it expected to provide up to 42TWh of low carbon hydrogen for use across the economy per year, based on a load factor of 95%.[10] The Government is basing the 95% figure on the expected number of hours the production facilities are available to operate rather than capacity.[11] The target was then doubled to 10GW in the energy security strategy following the February 2022 Russian invasion of Ukraine,[12] which the Government will expect to yield over 80TWh of hydrogen.

Despite this variance, it is safe to assume that the UK will need a secure supply of hydrogen to reach net zero. How much exactly is unclear, which could pose questions about whether the 10GW target is wholly necessary or if it risks wasting money. It is unlikely that the UK will be able to produce hydrogen at a lower cost than some Middle Eastern countries, for example, which will be unbeatable in terms of cheap solar power that could be used for hydrogen production. But it might prove difficult to import later because the UK's neighbours will seek to meet their own needs first, while shipping hydrogen could be much more difficult and costly than shipping liquefied natural gas.[13]

Hydrogen is unlikely to be an area where the UK can compete internationally. But it will still be an important strategic resource that requires domestic production for resilience in a similar vein to primary steel production. It will also be particularly important for regional industrial clusters and the North Sea energy sector, which hundreds of thousands rely on for their livelihoods.

The Government has set a target: 10GW by 2030. The question now is how to reach it.

What will supporting an early hydrogen economy cost, and how will the Government pay for it?

Projecting the overall cost of the 10GW by 2030 target is tricky and contingent on volatile gas prices. But a guiding figure can be reached by making a series of evidenced assumptions.

First, there is an assumed an average strike price of £100/MWh for both blue and green hydrogen,[14] based on an illustrative figure from the Department for Business, Energy and Industrial Strategy in November 2022.[15] The real strike prices will be different for green and blue hydrogen, which could be higher or lower than £100/MWh. They will fall or rise with the price of electricity with the successful rollout of renewables and electricity market reform for green hydrogen, the price of gas for blue, and the cost of capital for both. They may also follow the same pattern we have seen with other climate technologies of rapid cost falls as knowledge improves and efficiency gains are made. But £100/MWh is a workable estimate.

The second variable is the selling price for the hydrogen. A selling price is hard to predict far in the future. The wholesale gas price could rise again as the share of liquefied natural gas (LNG), which has inherently higher costs, rises in the British energy system as the North Sea basin continues to decline. But if the Government is successful in electrifying heat, gas prices could go down as more supply is available. Our model assumes a selling price of £55/MWh based on a gas selling price of around £35/MWh and a premium of £20/MWh that companies would pay to avoid larger costs imposed by carbon pricing through the UK Emissions Trading System.

The £45/MWh gap between these two variables is what the financial support from the Government will be paying for. This would total £53 billion over a 20-year period, assuming the contracts for the hydrogen business models are 15-year contracts (as Contracts for Difference in the renewables sector are) and the first projects start producing in 2025.

The costs would not fall flat across the two decades. Following the first 2GW coming online in 2025, the amount needed per year will rise from just over £700 million to around £3.5 billion per year will be required from 2030, until costs begin to fall again as the first contracts end.[16]

This is likely a top-end estimate, but we have used an illustrative figure from the Government. If the strike prices turn out to be lower (which there is no way of knowing until the first auction), then the amount of revenue required will also be lower. If there was an average £80MW/h strike price and the same £55MW/h selling price, the Government would only need to raise just under £2 billion per year from 2030.

Figure 2: Differences in the revenue required due to different illustrative strike prices

Source: Onward analysis

We have not taken S-curves into account because they are difficult to predict.[17] If the success we have seen in the renewables industry can be replicated, they will fall over time as knowledge and efficiency improves. Offshore wind strike prices fell by over two thirds over just four auctions, from £120/MWh to £37/MWh.[18] But given we do not know where the first strike prices will land, we can only proceed on the basis of the Government's illustrative figures.

The hydrogen levy

In the short term, the £240 million Net Zero Hydrogen Fund (NHZF) is providing capital support for the early commercial deployment of hydrogen production projects. A total of 15 have been successful in the first round of funding.[19] The NHZF is funded by the Exchequer alongside the £1 billion carbon capture and storage Infrastructure Fund (CIF). At the 2023 Spring Budget, the Chancellor announced £20 billion in funding for early deployment of CCS, although it was not clear exactly how this commitment will be funded.

As mentioned above, the annual financial cost of supporting CCS and hydrogen will rise as more projects come online. Beyond the deployment of initial projects, the Government will support the deployment of hydrogen production through the Industrial Decarbonisation and Hydrogen Revenue Support Scheme (IDHRS).[20] The IDHRS will support hydrogen production, transportation, and storage and the CCS technology required for blue hydrogen and industrial decarbonisation through the Government's new hydrogen business models.[21]

The business models will provide revenue support to hydrogen producers to overcome the operating cost gap between low carbon hydrogen (represented by the strike price) and the selling price of gas.[22]

But rather than Exchequer funding, the Energy Bill provides powers to create a hydrogen levy administrator, which would raise money for the IDHRS through a "hydrogen levy" from "relevant market participants". In the original legislation, under subsection (8) of the first chapter of Part 2 of the Bill would be gas suppliers, electricity suppliers, and gas shippers.[23] This means funding the IDHRS would come from a new energy bill levy: suppliers would pass the costs onto consumers.[24] The expected start date is "2025 at the latest" according to the Government's factsheet on the hydrogen business models for the House of Commons stages of the Energy Bill.[25]

The Treasury has not stated why it will not pay for the IDHRS itself through general taxation. Given the overall costs are certain to run into the tens of billions overall, it could be that the Treasury sees it as a risk to the fiscal rules. The levy may have been the best option for the then-Department for Business, Energy and Industrial Strategy way to secure the necessary financial support as part of cross-Whitehall negotiations. This is not the first time the Treasury has chosen this method of raising revenue to support the development of industries: it took the same approach with the renewable energy sector. But, crucially, while renewables have and will directly result in cheaper household energy bills - hydrogen will not.

So how much would a hydrogen levy add to energy bills? This depends on factors beyond the strike and selling prices. Government policy will influence the price, including:

- Whether the Government decides to place the levy on all energy consumers or just on gas bills.
- If the Government is successful in incentivising more households to switch to electric heating, there will be fewer people paying gas bills to pay the levy, meaning a higher levy for carbon-intensive bill-payers.
- If the Government does not apply the hydrogen levy to industrial users, as it is doing with the British Industry Supercharger, it would mean higher costs placed on households and businesses.

We assume:

- The hydrogen levy is applied across households, businesses, and industry.
- The levy is applied across both gas and electricity suppliers for households, as per the original wording of the Energy Bill and to avoid placing unbearable costs on a shrinking number of dual fuel households.
- It is applied to industrial gas bills to avoid electricity prices rising, which would disincentivise electrification.
- The Government achieves its ambition of a 15% reduction in national energy use by 2030. Progress is also made in the electrification of heat. Domestic and commercial gas use is 284TWh, down from 411TWh in 2021. The industrial sector consumes 165TWh of gas, down from 195TWh in 2021.

Applying these assumptions to the amount of gas used in 2021[26], we that domestic and commercial gas use is 284 TWh in 2030, down from 411 TWh. The industrial sector consumes 165 TWh of gas, down from 195 TWh in 2021.

