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Image by Maddy Bennett

Introduction

Robert Gross, UKERC Director

When I took over as UKERC Director on March 2nd I travelled by train and E-bike to UKERC's offices at UCL. Energy use in the home and office forms a core part of UKERC's research so I recall noting the secondary glazing and air-conditioning unit and other energy related features of my new workplace. Within weeks, the use of energy in our office block was abruptly curtailed as the country was placed into 'lockdown'. My commuter energy use reduced to zero, and the air-conditioned office was replaced by a spare bedroom. The changes 2020 has brought to society, the economy and our use of energy services were almost unimaginable at that time. As I write, England just ended another lockdown. This time universities remained open, after a fashion, but there is no prospect yet of a return to anything like normal life and our energy use patterns, as with so much else, remain disrupted.

In this issue of UKERC's annual Review of Energy Policy we discuss some of the effects of COVID-19 on the energy system and how the unprecedented events of 2020 might impact energy use and climate policy in the future.

Our review examines the impact of lockdown on electricity demand, and what that tells us about a future system with a higher share of renewables. It explores the profound impact on transport, and how the economic downturn has affected new and second hand car markets, alongside the potential for 'phasing in' the 'phase out' of petrol and diesel vehicles.
We discuss how we can 'build back better' in terms of energy efficient building, and highlight UKERC research informing the 'green jobs' debate.

Irrespective of the travails of COVID-19 the UK government is determined to press ahead with Brexit, our analysis shows how poorly prepared we are in terms of both market access and carbon trading. We discuss the urgent need for policy action to decarbonise heating, as well as the supply chains and skills that the UK needs to do so. Finally, we explore how the Climate Assembly and COVID-19 pandemic have changed the landscape for engaging with climate and energy, highlighting how approaches to engaging society in the energy transition needs to be more innovative and ambitious.

As 2020 draws to a close energy and climate issues continue to be high a priority. We anticipate a UK White Paper on energy this year and 2021 will see the UK and Italy co-host the COP26 climate change negotiations, with the expectation of a return to positive engagement from the USA. The evidence suggests that ongoing public support for action on climate change is strong and it appears that the Government senses this sentiment and wants to provide leadership. Doing so will be challenging and require effort and ambition, but as the cost of leading low carbon technologies has fallen, the opportunity to maximise co-benefits and create economic value is higher than it has ever been. The need for analysis across all domains affecting energy supply and use has never been greater – from the performance of technologies to the behaviour of investors and beliefs of citizens. UKERC will continue to provide high quality evidence to inform, and lead, the energy debate.

The electricity system: powering through uncertainty

Keith Bell, University of Strathclyde

As in every part of society, the coronavirus pandemic has impacted the electricity sector. That, to date, there have been no major losses of supply represents a success. A key focus now needs to be developing commercial and regulatory frameworks for the future energy system.

The COVID-19 lockdown led to a significant reduction in electricity demand and, through the spring and summer, periods when an excess of low carbon power threatened the stability of the system.[1] This led to a call from the Electricity System Operator to Ofgem for the right to disconnect small scale generation from the distribution network if necessary, a contract with EDF Energy to reduce output from Sizewell B nuclear power station by 50%, and an anticipated increase in the annual cost of balancing the system of half a billion pounds. It also highlighted a problem that has existed for many years: the lack of coherent mechanisms for the monitoring and control of distributed generation. This must be rectified if secure system operation is to be achieved cost-effectively, and small-scale generation is to be able to participate fairly in both energy and flexibility markets and be reasonably compensated for any lack of access.

The overall reduction in demand masks changes in different customer segments. The fact that people are more likely to be at home for more of the time will lead to increased domestic energy use through the winter. The overall effect on bills is, as yet, uncertain as the health crisis has generally led to lower energy prices.

lockdown led to a significant reduction in electricity demand

Funding network upgrades

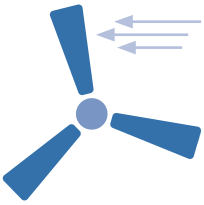
Security of supply became a subject of some contention in the RIIO-2 price control 'draft determination' announced by Ofgem. RIIO-2 is the exercise through which the regulator determines the income that the regulated gas network (transmission and distribution) and electricity transmission network companies will receive in the period 2021-26. The main headline from the draft determination was "*an expected £20 fall in [annual] network charges on bills per household*" at the start of the RIIO-2 period helping to offset the increase in investment and charges expected later.[2]

A significant challenge Ofgem faces in a price control is that the future is uncertain, in particular: how many new wind farms will want to connect (and where); when will demand for electricity start growing again; and what is the long-term future of the gas networks? To try

[1] See Bell and Hawker, 2020. Electricity demand during week one of COVID-19 lockdown. Access here.
And Drax, 2020. COVID-19 lockdown made Britain's electricity system cleaner and cheaper, but harder to control. Access here.

