A CLIMATE FUND FOR CLIMATE ACTION

THE BENEFITS OF TAXING EXTREME CARBON EMITTERS

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Autonomy

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Autonomy

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KEY FINDINGS

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» This report conducts a study of carbon emissions per income group in the UK over a twenty year period, using established ratios between income and carbon consumption.

» It then simulates a hypothetical carbon tax, asking the question: if the UK had implemented a tax on the excessive carbon consumption of the wealthiest 1%, how much could have been raised over the previous two decades? This is used as a case study to explore the potential of a Climate Wealth Fund and its possible uses.

» We find:

- **Climate politics in the UK is suffused with inequality.** The top 1% of earners by income has generated roughly the same carbon emissions in a single year than the bottom 10% has emitted in more than two decades. In other words, it would take 26 years for a low earner in the UK to consume as much carbon as the very richest do in a single year.

- **The top 1% on its own (around 670,000 people) have consumed more carbon than the entire 3rd income decile (equivalent to ~6.7 million people)**

- There have been missed opportunities. If a carbon tax had been set at the price proposed by the Swedish Ministry of Finance (approximately £115 per ton of carbon), **revenue raised from the top 1% would have amounted to £126 billion over a twenty year period**. Changes to the tax system are vital if future opportunities are not to be missed.

- £126 billion would have been sufficient for the UK to:

    ◊ Invest in almost five times current offshore wind capacity

    ◊ Triple current solar (PV) capacity

    ◊ Double onshore wind capacity

    ◊ Add 2.1 GW of tidal energy capacity and add a similar amount of pumped storage hydropower.

    ◊ Retrofit almost 8 million homes, upgrading their efficiency to EPC "C", cutting energy bills while reducing overall emissions.

- These investments would amount to drastically replacing gas-generated energy with renewable sources, and would decrease dependency on imports.

- With no UK carbon tax in place, the richest 1% have been free to 'dump' disproportionately large amounts of carbon into the atmosphere for little to no cost, creating a burden now shouldered by the rest of the population. To green the UK economy, and bring about the change current and future generations desperately need, this must change.

INTRODUCTION

INTRODUCTION

Climate scenarios modelled on a time horizon dating back to the Palaeolithic period indicate that current structural changes in the climate stem from dangerous levels of greenhouse gas emissions.[1] Current concentrations of CO2 are now at levels which have not been observed for at least 2 million years, while other greenhouse gases (methane and nitrous oxide) have reached heights not seen in the last 800,000 years. These increases in greenhouse gas emissions are increasing global surface temperatures, driving the current climate crisis, and accelerating a range of further ecological catastrophes such as species extinction.

Climate change is marked by an escalatory dynamic, where growing costs are imposed on future generations, which present day actors are nevertheless disincentivized from addressing – needing to impose other 'costs' on themselves, from which they may not always directly live to benefit.[2] As such, it is commonly recognised that, to encourage concerted action in the interest of future generations, an intensive public investment program is required to induce government and markets to lead technological and industrial transitions to adopt climate change mitigation and adaptation measures.

In this paper, we show how a carbon tax, aimed at the excessive consumption of the UK's richest individuals, could offer a powerful source for such investment, by feeding a Climate Wealth Fund that could help to finance much of the crucial industrial policy required to achieve a green transition: from a massive expansion in renewable energy generation and storage, to vital retrofitting of housing stock.

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1 IPCC, (2021) Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.

2 Carney, Mark (2018) "A transition in thinking and action." Remarks at the International Climate Risk Conference for Supervisors, The Netherlands Bank, Amsterdam.

To illustrate this, we focus on a hypothetical case study, and ask: **how much *could have* been raised for a Climate Wealth Fund, had the UK levied a carbon tax on the excessive consumption of the richest 1% for the last 20 years (1998-2018)?**

Our findings make clear that, **by allowing the disproportionately destructive carbon consumption of the 1% to continue undeterred, the UK Government has lost out on around £126 billion in additional revenue that could have funded wide scale domestic renewable energy production**. In a period of energy crisis, in which the UK's dependence on environmentally destructive foreign imports has been acutely exposed, the failure to tax, and then invest, in a greener alternative appears highly regrettable.