Our calculations used the Government's illustrative figures for hydrogen strike prices of £100/MWh and assumed a gas selling price of £55/MWh, creating a 'cost gap' of £45/MWh. Assuming a 7.9 TWh output per gigawatt of hydrogen production, this would mean £355 million is required every year to support 1GW of hydrogen production.[27]

We have assumed the hydrogen business model contracts will last 15 years. £354,780,000 per year to support a gigawatt of production, spread over a 15-year contract, would equal £5.3 billion. For 10GW, this would mean approximately £53 billion is required. The revenue required per year rises and falls as 15-year contracts for hydrogen producers start from 2025 to 2030. From 2030, £3.5 billion is required per year.

We also projected future gas use in 2030 using existing government policy. It assumes the domestic, commercial and industrial sectors use 449 TWh of gas combined. This provides 449,300,000 "levy units", which each cost £7.90 to pay for the required £53 billion.

Table 1: Assumptions made in calculating the cost of the hydrogen levy on energy bills
Source: Onward analysis

Assumption	Figure
Financial support required for 10GW of hydrogen overall	£53 billion
Financial support required for 10GW of hydrogen production per year from 2030	£3.5 billion
Gas demand from households, businesses and industrial users in 2030	449 TWh
Total levy units (1 MWh) to support 15 year contracts based on gas demand	449 million
Levy unit cost	£7.90/MWh
Average domestic energy consumption (gas and electricity)	14,900 KWh

For the average household, the hydrogen levy would rise from £47 in 2025 to £118 in 2030. This would be a 10% rise for dual fuel bill payers. Assuming existing policy costs decline in line with projections from the Office for Budget Responsibility, households would still be paying over £250 in green levies per year. [28]

The problems with the hydrogen levy

The ambition from the Government on hydrogen is welcome. And there is an underlying logic to the Treasury's desired approach of funding it through a levy. But the hydrogen levy is the wrong option. This section sets the three key reasons why - it will raise retail energy prices, it exacerbates fuel poverty, and it will undermine political support for hydrogen and decarbonisation more widely.

The hydrogen levy would raise energy prices and limit economic growth

Secure access to reliable and affordable energy is a necessary ingredient for sustainable economic growth. Economic growth is vital for improving our standard of living and funding public services, as well as supporting progress towards net zero by enabling investment in technological innovation, the transition to clean energy, and other climate change solutions.

In the foreword for *Powering Up Britain*, the Energy Secretary said the Government's aim is to have the cheapest wholesale energy prices in Europe by 2035.[29] In his first interview in his new position with *The Times*, Grant Shapps said "the most successful economies in the world are the ones that have cheap energy prices."[30]

Government policy technically focusses on wholesale energy prices, which it expects to fall as more cheap renewable energy is deployed. But this has been lost in messaging and simplified to the cheapest energy prices. Retail energy prices, the prices we all actually pay, include elements such as the standing charge, policy costs, and network charges.

With the implementation of a hydrogen levy, which could cost around £3.5 billion per year from 2030, the Government is raising energy prices, making it more difficult to achieve its own goals of the cheapest energy prices in Europe and growing the economy. It will be opting to push up household, business, and possibly industrial bills, making it harder to save, spend money elsewhere, invest, or run a business.

There are some necessary rises in parts of our energy bills on the way already. It is impossible to avoid network costs rising in the medium term as we build more grid infrastructure to electrify the economy. This is a necessary investment to shield the UK from volatile fossil fuel markets and move to a more efficient, clean, secure energy system.

But it is more difficult to communicate the benefit that hydrogen will bring to households. The development of green hydrogen could lower balancing costs, which feed through to final energy bills as lower network costs, by providing a long-term storage solution. But households would mostly be paying for the decarbonisation of energy intensive industries where the need for hydrogen is greatest.

If the Government took the strategic decision to encourage hydrogen for domestic heat in 2026, a hydrogen levy might be more justifiable for households. But in that scenario. most bill payers would pay substantially more for their energy than if they switched to a heat pump instead. Renewable energy is rapidly pushing down the wholesale price of electricity, whereas the wholesale price of gas

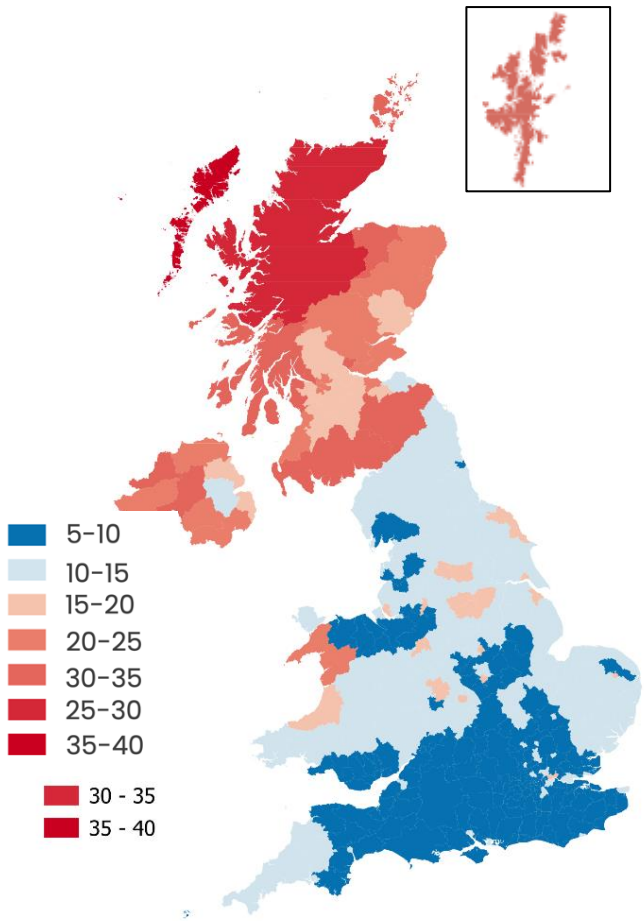
would be pushed up dramatically as more hydrogen entered the gas network. It would remain the permanently higher option: using hydrogen for heat is less efficient than electrification.

Unless the hydrogen levy was included in the new British Industry Supercharger,[31] which takes policy costs and potentially network costs off industrial energy bills and socialises them across residential energy bills, it would also push up costs for industry. We have not assumed this in our model, but it would be an option to ease the financial burden on households from the levy. Despite making much better use of the hydrogen on a sector-wide basis to drive decarbonisation compared to the domestic heating sector, it would be unfair for companies that do not need hydrogen who would be subsidising their competitors.

The hydrogen levy is regressive and will make fuel poverty worse

As the levy would be a flat rate, less well-off households will have to pay the same rate as their more financially fortunate neighbours. A household is fuel poor if it needs to spend more than 10% of its income to keep warm.[32] Artificially raising energy prices by applying levies would push more people into fuel poverty, hindering the Government's efforts to tackle the issue.