[2] Ofgem, 2020. Ofgem proposes £25 billion to transform Great Britain's energy networks. Access here.

to deal with this, Ofgem has granted a certain amount of 'baseline' funding and then will leave decisions, on additional funding to a number of 'uncertainty mechanisms'. It has also made a very welcome allowance for money to be used for innovation and R&D.[3] What is so far unclear is how the uncertainty mechanisms will work, and how quickly Ofgem will be able to make decisions, and whether the mechanism for dealing with uncertainty will, itself, create uncertainty.



40 GW

target for offshore wind capacity by 2030

The electricity transmission owners requested allowances totalling £3.9 billion for work on renewing their networks. However, Ofgem has said that they made the case for only a fraction of it and, in the draft determination, granted only £1.6 billion.

Citizens Advice argued that Ofgem had not gone far enough in restricting the network companies' income.[4] The companies, however, pointed to what they saw as errors in Ofgem's analysis.[5] National Grid Electricity Transmission claimed it would allow "risk levels to rise by at least 24% consequently reducing reliability".[6] Ofgem's final determination is due to be published around the same time as this review.

System flexibility

During 2020 the UK government made some important announcements about the future of renewable electricity generation. Onshore wind and solar power will be able to compete in the next auction for Contracts for Difference (CfDs)[7], with the next CfD auction promised to open in late 2021. In addition, a target of 40 GW of offshore wind capacity by 2030 has been confirmed and a new target has been set for up to 1 GW of floating offshore wind by 2030.[8]

These are welcome developments. However, they also underline the challenge of how to integrate large amounts of variable renewable energy into the energy system – 40 GW is a huge amount of power and its connection into the network needs to be well coordinated. The number of hours in the year when the total power available from low carbon sources exceeds demand will increase even when many gas and oil fired boilers have been replaced with electric heat pumps and combustion engine vehicles have been replaced with electric vehicles.

[3] UKERC Ofgem RIIO-ED2 consultation response. Access here.
[4] Citizens Advice, 2020. Ofgem could save consumers a further £1.7 billion in next network price control. Access here.
[5] SP Energy Networks, 2020. Our RIIO-T2 Business Plan. Access here.
[6] National Grid Electricity Transmission, 2020. Our letter to Ofgem. Access here.
[7] BEIS, 2020. Support for onshore wind to drive green commitment. Access here.
[8] Prime Minister's Office, 2020. New plans to make UK world leader in green energy. Access here.

Various commentators have rightly highlighted the need for 'flexibility' within the electricity system to deal with variations.[9, 10] However, the correct mix of flexibility needs to be provided. Flexible demand can be extremely valuable at timescales of a few hours, but solutions are required that will provide zero emissions power during 'wind droughts' that could potentially last many days.

We are moving into an important transition in which existing, unabated fossil fuelled plant needs to be phased out. To what extent can we rely on energy markets (suitably adjusted, e.g. to shorter settlement periods or locational pricing) to incentivise provision of the right kinds of flexibility in the right places? Or does the provision of appropriate flexibility need to be led by a system operator or network owners that define specific services and procure them?

There is increasing interest in hydrogen as a flexible fuel, manufactured using surplus electricity or via methane reformation with carbon capture and storage.[11] Hydrogen can be moved in both time and space and used in industrial processes or transport, as a fuel for heating, or in the generation of electricity. However, a market for low carbon hydrogen does not yet exist.

Furthermore, the low efficiency of converting electricity to hydrogen and back again, and the current high cost of electrolysis opens up potential opportunities for other forms of medium to long-term energy storage.

Agreed action is needed

The challenges in defining the right set of commercial and regulatory frameworks for the future energy system are considerable and the consequences of getting it wrong could be very serious. However, there may not be a 'perfect' solution and regulatory or market change can take a long time. The challenge for policy is to sustain investment in low carbon technologies whilst simultaneously encouraging new sources of flexibility. This will require consideration of the arrangements we might need in the future as well as a transition plan to avoid a hiatus. As we move into 2021, UKERC's research will have a strong focus on both challenges and we will work with government and wider stakeholders on transition plans and longer-term options for market reform. Given the urgency of the task perhaps the main immediate requirement is for pragmatism and learning by doing, fine tuning policies to enable action and ensuring that we do not allow the 'best to be the enemy of the good'.

[9] Hawker et al., 2017. UKERC Response to BEIS/Ofgem call for evidence on a smart, flexible energy system. Access here.

[10] Heptonstall and Gross, 2020. A systematic review of the costs and impacts of integrating variable renewables into power grids. Access here.

[11] See, for example, European Commission, 2020. Questions and answers: A Hydrogen Strategy for a climate neutral Europe. Access here.