However, by demonstrating the extent of lost past revenue, the case for the urgent introduction of a carbon tax focused on the UK's very richest only becomes clearer. The sooner a levy on the excess consumption of the 1% arrives, the quicker that a Climate Wealth Fund – targeting investment in green industrial transformation – can begin to grow. With ambitious net-zero targets set by the UK Government, and climate crisis escalating around the world, time is of the essence.

METHOD

METHOD

To model the effects of our carbon tax, we have calculated estimated carbon emissions since 1998 for the UK's 'bottom' 9 income deciles, before splitting the 'top', most wealthy, 10th decile into two groups respectively: the top 10% *without* the 1% (90-99%), and the top 1% itself.

First, we began by tabulating emissions per capita since 1998, before calculating how much each income group falls below or above the UK's annual average.[3] With each group's relative carbon 'debt' or 'dividend' calculated – that is, how much *more* or *less* they emit compared to the UK average – we could then total these values from 1998 until 2018, generating a figure for 'total' relative carbon emissions by group since 1998.

In order to then convert these 'debts' and 'dividends' from carbon ton units to a corresponding money value over time, we multiplied the cumulative carbon debts and dividends by £115: the value used by the Swedish Government. This was chosen as an actually-existing but ambitious carbon price.[4]

In this report, we model a 'Pigouvian' form of carbon tax – i.e. one focused on the excessive consumption of the wealthiest. As such, the carbon price of £115 per ton is taken to apply only to the top 1% of UK incomes, and only to their carbon consumption *above* the UK individual average. This therefore stands in the canon of tax fairness,[5] looking not to tax the entire amount emitted/consumed by the top 1%, but simply the 'excess'.[6]

3 To see and download the full dataset, see Subak's Data Catalogue: https://data.subak.org/dataset/uk-carbon-emissions-by-income-decile-1998-2018

4 See Tax Foundation (2020) 'Looking Back on 30 Years of Carbon Taxes in Sweden'. Available at: https://taxfoundation.org/sweden-carbon-tax-revenue-greenhouse-gas-emissions/

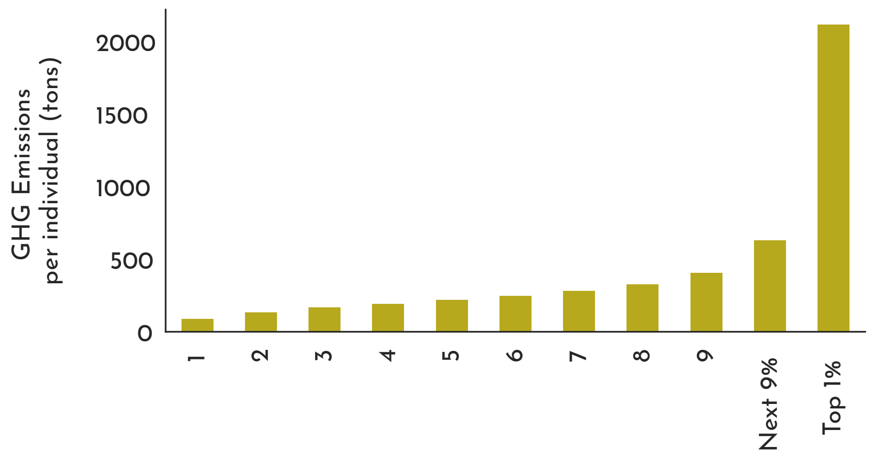
5 Collard, David (1996) "Pigou and future generations: a Cambridge tradition." ***Cambridge Journal of Economics*** 20.5: 585-597.