Figure 3: Proportion of households (%) in fuel poverty in the UK
Source: Sub-regional fuel poverty by Local Authority (England), Scottish House Condition Survey, Local Authority Analysis 2017-2019 (Scotland), Welsh Housing Conditions Survey 2017-18 (Wales), Housing Condition Survey 2016 (Northern Ireland)



And because wealthier households are more likely to be more energy efficient,

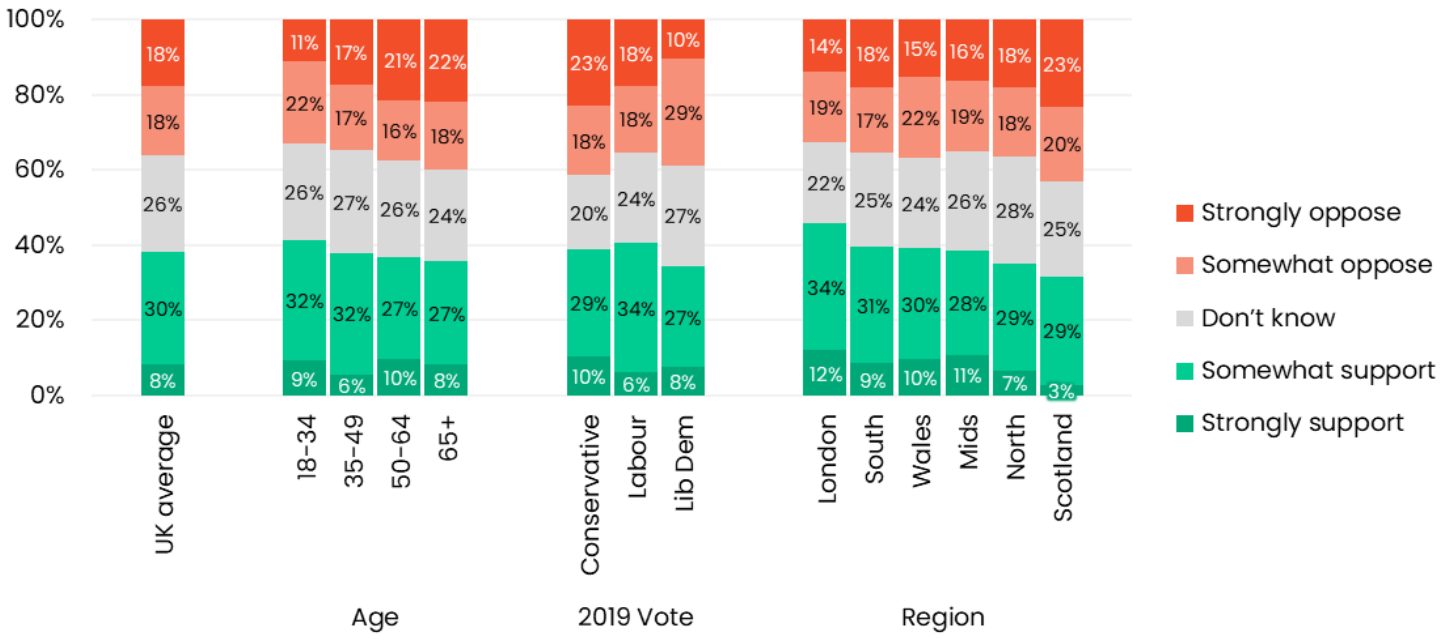
they are more likely to be able to adopt alternative technologies to reduce their reliance on gas (hydrogen or fossil gas) altogether. If the Government's policy of rebalancing energy bill levies to gas to encourage electrification at the end of 2024 applies to the hydrogen levy as well, a shrinking number of gas customers would be paying more and more, as reflected in our calculations.[33]

By raising energy bills through the hydrogen levy, the Government would likely come under political pressure to commit more taxpayer resources to support those households, businesses, and industries which lose out financially to its decision to regressively fund energy policy initiatives. This would be an inefficient use of taxpayer resources.

The political backlash risks support for hydrogen and the broader net zero agenda

As well as being counterproductive to wider energy policy, the regressive nature of the hydrogen levy risks undermining political support for the development of a domestic hydrogen economy. Our polling found that 38% of people support a levy to help develop the hydrogen industry in principle, following an explanation of how hydrogen could be used to improve energy security, reindustrialise, and fight climate change (vs 36% who were opposed).

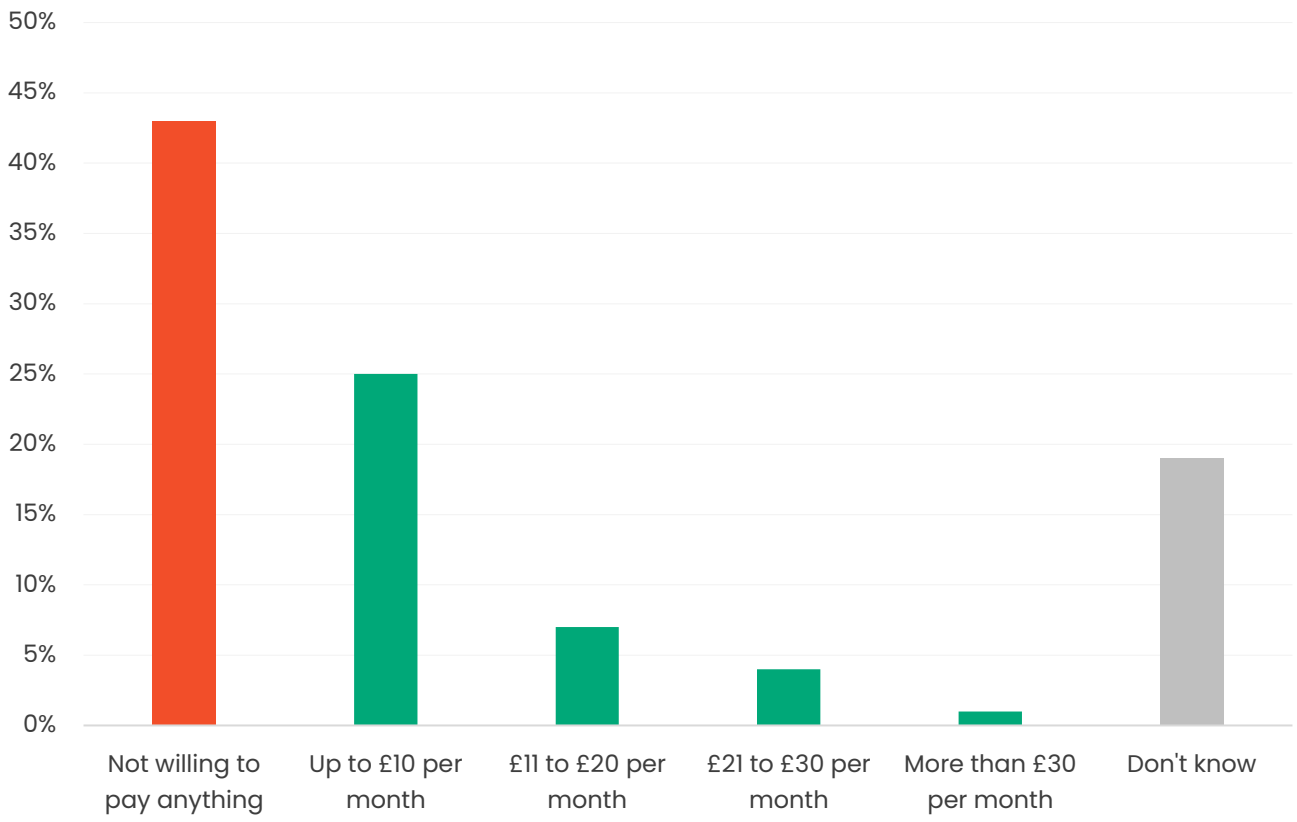
Figure 4: Public support for a hydrogen levy in principle
Source: Opinium polling for Onward in April 2023 (see annex of this research note)



But 43% of people would not be willing to pay anything extra on their bills to support hydrogen. 25% of people would be willing to pay up to £10 per month, whereafter support falls off rapidly.