Mobility change and the future of low carbon transport

Christian Brand, University of Oxford

drop in new car sales compared to 2019

Transport is at a crossroads where, perhaps more than any other sector, the opposing forces of economic spring-back from COVID-19 and carbon reduction are so fiercely in competition. The pandemic-induced recession may well lead to an extended dip in car use as we have seen historically during such times. However, by the end of October car traffic in the UK was already 83% of its pre-COVID-19 levels, and heavy goods vehicle traffic had increased by 8%.[12] The use of the bus network was already in decline before the pandemic, but with social distancing requirements and an aversion to using public transport, passenger numbers are down further, with use now at between 56% (London buses) and 33% (national rail) of its pre-COVID-19 levels.[12] This means more use of other modes instead – for many, this could mean buying an older, second hand car. While electrification may be our best chance to decarbonise the new vehicle fleet, it will not impact the internal combustion engine (ICE) vehicles already in circulation. We need to travel less, and we need to accelerate the transformation of the new and used car markets now, not at some future 'phase out' date. A faster transition would also create additional economic activity and jobs in the UK.[13]

The foot is off the accelerator

The car market has been disrupted by the economic impacts of COVID-19. While some private car owners are bringing forward buying a vehicle, most are running a vehicle for longer. Fleet managers are also delaying fleet renewal, with around 10,000 fewer new cars.

New car registrations dropped by 4.4% in "weakest ever 'new plate' September".[14] Despite this, battery electric (BEV) and plug-in hybrid (PHEV) car uptake grew substantially over the past year, petrol and in particular diesel sales slowed the most. Latest figures show a BEV market share of 5.4%, up from 1.3% in 2019, while diesels decreased by 7% in the same period.

This downturn in new car sales is not necessarily a good thing for climate change: older vehicles emit more, and slower turnover delays the market penetration of zero (tailpipe) emission vehicles. To shed light on this issue we used scenarios of the future car market to explore the likely CO_2 impacts over the next 30 years.

Our analysis suggests that delayed purchasing and COVID-19 will result in a 30% drop in new car sales compared to 2019. Lower-than average sales continue beyond immediate 'recovery', thus slowing fleet turnover and ultra low emission vehicle (ULEV) uptake.[15] In one scenario we assumed that the slowdown would last until 2025, with buyers delaying purchasing a new car by four years. The economic downturn due to COVID-19 means less disposable income for new cars, and as manufacturers shift models from conventional to electrified, consumers may delay purchasing until the 300 mile range and fast recharge BEV prices come down. These delays lead to diesel cars and vans staying on our roads for longer; in a baseline projection which considers fleet

[12] DfT, 2020. Transport use during the coronavirus (COVID-19) pandemic. Access here. The % changes compare the last two weeks of October 2020 with the last two weeks of October 2019.

[13] Cambridge Econometrics and Element Energy (2020) The impact of a 2030 ICE phase-out in the UK. Access here.

[14] SMMT, 2020. New Car Registrations, September 2020. Access here.

[15] ULEV = battery electric (BEV), plug-in hybrid electric (PHEV) and hydrogen fuel cell electric (FCEV) vehicles.

[16] We also looked at the impact of 20% and 150% tax levels. Results are shown in the Figure as sensitivity ranges.

turnover without the impacts from COVID-19, the total fleet of diesel cars falls by 4.7million between 2020 and 2030, but with delayed purchasing (by four years up to 2025) roughly one million more are operating on Britain's roads in 2025. The purchase of new ULEV cars is also impacted. In the baseline case ULEVs are expected to make up about 8% of the fleet in 2025 and 27% in 2030; delayed purchasing may lower this to 5% in 2025 before picking up to reach 32% in 2030. As a result, tailpipe CO_2 emissions increase in the short term, with annual emissions being up to 4 Mt higher than in the base case. In the medium term, annual emissions are up to 2 Mt lower than in the base case, as pent up demand is met with more people choosing ULEVs over conventional vehicles. Cumulatively, a slower turnover could add 7 Mt of tailpipe CO_2 emissions between 2021 and 2030, but only 1 Mt between 2021 and 2050. Once vehicle and fuel lifecycle emissions are factored in the cumulative effect over the next 30 years can be considered marginal

A market transformation approach: phasing in the phase out?

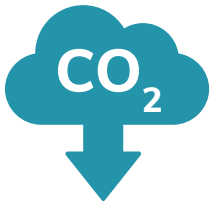
A 'phase out' target date is helpful in providing a long-term signal and driving down emissions in the medium-to-long term, but setting a future date which defines a before/aftermarket may be too blunt and will lead to distortions and perverse behaviours in the lead up. We have therefore explored a market transformation approach, essentially the 'phase out' being 'phased in' over the coming decade - highest-emitting vehicles are gradually phased out prior to the target date, after which only new zero emission vehicles are sold.

'Phasing in' the 'phase out' was modelled as a CO_2 graded tax on new cars, with 'tax eligibility' gradually tightening from 2021 to 2030. Starting in 2021, with a 50% purchase tax[16] (as in Norway on non-electric cars) on the pre-tax price of cars emitting more than 225 gCO_2/km. From 2022 this included all cars emitting more than 190 gCO_2/km and so on, until 2030 when only zero carbon cars avoid the tax. Over the course of the decade a growing number of higher carbon models attract the tax, and only zero-tailpipe emission vehicles are tax free from 2030 onwards.