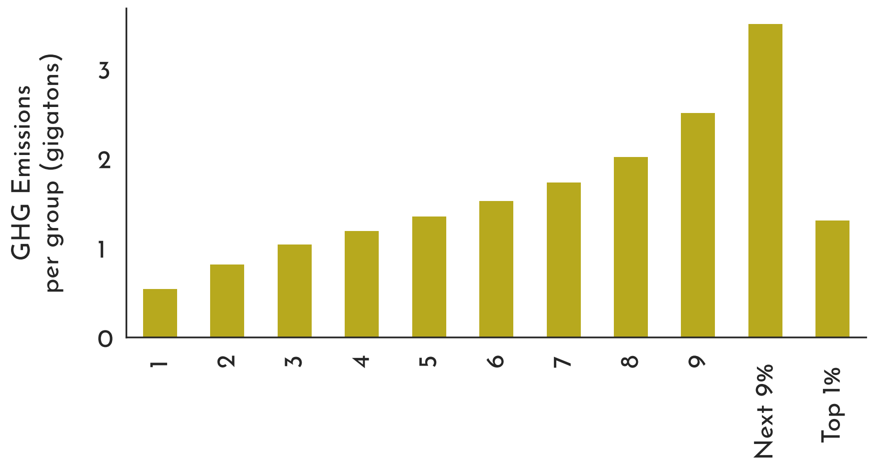
6 We count 'excess emissions' to be those above the national average. See Annex 1 for this data.

FINDINGS

FINDINGS

Carbon consumption is drastically unequal across income groups





Figures 1a and 1b: Greenhouse gas (GHG) emissions by an average individual within each income group, and by each income group total, (1998 - 2018).[7]

In the graphs above, we show that, in terms of emissions accumulated across 20 years by income group, **the top 1% emit the same (or greater) volume of greenhouse gases as each of the bottom three income deciles, themselves each made up of around 10% of the British population - or around 6.7 million.**

7 Chancel, Lucas (2021) "Climate change and the global inequality of carbon emissions, 1990-2020." World Inequality Lab: Paris, France.

The asymmetric emissions of greenhouse gases are also evident when comparing the individual emissions accumulated by the average individual in each of income groups. **Across 20 years, the cumulative emissions of an individual in the top 1% reaches 2,015 tons whilst someone in the bottom 10% will have emitted only 88 tons.**

The typical individual at the top puts as much CO2 into the atmosphere as all those from the bottom 9 income groups combined

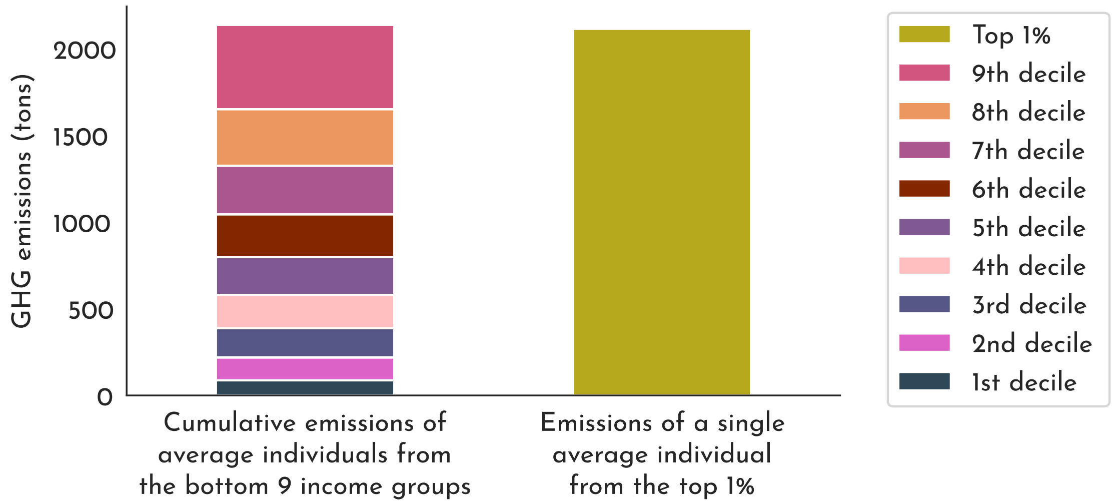


Figure 2: Emissions by an individual in top 1%, versus individuals in bottom 9 income groups.
Source: Autonomy analysis of Chancel's database.