Figure 5: Public support for a hydrogen levy in practice

Source: Opinium polling for Onward in April 2023 (see annex of this research note)



If voters feel that costs for new green technologies are being spread unfairly, it could cause a political backlash. Without the strong public support for action on the environment that the UK has enjoyed for several years now, there will not be sufficient political support for the investment and policy required to achieve net zero. When touching on the hydrogen levy in the second reading of the Energy Bill, Conservative MP Alec Shelbrooke said: "we have to take the public with us on this. We cannot keep adding to people's bills to try to make things work".[34]

Figure 6: What do the public primarily blame for rising energy bills?

Source: Opinium polling for Onward in April 2023 (see annex of this research note)

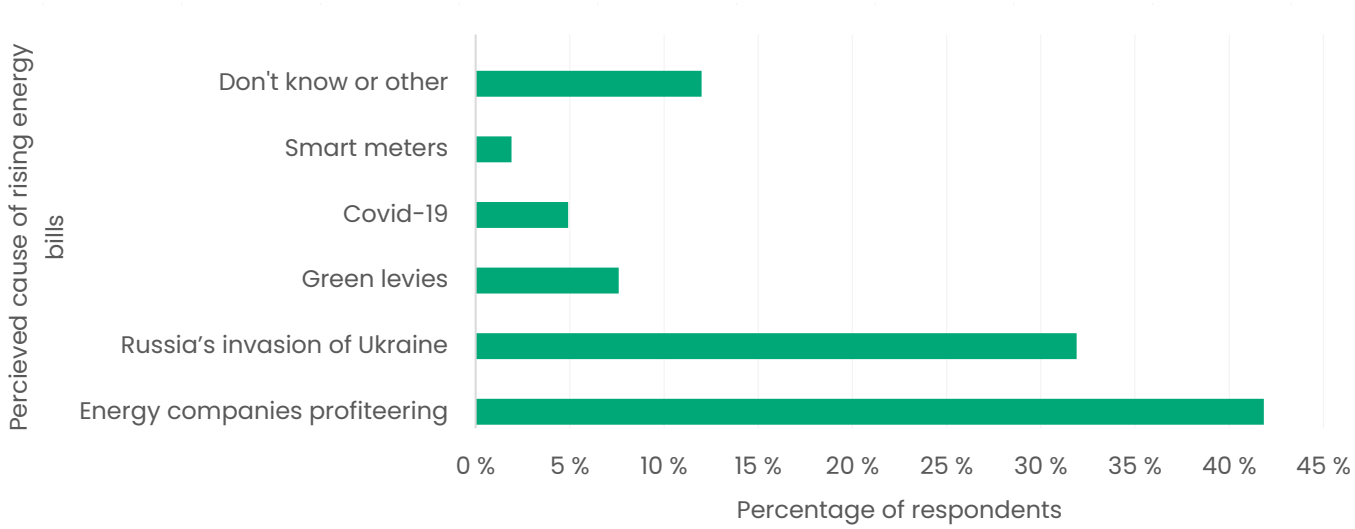
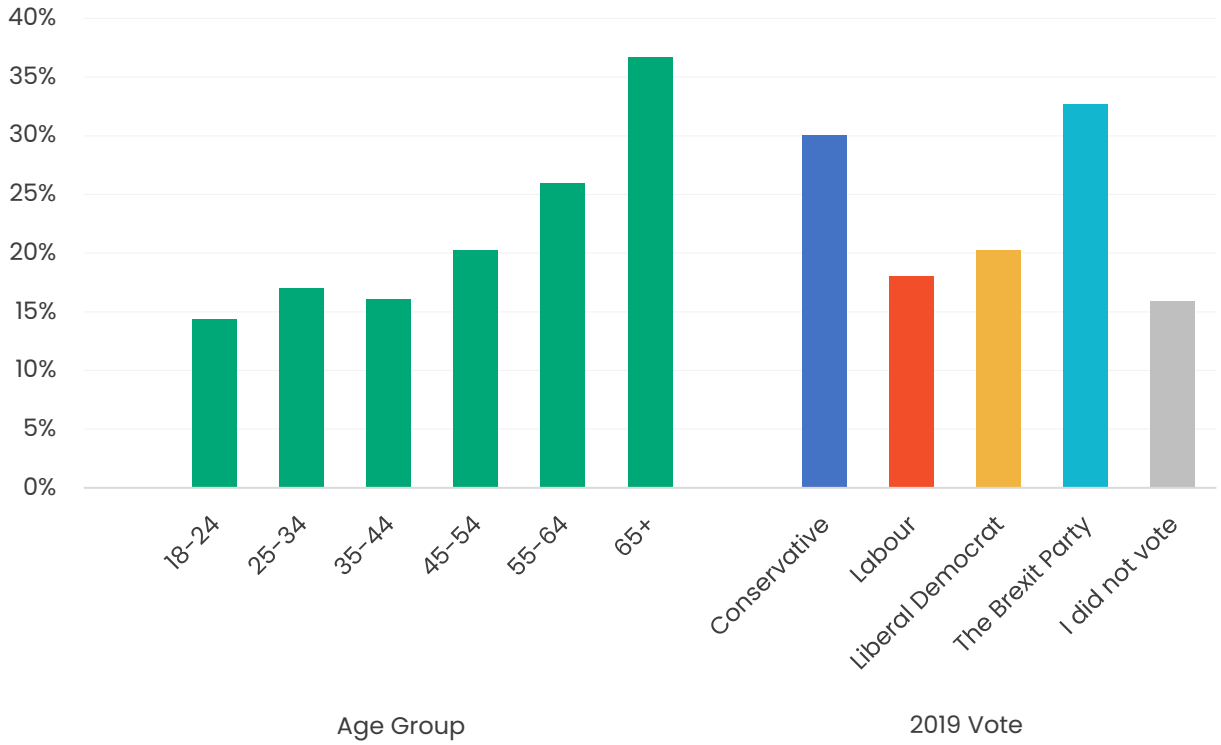


Figure 7: Proportion of people who selected "Reducing the environmental levies on energy bills, sometimes called 'green taxes'" as a way of reducing the cost of living (February and April 2022)

Source: Taking the Temperature, Onward, April 2022



The term 'green levies' refers to the environmental and social levies that are currently predominately placed on electricity bills. They are generally fixed costs, so they do not rise and fall with the overall bill as VAT does. They raise money for various Government policies that energy supplier companies have to implement, such as the Renewables Obligation and the Energy Company Obligation. Green levies cost around £153 per household in 2022.[35]

People do not in general blame the green levies for the rise in energy bills. Polling conducted for this research note found that only 8% of respondents felt they were the main cause of the rise since late 2021. They are more likely to blame energy companies profiteering (42%) and the Russian war in Ukraine (32%).