We found significant reductions in tailpipe CO_2 emissions, due to the faster turnover towards lower carbon cars (Figure 1: Direct). The reductions 'peak' in the early 2030s at 6 $MtCO_2$ per year. Lifecycle CO_2 emissions also decline, rising to a difference of 7 $MtCO_2$ p.a. in 2030 (Figure 1: Lifecycle). The effect of the policy is felt throughout the 2030s and beyond, as the more efficient fleet operates well into the 2040s.

The policy could save 32 $MtCO_2$ in tailpipe emissions between 2020 and 2030, and a further 65 $MtCO_2$ between 2031 and 2050. Lifecycle emissions savings were also estimated at 114 $MtCO_2$ between 2020 and 2050. These are sizeable savings, with the cumulative 2020-50 savings in the order of 1.6 years of UK car CO_2 emissions.

This shift is not only due to increased sales of ULEV cars but also a shift towards more efficient petrol HEV and diesel ICE cars during the 2020s. By 2025, however, ULEVs become the 'natural choice' for buyers. In 2025, the market transformation approach results in a ULEV market share of 43%, significantly higher than the 34% expected in the baseline scenario.

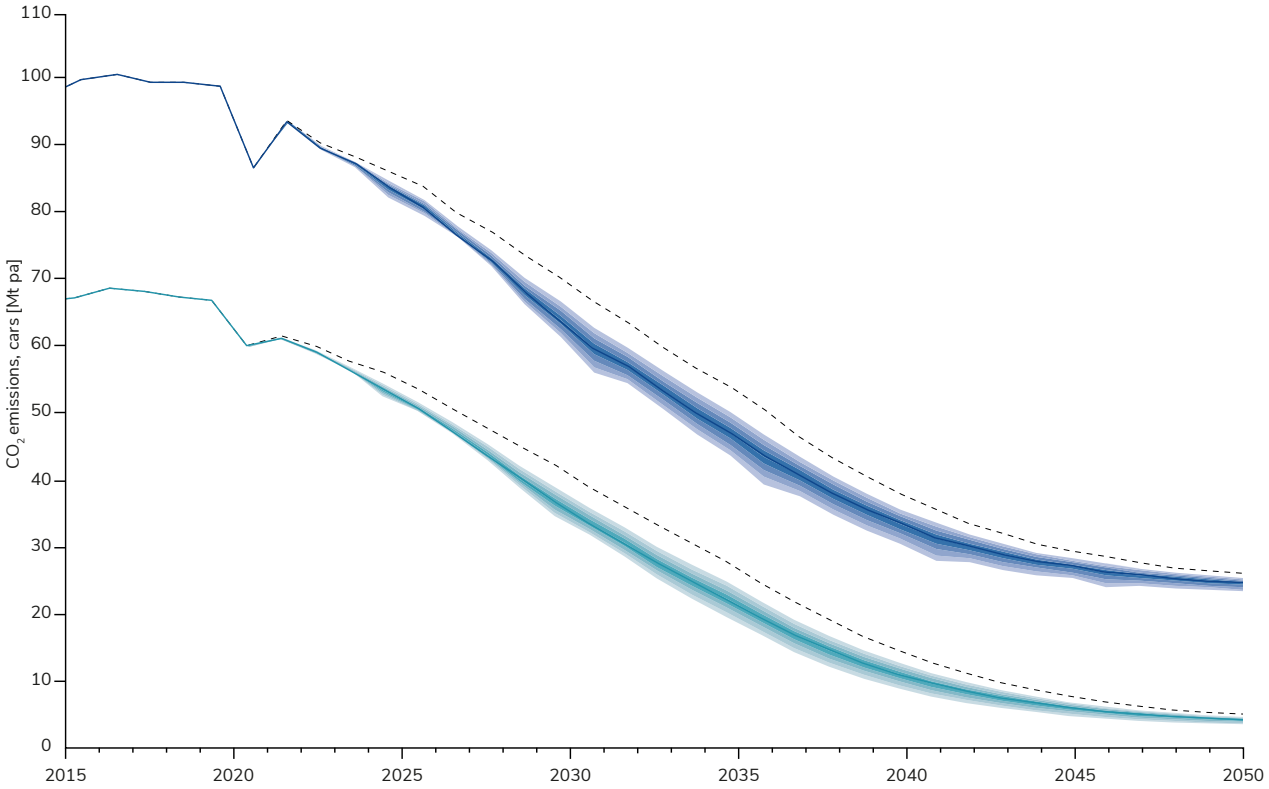


phasing in the phase out could achieve cumulative savings of 30 $MtCO_2$ over the next 10 years

Setting a clear, phased approach would provide motor manufacturers with market certainty as consumers are steered towards greener vehicles. If implemented early, it may also buy time beyond 2030, potentially allowing for the phase out date to be pushed a little further, thus alleviating some manufacturers' concerns that they cannot transition in time.