We can also display this disparity through the above stacked bar chart, which shows the cumulative emissions of an average individual in each group. On the left, we see the accumulated emissions of 9 different individuals belonging to the first 9 income deciles. On the right, we have plotted the cumulative emissions of an individual in the top 1%. **The stark divide is clear: emissions of an individual in the top 1% correspond roughly to the total emitted by *9 people* from the deciles that make up the remaining bottom 90%.**

A carbon tax holds significant revenue raising power

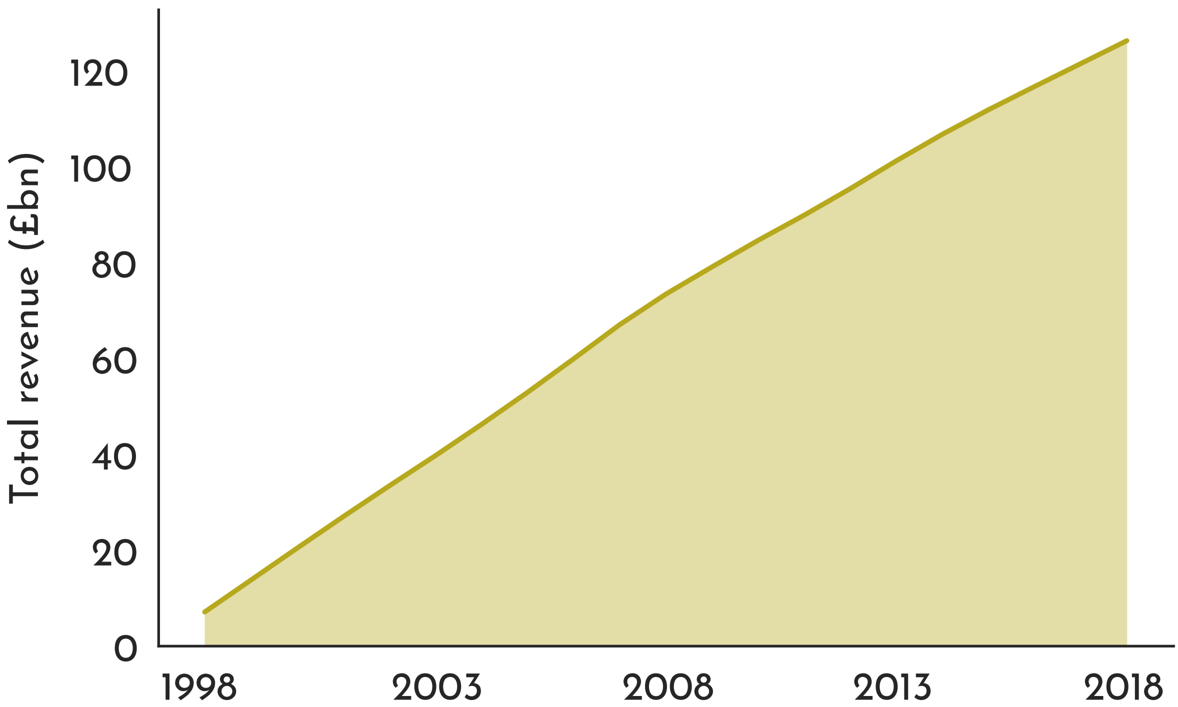


Figure 3: Cumulative tax revenue (£bn) that could have been accrued between 1998 and 2018, had a carbon tax been applied to the top 1% of earners.
Source: Autonomy analysis of Chancel's database

Had the emissions of the top 1% been subject to a carbon tax set at £115 per ton, in line with the Swedish government price, we can **we can infer that the cumulative tax yield would have been £126 billion** (see Figure 3).

PUTTING A CARBON TAX TO WORK

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What could the proceeds of a carbon tax on the 1% be put towards?

One powerful option, which we focus on here, is a Climate Wealth Fund: a publicly owned investment fund, which could lead on supporting capital-intensive infrastructure projects such as the drive to clean the UK energy grid, or improve household energy efficiency, for instance.[8]

Returning to our case study, looking at a hypothetical carbon tax on the UK's 1% over the past two decades, in this section we develop in more detail the scale and breadth of infrastructure projects that could be supported by a fund worth £126bn.