But, during 2022 when we saw a spike in energy bills caused by the rise in the wholesale price of fossil gas, there were calls for green levies to be scrapped by Conservative MPs. Sir Ian Duncan Smith said, "we have to suspend those levies so for the next 12 months or so the public will find that the cost no longer rises". [36] During the 2022 summer Tory leadership contest, Liz Truss, Penny Mordaunt, and Kemi Badenoch all committed to suspending green levies.[37] Reform UK, whose leader said he wanted to make net zero "the new Brexit", has likewise made green levies a focus of their campaigning.[38]

In Onward's *Taking the Temperature* report, which was published in April 2022 as energy prices were rising, high costs were found to be the key reason for resistance to 'green' policies like supporting a low carbon hydrogen industry: over a third (38%) of voters agreed that "going green is too expensive" compared to 29% who disagree.[39] There was support among important political constituencies to cut green levies, including 37% of the over-65s.[40] 'Scrapping the green levies' became a key feature of Liz Truss' election campaign in 2022[41] the levies were moved into general spending in the infamous Growth Plan, otherwise known as the "mini Budget".[42]

Certainty around political support for net zero from the Government, and therefore financial support, is critical for green investment in the UK. But it could be undermined by a political fight over the hydrogen levy. Increasing risk means a higher cost of capital, which would feed through to higher strike prices and therefore mean the hydrogen industry will need more support.

Due to its regressive nature, the levy has attracted criticism from both political left and right.[43] The Labour party supports the development of a hydrogen economy,[44] but it defeated the Government in the House of Lords over an amendment about who pays the hydrogen levy in March.[45] Labour peers removed the ability of the new hydrogen levy administrator to levy funds from gas and electricity suppliers, which are the companies that sell energy to domestic consumers.

In the second reading of the Energy Bill in the House of Commons, it was a key criticism of the Government. Ed Miliband, the Shadow Energy Secretary, noted, "putting the cost of hydrogen on consumer bills, as the legislation originally proposed, is not the right way forward… We cannot just add levy after levy because the Treasury says, 'We don't want to invest.'"[46]

Under Labour's amendment, the hydrogen administrator would be able to raise funds from gas shippers and the Consolidated Fund (the Government's current account). Gas shippers buy and sell gas and arrange for the transportation of gas through the transmission and distribution pipeline networks owned by companies like National Gas or SGN.

By placing the costs wholly onto gas shippers, we would still see a rise in retail energy prices, although the costs might technically count as "network costs" rather than "policy costs". This would still be fundamentally regressive. But by removing the suppliers and adding in the Consolidated Fund, Labour has provided the option for revenues to be taken from the Exchequer.

Without Treasury backing, the Government is likely to amend the Energy Bill again to place the costs back onto suppliers and take away the option of using the Consolidated Fund. Here, the Labour Party has created a political trap. Labour will be able to argue that during a cost of living crisis caused in large part by rising energy costs, Conservative MPs are voting to raise energy bills to pay for something that consumers will not even benefit from.

Potentially even more politically toxic would be an argument that households are subsidising the oil and gas industry. Oil and gas companies are investing their much-needed capital and expertise into the hydrogen and CCS industries. BP's H2 Teesside project alone will bring 10% of the Government's 10GW online by 2030 as well as fresh jobs and investment.[47] But this would come at a time of record profits by oil and gas companies: our polling found that the public primarily blames profiteering for the rise in their energy bills (42%), even more than the war in Ukraine (32%).

In the present tight fiscal environment, it is understandable that the Treasury is reluctant to take on a new, significant and uncertain financial burden. This could mean tax hikes or spending cuts elsewhere to maintain the Treasury's fiscal rules.[48] The levy itself could, arguably, be marginal for bill payers, especially in a world where strike prices end up being low and selling prices are high.

But the threat of rebellion from the Conservative benches reported in the *Sunday Telegraph*,[49] opposition from green groups, and campaigning from the Labour party might risk political support for hydrogen within the Government. This would raise uncertainty about the future of the UK's hydrogen economy. Without a certain alternative source of funding, investors will be less confident in investing in the UK compared to other countries which are supporting directly from taxpayer funds with firm political commitment. Identifying a source of funding that satisfies the Treasury, backbenchers, and the public is key.

Recommendations: An alternative approach to the hydrogen levy

The Government will need around £3.5 billion per year to support its ambition for the UK to reach its target of 10GW of low carbon hydrogen production by 2030, with the first projects coming online from 2025.

We recommend the Government use revenue raised by phasing out free allowances in the UK Emissions Trading System (UK ETS) during the second allocation period (2026-2030). We see this as new, unforecast revenue which would not break the Treasury's fiscal rules while spending it appropriately, in line with the primary objective of an ETS: decarbonisation.

Explainer: The UK Emission Trading System (ETS)

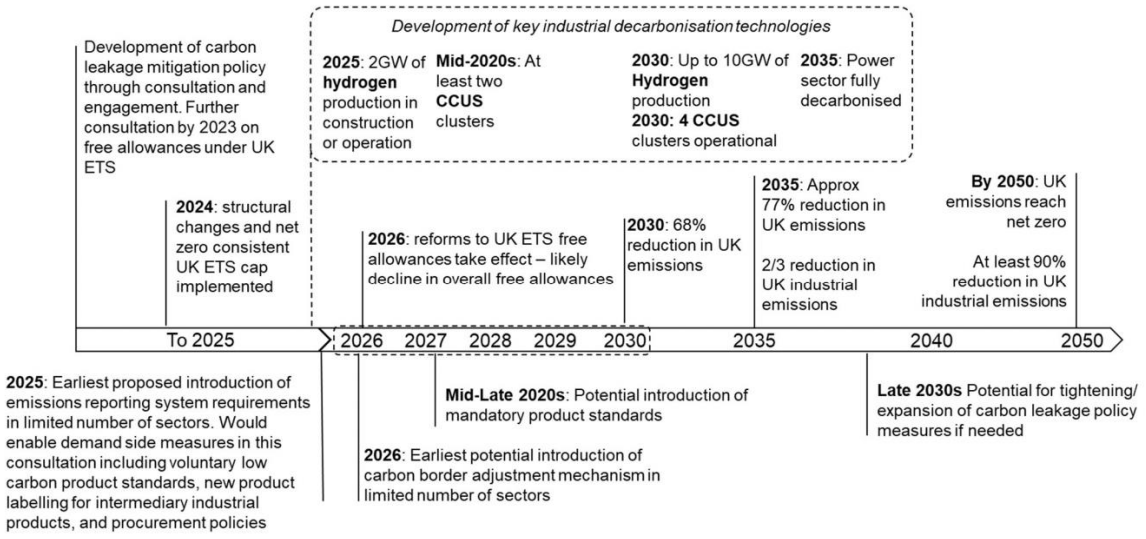
An ETS is a 'cap and trade' carbon pricing system for reducing carbon emissions. A cap on emissions is set and companies operating in the sectors covered by the ETS bid for allowances to emit carbon. It puts a price on the negative externality of carbon dioxide emissions, correcting a market failure and incentivising decarbonisation.

The UK ETS was set up after leaving the EU ETS. The Government committed to making the UK ETS aligned to net zero in terms of allowances and expanding to cover more sectors.[50] The UK ETS currently covers the power sector, domestic aviation sector, and energy intensive industries, although the Government has made it clear it wants to expand the scheme.[51]

The UK ETS Authority operates the UK ETS, but the Treasury receives the revenues, putting them into general spending. The amount of revenue raised depends on how high or low the carbon price is and the amount of permits that are auctioned.