In sum, we recommend a market transformation approach now targeting the highest emitters early, in addition to ending the sale of fossil fuel vehicles in 2030. Both policies need to be supported by accelerated investment in EV charging networks and campaigns that inform buyers of the benefits of electrification and the pitfalls of buying larger, higher carbon vehicles. Earlier action would also create additional economic activity and net jobs in the UK.[13]

Figure 1: CO_2 emissions from cars, in the baseline and market transformation scenarios



Key:
- depicts baseline
- Lifecycle CO_2 emissions = direct/tailpipe emissions+ fuel production+ vehicle production, maintenance, end-of life.
- Direct CO_2 emissions = direct/tailpipe only.

The Green Homes Grant is a great start. What next?

Robert Gross, UKERC Director; Faye Wade, University of Edinburgh; Richard Hanna, Imperial College London; Phil Heptonstall, Imperial College London

The Treasury has estimated that the Green Homes Grant introduced as part of the COVID-19 recovery package, spent over one year, could support more than 100,000 jobs.[17] Energy efficiency products and services, including lighting, currently provide around 150,000 jobs in the UK (see Figure 2, pg 10) - this equates to over two thirds of UK employment in low carbon and renewable energy businesses, according to the Office for National Statistics.[18] Future projections for England estimate that, by 2030, roughly 160,000 jobs will be in low carbon heat, and another 145,000 will be in energy efficiency products, including insulation, lighting and control systems.[19]

Build back better

There are many good reasons to prioritise energy efficient refurbishment. The UK has one of the oldest, most poorly insulated and draughty housing stocks in Europe.[20] Space and water heating in buildings contributes around 40% of UK energy consumption and 20% of UK greenhouse gas emissions.[21] Several recent reports make a strong case for the co-benefits of investing in home energy refurbishments.[22, 23]

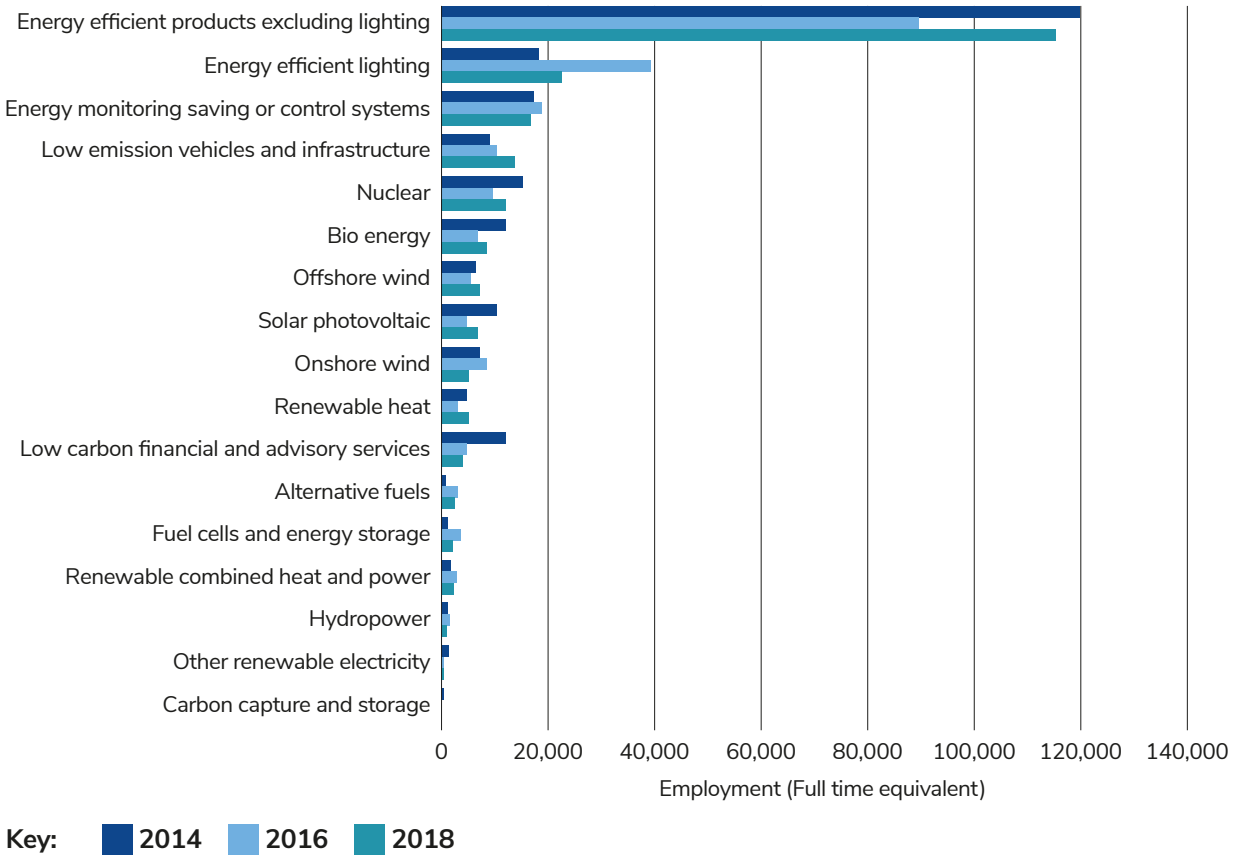
Properly insulating UK homes can help to alleviate fuel poverty, meet the UK's longer-term net zero climate target, and support a just transition. It can also create jobs in a distributed way around the country, including "levelling up" in regions most affected by unemployment and lack of investment. Doing this for just one year would have limited benefits for the climate, and that is why UKERC analysis argues for a long-term commitment.[24]