We model two main allocations for a Climate Wealth Fund: improving renewable energy supply (through diverse modalities) and improving household consumption efficiency.

8 This could be a powerful complement to a body such as 'Great British Energy', currently proposed by the UK Labour Party, a state-owned company to build or co-invest in low-carbon projects and boost renewable energy supply. See Elgot, Jessica (2022) 'Labour will launch publicly owned Great British Energy, Starmer vows', ***The Guardian***, 27 September 2022. Available at: https://www.theguardian.com/politics/2022/sep/27/labour-will-launch-publicly-owned-energy-firm-keir-starmer-vows

A £126bn Climate Wealth Fund could be used to significantly improve energy supply and demand

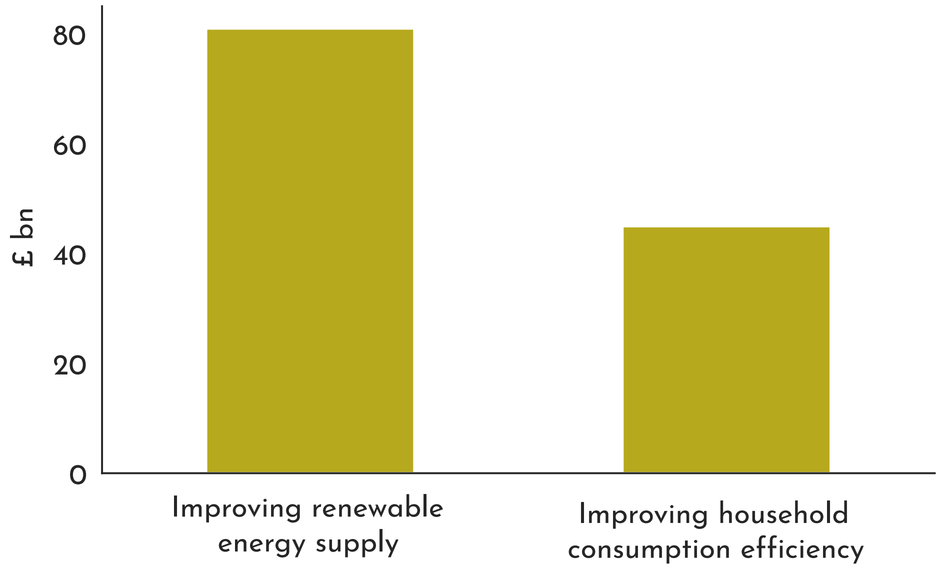


Figure 4: How a Climate Wealth Fund could be divided between improving supply from renewable sources and improving household consumption efficiency
Source: Autonomy analysis of ONS[9] and GOV.UK[10]

9 Henretty, Nigel. (2020) "Energy Efficiency of Housing in England and Wales." Office for National Statistics. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/energyefficiencyofhousinginenglandandwales/2020-09-23

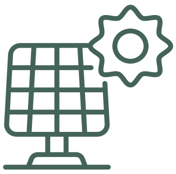
10 "British Energy Security Strategy." **GOV.UK.** Available at: https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy

Proceeds of a UK Climate Wealth Fund could have been put to use accelerating investment in the UK's Net Zero targets, currently set for 2030, ensuring a decarbonised and secure electricity system. This investment could have increased the potential capacity of the UK National Grid by 89GW, through additional solar, wind and tidal generation, as well as improved hydro pump storage. It would also have reduced the UK's oil and coal dependency to zero, and cut gas dependency by 50%. Given that the operational costs of renewable energy are much lower than non-renewable sources, it could also have put in place savings of as much as £90bn until 2030.[11]

Renewable energy type	Capacity (GW)		Current deficit (GW)	Cost (£bn)
	Current	**2030 targets**		
Solar photovoltaics	*14*	*42*	*28*	*36*
Onshore wind	*14.5*	*30.8*	*16.3*	*16*
Offshore wind	*11.3*	*52*	*40.7*	*14*
Marine (tidal)	*0*	*2.1*	*2.1*	*10*
Storage (hydro pumped)	*2.7*	*4.8*	*2.1*	*5*
Total				**81**