The UK ETS Authority also offers a number of 'free allowances', where companies do not have to pay to pollute, to avoid 'carbon leakage'. Carbon leakage is where pricing in pollution leads to a company moving operations abroad to avoid paying for their pollution. The Department for Energy Security and Net Zero published a consultation on how to mitigate carbon leakage in March 2023.[52]

The option which appears most favoured by the Government, which the EU is already committed to implementing from 2026, is a carbon border adjustment mechanism (CBAM). A CBAM would place a price on the embodied emissions of products entering the UK, which would level the playing field between companies operating in countries without a carbon price and companies in the UK. This would allow for the phase-out of free allowances, which the government intends to do.[53]



Timeline from the Government's carbon leakage consultation

The Treasury already collects revenue through carbon pricing with the UK ETS. The Treasury will have received £6.5 billion in 2022 due to a tripling of the carbon price to £85, from £28 per tonne of CO_2 in 2021.[54]

Developing a hydrogen economy is a vital way for businesses that pay a carbon price under the UK ETS to cut their emissions and reduce the amount they spend on carbon allowances. This would mean the money is invested in preventing pollution.

And it would make British companies more competitive in markets that price carbon. This is particularly true for the industrial sector, which cannot rely on electrification alone for its 'deep decarbonisation'. Indeed, the 2030 low carbon hydrogen production target is illustrated in the Government's own timeline for a CBAM from its consultation, as seen in Box 1.

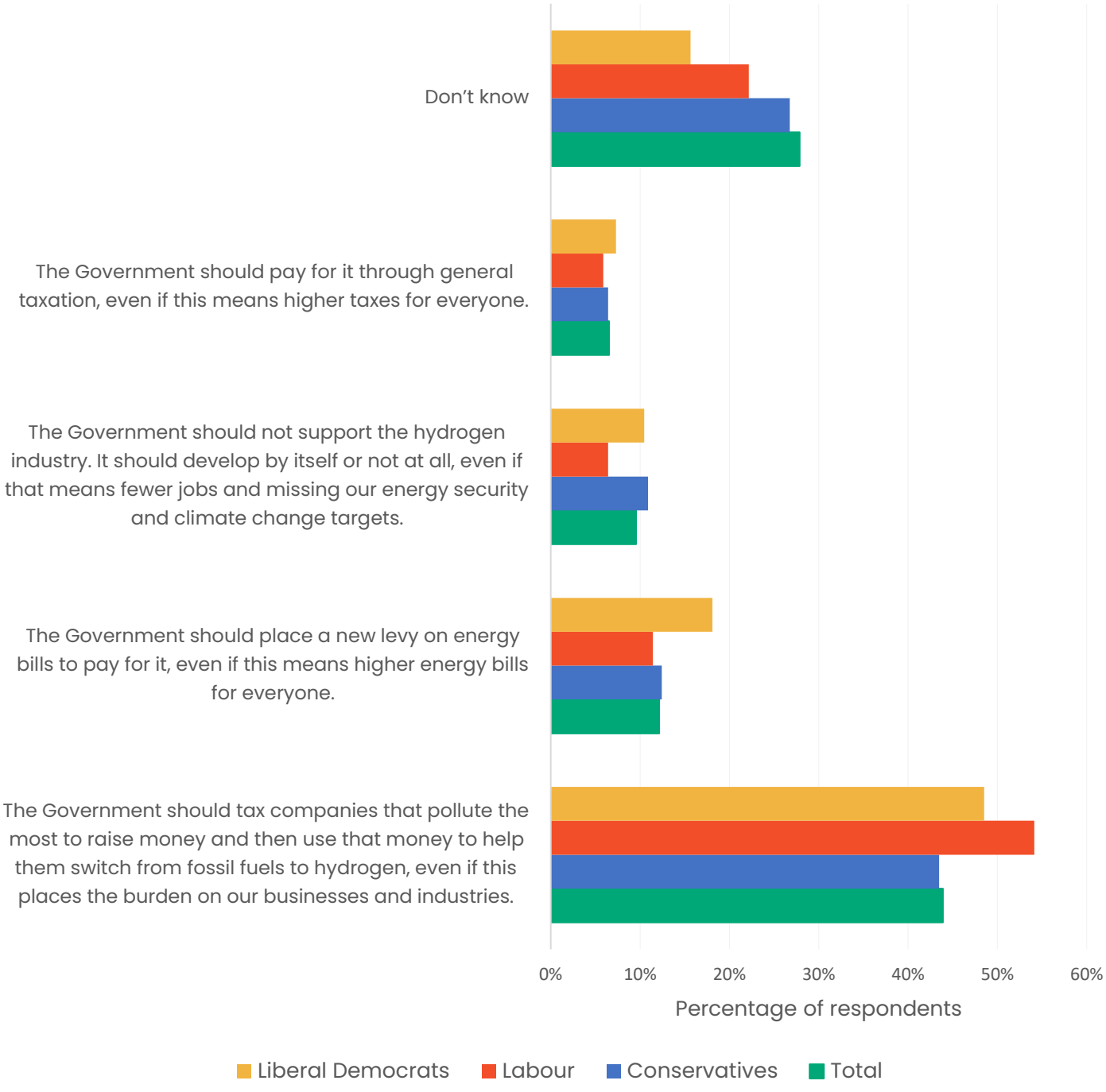
In theory, the Government could use existing ETS funds to cover the support for hydrogen. Annual revenue is set to stay above £5 billion, more than enough to cover the £3.5 billion per year figure.[55] Although hydrogen will not be the only decarbonisation method or technology that this money should be invested in: sustainable aviation fuels might also need early support for example.

Our polling also shows that this is the most favoured option by the public, with 44% of respondents agreeing it is the best way to fund the development of a new hydrogen economy, far more than support for a hydrogen levy (12%). The principle of using money raised by carbon pricing for decarbonisation also has support from the industrial sector.

The issue is that the revenue that has been already raised by the UK ETS goes into general spending (or the "Consolidated Fund") and the Treasury traditionally holds firm against any hypothecation of revenues.[56] If the Government were to shift those existing revenues into decarbonisation investment, it would have to either cut spending or raise taxes. This is likely to be resisted by the

Figure 8: Public opinion on how the Government should pay for supporting a new low-carbon hydrogen industry.

Source: Opinium polling for Onward in April 2023 (see the annex of this report)



Treasury, who are keen to maintain and project fiscal discipline – particularly in the year before a general election. UK ETS funds from the first allocation should therefore be considered unavailable.

With these points in mind, we have modelled how much revenue could be raised by phasing out free allowances in the second allocation period of the UK ETS, which begins in 2026. This is when the UK Government has said it expects to see a "likely decline in free allowances" (see Box 1).

Recommendation 1: Use revenue that would be raised from 2026 by phasing out free allowances in the UK Emissions Trading System (UK ETS) to pay for producing 10GW of hydrogen.

We have three scenarios based on the speed of the phaseout. The first is a slow phaseout of free allowances over the four-year period, with full carbon pricing by 2030. The second is a slightly faster phaseout by 2028 and the third is faster still, by 2027. Sustainable Aviation, the aviation sector trade body, is working on the assumption of a 2027 phaseout,[57] but companies in the industrial sector tend to be in greater need of public support and will probably lobby the Government for a slower phaseout. But the faster the phaseout of free allowances, the more revenue will be raised during the second allocation period of the UK ETS.

In all phaseouts, we have assumed a decarbonisation pathway in line with the Climate Change Committee's sixth carbon budget. The amount of revenue in each phaseout scenario is uncertain because it depends on future carbon prices. We have used three carbon price trajectories that were established by the UK Government and collated by the OECD (see Table 1).