Skills gaps

One of the biggest challenges to realising the benefits of an energy efficiency programme is the availability of appropriately skilled workers. For example, a key near-term (2020-2025) skills gap has been identified in the design, specification and installation of heat pumps.[19] The complex processes involved in energy retrofitting also require 'energy literacy' across all construction roles.[25] Delivering the new skills needed for retrofitting our homes will require a rapid shift in the UK's provision of existing vocational qualifications. The recovery package is an opportunity to develop new structures for the provision of training so that skills gaps can be filled.

[17] HM Treasury, 2020. A Plan for Jobs 2020. Access here.
[18] ONS, 2020. Low carbon and renewable energy economy, UK: 2018. Access here.
[19] LGA, 2020. Local green jobs – accelerating a sustainable economic recovery. An Ecuity Consulting report for the Local Government Association. Access here.
[20] Association for the Conservation of Energy, 2015. The cold man of Europe – 2015. Access here.
[21] CCC, 2016. Next Steps for UK Heat Policy. Access here.
[22] Energy Efficiency Infrastructure Group, 2020. Rebuilding for Resilience. Access here.
[23] IPPR, 2020. Transforming the economy after Covid–19. Access here.
[24] Rosenow et al., 2020. The pathway to net zero heating in the UK. Access here.
[25] Clarke, et al., 2017. What kind of expertise is needed for low energy construction? Access here.

Figure 2: Low carbon and renewable energy employment estimates by sector in the UK, 2014 to 2018



Source: ONS, 2020

Employment is measured in full-time equivalents (FTEs) and is rounded to the nearest 100. For carbon capture and storage in 2016 and 2018, employment was estimated to be less than 100 and is not shown in the chart. All employment estimates are subject to uncertainty ranges not shown in the chart: coefficients of variation and 95% confidence intervals.

This must include general knowledge of low energy construction and skills in understanding the 'whole house' needs, alongside tailoring to specific skills for the trade or role.

Energy efficiency is a good start: what next?

There is good evidence to support a focus on household energy efficiency as a priority for stimulus spending linked to decarbonisation, provided the right training is provided. But the question still arises as to what next?

In a speech in October 2020, Prime Minister Boris Johnson highlighted the potential of offshore wind to create jobs, so is the Government right to focus on clean growth? UKERC has two current strands of research relevant to this topic: we have ongoing research on energy and economic growth and we have embarked upon a fresh review of the evidence for net job creation from policy support for energy efficiency and renewable energy, updating 2014 research (Blyth et al, 2014).[26]

In this research we found that job impacts are assessed in two ways. Many studies provide estimates of the gross impact of individual low carbon energy related projects. However, it is also important to consider the jobs that might be lost changing from one form of energy to another – the loss of jobs in fossil fuel extraction and processing for example. Some authors explicitly calculate the net job impact taking account of job losses. Although UKERC found this to be a smaller set of literature, we were able to compare the net impacts of investing in renewable energy with investing in fossil fuels.