Table 1: Investment in renewable energy targets, and the costs of achieving them.
Source: Autonomy calculations of data taken from Ember (2022)

11 MacDonald, Phil (2022) 'A Path Out of the UK Gas Crisis' ***Ember***, 23 September 2022. Available at: www.ember-climate.org/insights/research/uk-gas-power-phase-out

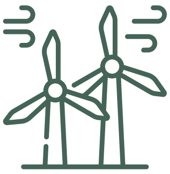


SOLAR (PHOTOVOLTAIC)

£36 billion, 14GW -> 42GW

A Climate Wealth Fund could have allocated £36bn in investment in solar farms across the UK. This would suffice to triple the current UK's solar capacity from 14GW to 42GW.

This estimation is grounded in a linear extrapolation from the capital expenditures necessary to build Cleve Hill Solar Park, in Kent. The necessary budget for this project was £450m, for a capacity of 350 megawatts (MW).



WIND (ONSHORE AND OFFSHORE)

Onshore: £16 billion, 14.5GW -> 30.8GW

Offshore: £14 billion, 11GW -> 52GW

For onshore wind farms, a Climate Wealth Fund could have allocated £16bn to more than double current capacity from 14.5GW to 30.8GW.

Our wind capacity calculation is grounded in costing each GW of a set of wind turbines capacity at approximately £1bn. For funding capital expenditure in offshore wind farm projects, we estimated an almost five-fold growth of the current capacity from 11GW to 52GW. In order to achieve this, it would be necessary to allocate £14bn. This budgetary allocation is based on the investments made for Hornsea Project One.

MARINE (TIDAL STREAM ENERGY)

£10 billion, 0GW -> 2.1GW

Tidal energy, although more costly, is key for diversifying energy sources and providing sustainable long-term energy security - such schemes can have a lifecycle of more than 100 years.

We estimate that with £10bn investment the UK's tidal energy capacity could be increased from 0 to 2.1GW. This estimation is based on the budget for capital expenditure of West Somerset Lagoon near Bristol Channel.

STORAGE (HYDRO PUMPED)

£5 billion, 0GW -> 2.1GW

Hydro pumped storage is one of the most efficient and cheap energy storage systems. Although the costs can vary according to the geography of its installation, we have estimated that the cost of adding 2.1GW would be £5bn.