Table 2: UK carbon price trajectories for 2030 and 2050

Source: OECD, UK Government [58]

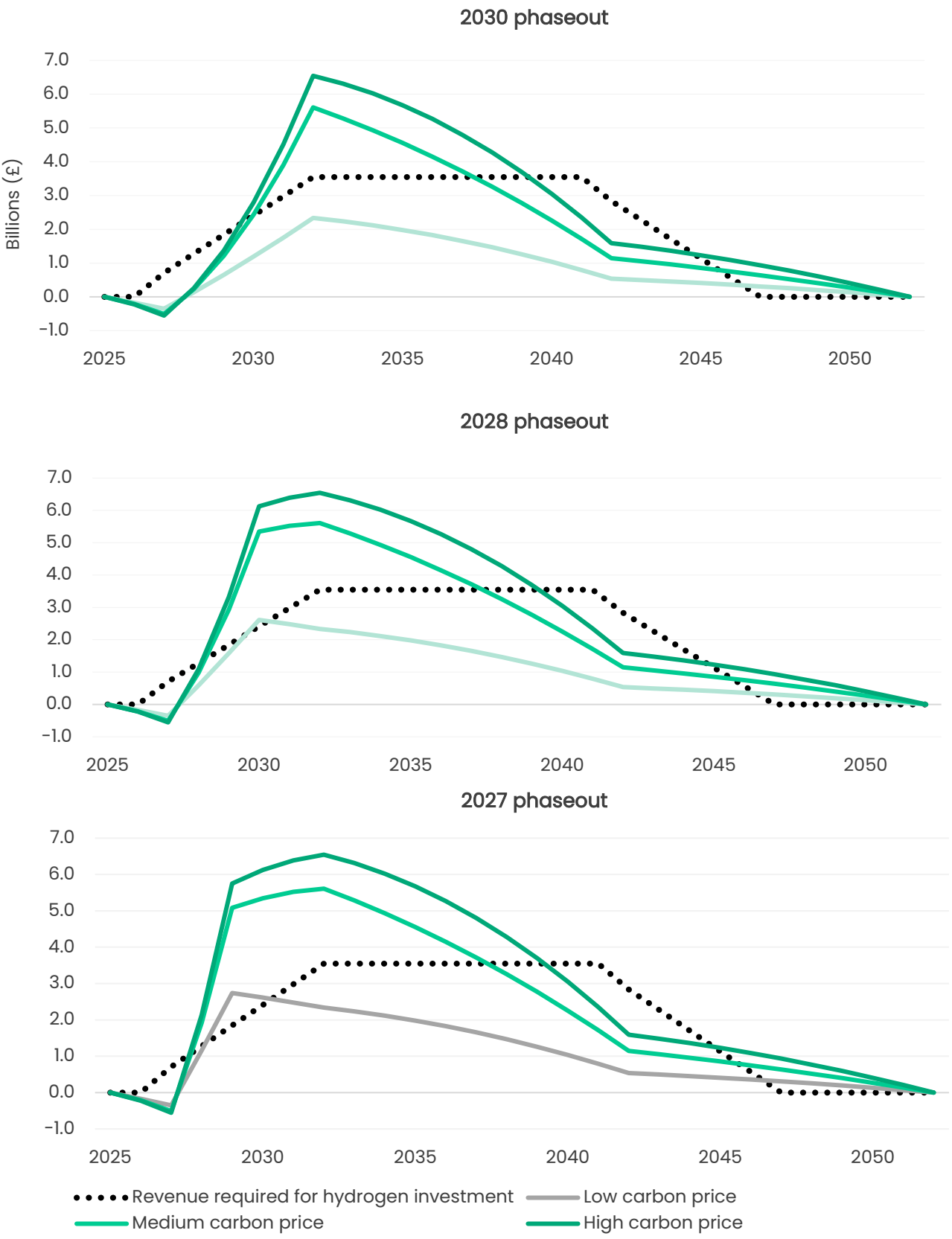
	Low	Medium	High
2030	£100/tco2	£140/tco2	£280/tco2
2050	£189/tco2	£378/tco2	£568/tco2

In all medium and high carbon price scenarios apart from one, phasing out free allowances raises enough revenue to avoid the need for a hydrogen levy over a 20-year period, with a surplus. The initial surpluses raised in the early years, before revenues begin to decline due to decarbonisation, covers the deficits in annual revenue in later years. In a medium carbon price with a 2030 phase out of allowances, a minor deficit of £1.1 billion over the whole 20 years (roughly £55 million a year if distributed evenly) means the levy could still be avoided.

In the low carbon price scenarios, the amount that is required to be raised by other means is reduced significantly. In a 'low and 2030 scenario, the overall amount required would be reduced by 43%. With a low carbon price but faster 2027 and 2028 phaseouts, it would at least be cut in half.

Figure 9: Revenue raised from phasing out free allowances under the UK ETS at different speeds

Source: Onward analysis



A low carbon price presents a tougher challenge, but it can open up other options rather than the hydrogen levy. For example, the Government could extend the UK ETS to the domestic maritime sector. This could raise an additional £1 billion per year in a low carbon price scenario by 2030. It is also worth keeping in mind that strike prices could be much lower: a £80 strike price would mean a worst-case scenario of a £6 billion deficit over 20 years, but it would crucially ensure the Treasury has time to find the additional revenue for later years when UK ETS revenues are running out.

Importantly, we have not included aviation free allowances in our modelling. The aviation industry would likely argue for those free allowances, which are allocated separately from the power and industrial sectors, to be invested into supporting sustainable aviation fuels (SAFs). This is as important to the UK's aviation decarbonisation pathway as hydrogen is for industrial decarbonisation, and supporting SAFs this way already has strong political support.[59] We also have not applied revenues which could be raised by the CBAM itself due to their uncertainty.

But what does this mean in terms of practical next steps for the Government? The consultation for carbon leakage is ongoing, and while it appears minded to implement a CBAM, which Onward and many other organisations have repeatedly called for, the Treasury would likely point out there is no final decision yet. The Government might therefore want to amend the Energy Bill again to keep the option to place the levy on energy suppliers to maintain confidence.

The Department for Energy Security and Net Zero should at least keep the option of the Consolidated Fund on the table in the legislation, even if it has to re-amend to add the option for a hydrogen levy back into the legislation. This will improve investor confidence by providing more options to raise revenues and avoid a clash with Labour and other opponents of the levy. But the Government should be clear it is exploring alternatives to avoid a levy on bills. Given the Energy Security Secretary underlined the fact that the Energy Bill does not itself implement the levy, merely takes powers to establish one,[60] this should not be a problem for the Treasury.

Keeping hydrogen strike prices low

It is critical that the Government does what it can to create a good investment environment to help keep down strike prices. An average strike price of £80/MWh and a £55/MWh selling price makes the scale of public subsidy much less daunting. All medium and high carbon price scenarios, regardless of the pace of free allowance phaseout, would see more than enough raised to cover the costs, with a £29.5 billion surplus over 20 years in a scenario with a medium carbon price and a 2028 phaseout.

There are two important policies that could be enacted this year that should lower strike prices even in 2025. The first is to provide longer and/or more generous capital allowances for infrastructure that is needed for reaching our energy security and net zero. The second is allowing blending of hydrogen so the gas grid can act as a "reserve offtaker". This is where hydrogen producers sell their excess hydrogen to the gas network when they do not have a suitable industrial buyer.