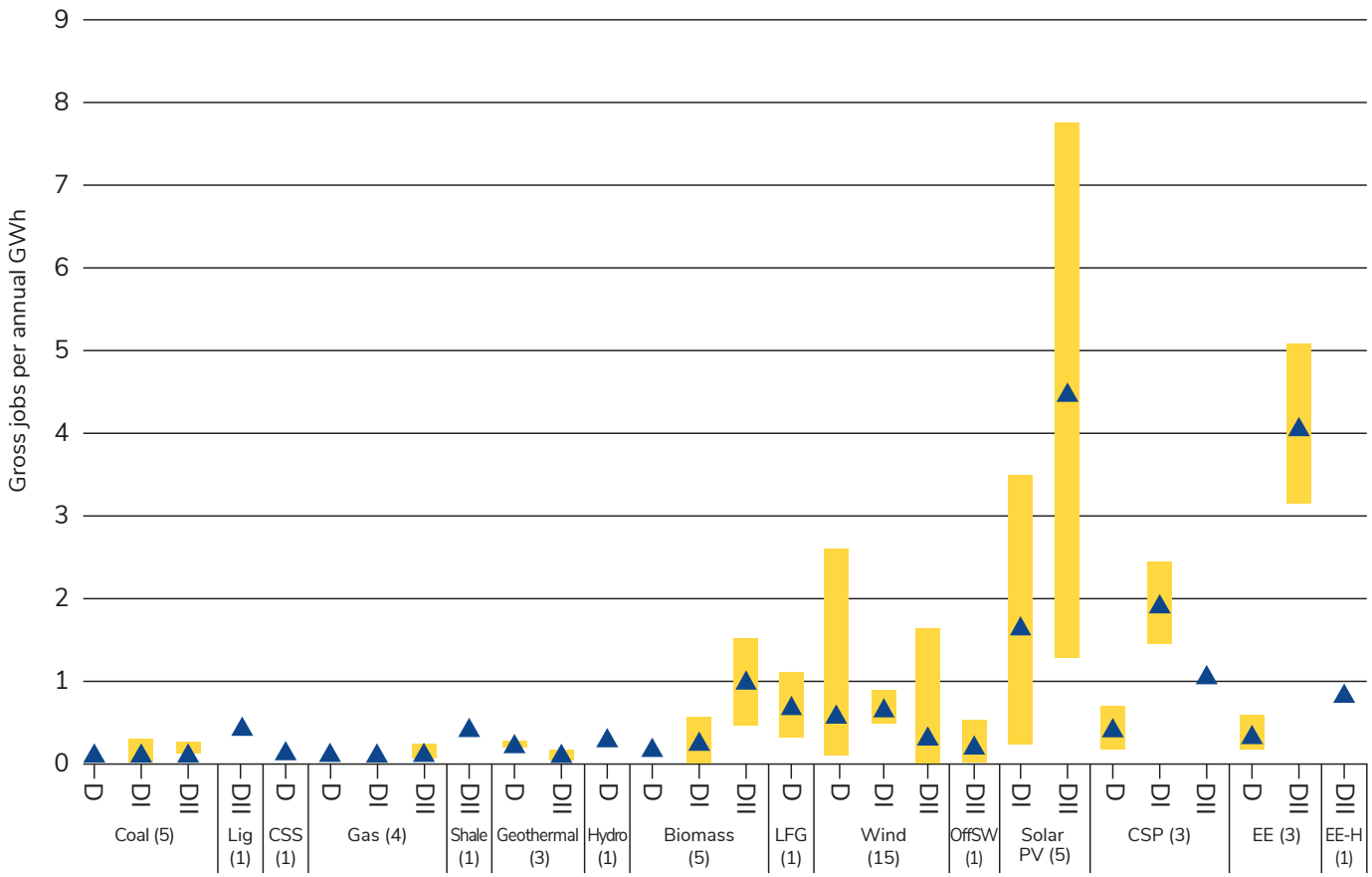
Creating jobs

UKERC's analysis from 2014 makes interesting reading, by calculating the impacts from a wide range of studies we found good evidence that in general, renewable energy and energy efficiency are more labour-intensive than either coal- or gas-fired power plant, as illustrated in Figure 3. This finding holds when assessing job creation on both a gross and net basis.

This suggests that at least in the short-term, building new renewable generation capacity or investing in greater energy efficiency would create more jobs per unit of energy delivered than investing in an equivalent level of fossil fuel-fired generation. It is interesting to note that in 2014 renewable energy tended to be significantly more expensive than fossil fuels, a factor that has changed significantly in the interim as renewable energy costs have fallen. Our new analysis will assess how this changes the overall picture.

[26] Blyth, W., Gross, R., Speirs, J., Sorrell, S., Nicholls, J., Dorgan, A, and Hughes, N, 2014. The evidence for net job creation from policy support for energy efficiency and renewable energy. A report by the UKERC Technology & Policy Assessment Function November 2014 v. 2. Access here

Figure 3: Gross jobs per annual GWh generated



Key: ▲ Average ▬ Range Number of studies in brackets.

D: Direct jobs
DI: Indirect jobs
DII: Induced jobs
CCS: Carbon capture and storage
LFG: Land-fill gas
OffSW: Offshore wind
CSP: Concentrated solar power
EE: Energy efficiency
EE-H: Energy efficiency in households

Source Blyth et al., 2014

Long-term issues

Policies have economic and societal impacts beyond their initial stimulus impacts. This is particularly true for decisions that concern long-lived strategic infrastructure, like power lines, road or rail links, or pipelines for CO_2. In these cases, it is important to assess the balance of costs and benefits to the economy in the longer term. Projects that have a persistent and beneficial impact on the economy beyond the timeframe of the initial stimulus effects should also contribute to long-term sustainable growth. In this longer-term context, labour intensity is not necessarily economically advantageous. If it implies lower levels of labour productivity (economic output per worker), then it could ultimately have adverse economic effects. The economic characteristics that matter in the long-run are not jobs per unit of investment, or per unit of energy, but whether or not the investment contributes to an economically efficient transition towards the country's strategic goals.

Since the UK has far reaching ambitions to create a low carbon economy it makes sense to look beyond short-term job creation to consider the options that will provide affordable and resilient low carbon energy services. This is particularly true where there are co-benefits such as improved air quality, more comfortable homes, resilient energy supplies, or reduced congestion.