Greening the UK's National Grid would cost £81bn

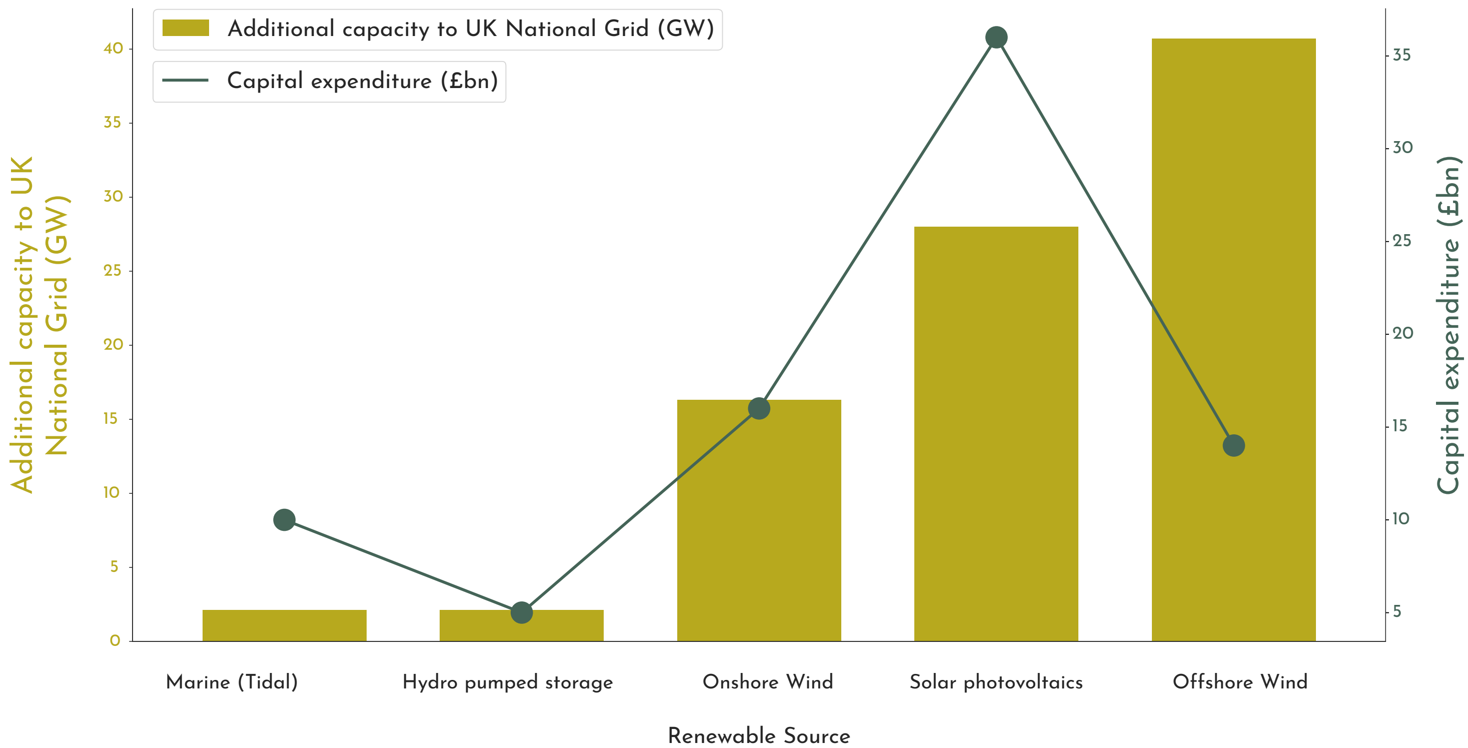


Figure 5: Cost and additional capacity of renewable energy projects that could have been funded through a Climate Wealth Fund
Source: Autonomy analysis of upfront investment in similar projects in the UK[12]

The chart above shows that the biggest gains will come from upfront investment in solar energy, as well as onshore and offshore wind energy. Although tidal energy requires greater upfront investment, relative to the increase in capacity, this investment is important because, in addition to helping to diversify the UK's renewable energy sources, it has a much longer duration: the depreciation of tidal energy is slower compared to onshore and offshore wind farms.

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12 Ambrose, Jillian (2020) 'Britain's Largest Solar Farm Poised to Begin Development in Kent', ***The Guardian***, May 24, 2020. Available at: https://www.theguardian.com/environment/2020/may/24/britains-largest-solar-farm-poised-to-begin-development-in-kent; Decher, Ulrich, and Jessica R. Lovering and Todd R. Allen (2011) "The Economics of Wind Power." ***ANS.*** Available at: https://www.ans.org/news/article-638/the-economics-of-wind-power/#:~:text=Cost%20of%20wind%20farms%3A,year%20(116%20x%201.25);
Biggar Economics, (2020)"Economic Assessment of SSE Projects in the Great Glen 0903." Available at: https://www.sse.com/media/l1mhxgpg/biggar-economics-economic-assessment-of-sse-projects-in-the-great-glen.pdf;
The Logistics Institute (2022) "Hornsea Project 1'. Available at: https://lido.hull.ac.uk/Industry/WindFarmSite/Hornsea_Project_1#:~:text=Hornsea%20Project%20One%20has%20a,at%20least%20%C2%A34.2%20billion
Smith, Jamie (2021) "How Much Does It Cost to Upgrade EPC from D to C?: Nexus." Nexus Energy Solutions. Available at: https://nexusenergysolutions.co.uk/how-much-does-it-cost-to-upgrade-epc-from-d-to-c/.
Tidal Engineering (2021) "Tidal Engineering and Environmental Services." Available at: https://tidalengineering.co.uk/

A Climate Wealth Fund could be used to retrofit more than 7m UK homes

Besides greener energy generation and storage, a Climate Wealth Fund could also have been used to allocate £45bn to retrofit more than 7 million UK homes, upgrading their Energy Performance Certificates (EPCs) to at least "C" levels, and thus reducing inefficient UK housing stock from 12 million to 4.5 million.