In the 2023 Spring Budget, the Chancellor announced that from April 2023 until the end of March 2026, companies can claim 100% capital allowances on qualifying plant and machinery investments,

"with an intention to make it permanent as soon as we can responsibly do so".[61] Long-life assets (25 years or more) would get 50%.[62] This is part of the UK's response to what is fast becoming a global arms race for green technologies.

Recommendation 2: Make capital allowances for net zero infrastructure permanent.

This is a step in the right direction and should lower the overall cost of projects which are crucial for meeting our energy security and net zero targets, including but also beyond hydrogen projects. The UK needs a substantial infrastructure upgrade if it is to successfully transition to a cleaner and more secure energy system based on renewable energy, nuclear power, hydrogen, gas with CCS, clean heating technologies, electric vehicles, etc.

Due to the national security imperative of securing our energy supplies and bringing more domestic production online, it would be prudent to prioritise the necessary technologies for the clean energy transition. As discussed in the previous section, low and stable energy prices help economic growth.

Making these capital allowances permanent would lead to lower hydrogen strike prices for the hydrogen industry without giving it special treatment within the energy sector. The amount of money that will need to be raised each year to subsidise hydrogen production would be lower. Or, if the Treasury moves ahead with a hydrogen levy, it would lower the amount that would be levied on household bills.

Another way to lower financing costs for hydrogen projects and therefore strike prices is allowing blending. This is an increasingly contentious issue which could prove as damaging to consumer confidence as the hydrogen levy if carried out poorly, but it is also a good market development mechanism. The Government needs to communicate the policy clearly.

Recommendation 3: Permit the blending of hydrogen so the gas grid can act as a reserve offtaker to lower strike prices.

'Blending' refers to allowing blending hydrogen into the gas network. It is currently prohibited under Schedule 3, Part 1 of the Gas Safety (Management) Regulations 1996.[63] Safety trials recently concluded for distribution level blending and are due to be finalised by late 2023 for the transmission level. The Government will then decide whether to allow blending of up to 20% hydrogen by volume in the gas transmission and distribution networks.[64] Jane Toogood, the Government's hydrogen champion, said the Government should stimulate demand in "blending, heating, and transport".[65]

The idea behind allowing blending is that it would allow the grid to become a reserve offtaker and develop the market for hydrogen. In other words, there would be somewhere to dump excess hydrogen so that production facilities can keep running. Otherwise, they would have to switch off because storing large amounts of hydrogen on-site is too difficult and would require a lot of new, extremely stringent regulation due to safety concerns. Blending will make financing hydrogen production projects easier by reducing capital and operational costs, thereby lowering the amount needed to support the hydrogen industry.

Blending could help some green hydrogen projects to be developed for industrial use in particular. For example, if there is a green hydrogen producer which has agreed to supply a nearby industrial company directly, but that offtaker goes bust, is shut down for maintenance, or faces delays in beginning operations, allowing the green hydrogen project to temporarily blend lowers the risk of investment and overall costs of a project, leading to lower strike prices.

Allowing blending into the transmission network could also reduce curtailment for intermittent renewables, reducing energy prices for consumers across the country. It would allow wind projects to divert their power to electrolysers instead of switching off, which could then either be used for deep decarbonisation or blended into the gas transmission network with an unnoticeable increase in wholesale gas costs.

But blending should not be viewed as a means for decarbonisation itself. It would offer very little benefit in terms of cutting emissions. But if it helps to overcome the 'chicken and egg' problem of scaling up a domestic low carbon hydrogen supply, which is necessary for reaching net zero, then it could be argued that it helps the UK to decarbonise in a wider sense.

And it should also not be seen as a source of demand, as Toogood suggested. A 20% blend should not be a "target to reach" for the gas industry. There is no benefit from a consumer point of view. There are varying degrees to how much the cost impact would be, but consistent unnecessary blending would certainly lead to higher wholesale gas prices feeding through to energy bills. It would also require an incredibly large amount of hydrogen and would be a very poor use of a finite hydrogen supply.

A justified concern about blending is that allowing it might be seen as a sign that the Government is favouring hydrogen for heat, which would send a negative market signal discouraging investment in electric heating. The Government has been clear that blending is a separate issue to whether to allow hydrogen for heat to go ahead, on which it will make a strategic decision on in 2026, and that if blending is permitted to happen that industrial customers should be prioritised for hydrogen.[66]

Allowing blending of up to 20% should not be seen as a step towards a 100% hydrogen heating system, which will be far more challenging and require significant and expensive infrastructure upgrades. As mentioned in the previous section, the electrification of heat is the far more cost-effective option and is much more beneficial to energy security. A UK that undergoes a 'System Transformation' toward hydrogen for heat will be far more reliant on imported fossil gas and exposed to the markets it is bought from due to the sheer amount of blue hydrogen that would be required (see Figure 1).[67]

To make sure the gas grid really does act as a reserve offtaker, the Government could establish a second rate of support (or withhold support entirely) for any hydrogen produced that is blended without good reason. The hydrogen producer would need to show it could not find a suitable customer. These could include large scale storage facilities in the future. The Government should also consider a blending limit lower than 20% to protect households and businesses connected to the distribution networks.

This would ensure there is somewhere to dump excess hydrogen as a last resort, but without actively incentivising dumping. To give a strong signal that blending should not be a priority, the

Government should ban hydrogen projects that base their business model entirely on selling their hydrogen to the grid.

Annex: Polling results

Opinium conducted a short poll of 2,000 UK adults, weighted to be politically and nationally representative. The first four questions were polled from 26- 28 April 2023. The fifth question was polled separately from 2- 5 May the same year.

Question 1: *How has the recent rise in energy bills impacted you and your family? Please select the statement that best applies to you.*

	General public	Conservative 2019	Labour 2019
Still comfortable	20%	34%	19%
Can afford	32%	34%	30%
Just about managing	32%	24%	37%
Cannot afford bills	11%	6%	11%
Not sure	4%	2%	2%

Question 2: *What do you primarily blame for rising energy bills?*

	General public	Conservative 2019	Labour 2019
Energy companies profiteering	42%	27%	47%
War in Ukraine	32%	52%	29%
Green levies	8%	6%	9%
The pandemic	5%	5%	4%
Smart meters	2%	3%	3%
Other/don't know	12%	7%	8%

Question 3: *Would you support or oppose a new Hydrogen Levy added onto everyone's energy bills to help fund this new technology?*

	General public	Conservative 2019	Labour 2019
Net support	38%	44%	43%
Net oppose	36%	37%	36%
Don't know	26%	19%	21%

Question 4: *How much more per month would you personally be willing to pay if a Hydrogen Levy was added onto everyone's energy bills?*

	General public	Conservative 2019	Labour 2019
Nothing	43%	44%	37%
Up to £10	25%	28%	30%
£11-£20	7%	7%	10%
More than £20	5%	6%	6%
Don't know	19%	15%	17%

Question 5: *Hydrogen is a gas which can be burned for energy. We could produce hydrogen here in the UK to import less fossil fuel gas from overseas. It could be used to cut greenhouse gases and tackle climate change. And a new domestic hydrogen industry would also mean more jobs for industrial areas. But it needs financial support in the early years to develop. How should the Government pay for this?*

	General public	Conservative 2019	Labour 2019
UK ETS	44%	43%	54%
Hydrogen levy	12%	12%	11%
Do not support	10%	11%	6%
General taxation	7%	6%	6%
Don't know	28%	27%	22%

Endnotes

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