The majority of houses in England and in Wales had an EPC rated within band D in 2019. This grade is far lower than the target of reaching EPC band C by 2035. Therefore, there is significant scope for a Climate Wealth Fund to support a retrofit scheme that will upgrade the energy efficiency of houses, through insulation as well as upgraded heat pumps, on a large scale.

We estimate that upgrading a house from an EPC rating of D to a C will cost £6,155 in each instance. Therefore, the Climate Wealth Fund could have provided resources to retrofit 7.5 million UK properties at a total cost of £45bn.

Current	After	Houses upgraded (millions)	Cost (£bn)
Houses below EPC "C" (millions)	Houses below EPC "C" (millions)		
12	4.5	7.5	45

Table 2: Targets and costs for retrofitting UK housing stock

CONCLUSION

CONCLUSION

By modelling the effects of a carbon tax, aimed at the excessive consumption of the UK's 1%, channelled into a Climate Wealth Fund, we have shown the potential to transform the UK's energy and housing landscape.

On the one hand, this report tells the tale of a missed opportunity. Had the UK Government acted earlier, a fund totalling £126bn from the previous two decades could have provided a hugely powerful instrument to green the UK economy and invest in domestic renewable energy production. With consumers currently being squeezed amid a cost-of-living crisis exposing UK dependence on (often environmentally destructive) energy imports, the cost of inaction has never been clearer.

However, the time to act has not passed. Every year in which the excessive carbon impacts of the wealthiest 1% continue unabated is another lost year in revenue to fuel a green transition. If the UK leads the way, by looking to a proportionate tax on the wealthiest – often the least exposed to the effects of climate crisis, and those with the broadest shoulders – it can begin building a fund to support the vital transformation of the UK economy that current and future generations desperately need.

APPENDIX 1: DATA SOURCES

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For carbon emissions by income decile data, see the Subak Data Catalogue, where tables can be downloaded: https://data.subak.org/dataset/uk-carbon-emissions-by-income-decile-1998-2018

Renewable Source[13]	Information Source	Capital cost (£)	Capacity (MW)	Source
Solar photovoltaics	*Cleve Hill Kent*	*450m*	*350*	https://www.theguardian.com/environment/2020/may/24/britains-largest-solar-farm-poised-to-begin-development-in-kent
Windfarm	*American Nuclear Energy*	*1.6bn*	*1000*	https://www.ans.org/news/article-638/the-economics-of-wind-power/#:~:text=Cost%20of%20wind%20farms%3A,year%20(116%20x%201.25).
Wind offshore	*The Logistics Institute*	*4.2bn*	*1200*	https://lido.hull.ac.uk/Industry/WindFarmSite/Hornsea_Project_1#:~:text=Hornsea%20Project%20One%20has%20a,at%20least%20%C2%A34.2%20billion.
Marine (Tidal)	*Tidal Engineering and Environmental Services*	*10bn*	*2100*	https://tidalengineering.co.uk/
Hydro pumped storage	*Glendoe Hydro Scheme in Scotland*	*226m*	*100*	https://www.sse.com/media/l1mhxgpg/biggar-economics-economic-assessment-of-sse-projects-in-the-great-glen.pdf
Retrofitting (EPC) rating of D to a C	*nexusenergysolutions*	*6,155*	*1 house EPC "D"*	https://nexusenergysolutions.co.uk/how-much-does-it-cost-to-upgrade-epc-from-d-to-c/

Table 3: Reference costs for Renewable Supply and Improving Demand (upgrading household EPC "D" to "C")

13 Renewable sources capital expenditure for upfront investment vary in space and time. There is a consistent trend that these technologies will decrease as time passes and the technology evolves. Also, the capital expenditure can vary according to the geography of the region. A favourable geography can drastically reduce the mobilised capital for an upfront investment in a renewable energy plant.

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