The Clean Growth agenda can also help create new industrial sectors with export potential, particularly if this can be done in less-prosperous regions or where fossil fuel supply chains could be partially repurposed (for example in the North Sea).

It may appear a little trite to suggest that the response to COVID-19 is simply to do everything that is already in the Clean Growth Strategy[27] and more. However, a strong economic case can be made to do just that.

[27] BEIS 2017. Clean Growth Strategy. Access here.

Brexit: running out of time at a crucial moment

Caroline Kuzemko, University of Warwick;
Antony Froggatt, Chatham House;
Mike Bradshaw, Warwick Business School

With the UK due to leave the EU on the 1st January 2021, the Brexit options still on the table have been reduced to either a very narrow deal, or No Deal. Time is also running out to establish alternative arrangements given that both options involve changes to current energy policies and/or practices. Indeed, no alternative to the EU Emissions Trading Scheme (EU ETS) has yet been agreed, which runs the risk of leaving a temporary gap in UK carbon pricing whilst a new regime is established. Alongside this, leaving the Internal Energy Market (IEM) is likely to place upward pressure on energy prices and create market uncertainty.

Brexit, and of course COVID-19, are taking up large parts of the UK civil service's policy capacity at a vital time for climate and energy policymaking, but there are also questions around global climate leadership. Delays to new carbon pricing arrangements, the Energy White Paper, and other vital policy developments do not bode well for the UK in the run up to hosting the UNFCCC's COP 26 in November 2021.

Implications for current energy policy

For several decades the UK's energy and climate policy has, in part, been based on integration with the EU. There have been clear advantages of this: membership of the EU ETS; developed trading rules; access to larger-scale markets, with implied benefits for economic efficiency and consumer prices; and interconnections that assist with electricity trade and accommodating the rising shares of wind and solar generation. Indeed, these benefits may well have increased with time and more interconnectors.[28] In addition, the EU has been a steady source of sustainable funding and policy implementation capacity, making a break with the EU will, without policy intervention significantly affect this.

As the UK leaves the EU ETS and the IEM on 1st January 2021 it will lose many of these advantages. As such, crucially, new domestic rules for emissions trading or carbon taxes, and EU trading and interconnection need to be agreed, but there is scant time left to negotiate and prepare for any new arrangements. This implies there will be a high degree of market uncertainty in the near to medium term.

For example, the UK would like trading across interconnectors to be 'transparent, market-based and non-discriminatory', thereby hoping that it will continue to have access to implicit trading and market coupling in the day ahead market. However, this may well not be possible, which could lead to a situation where the interconnectors between GB and the continental market will be switched to explicit trading (i.e. not including the transmission capacity in the auction). This could be seen as effectively a 'No Deal' for the electricity sector, and place upward pressure on UK consumer energy prices.

[28] Newbery et al., 2019. The benefits of integrating European electricity. Access here.

Another area of considerable uncertainty is over the type of carbon pricing mechanism, a core policy tool in the UK's emissions reduction so far. The UK government's preferred option is to develop a domestic trading regime linked to the EU ETS, similar to Switzerland. However, it remains unclear if the EU is willing to have a linked system.[29] If the UK's trading system is not linked to the EU ETS, then questions still remain: not least whether to establish a domestic only trading system, or move towards a taxation system. Either way, too little time remains to establish a new carbon pricing mechanism before the month is up.

Longer-term implications

Whilst time is running out to address climate change,[30] current energy policy is insufficient to meet existing UK carbon budgets,[31] let alone net zero energy. The scale of change required is large, inferring an urgent need for a comprehensive new sustainable energy policy programme and public and private investments.

Unfortunately, however, a series of much needed zero carbon policies have been delayed – firstly as a result of Brexit,[32] and then COVID-19. Indeed, it takes a good deal of policy capacity to re-envision energy policy towards meeting zero carbon targets, but Brexit has meant that it has not been possible to focus all relevant policy effort on decarbonising.

There may also be an impact on overall public spending capabilities. The Office for Budget Responsibility (OBR) estimates that, on the assumption of a 'typical' trade deal, there would be a 5.2% loss to UK GDP over the next 15 years, whilst estimates for No Deal estimate a far greater loss.[33] This hit will be in addition, of course, to COVID-19 economic impacts.[34] Within this context any Brexit-related upward pressures on energy prices (which will be exacerbated if the value of the pound deteriorates further) may well have negative implications for consumers. Furthermore, lower financial inflows for the Treasury as a result of lower growth, and in the instance that EU financing programmes are not replicated, does not bode well for public spending on sustainable energy.

[29] BEIS Committee, 2020. Letter re UK ETS Common Framework to Rt Hon Kwasi Kwarteng MP. Access here.

[30] IPCC, 2018. Special Report, Global Warming of 1.5OC. Access here.

[31] CCC, 2020. Reducing UK emissions: 2020 Progress Report to Parliament. Access here.

[32] Mason and Harvey, 2020. Boris Johnson doesn't get climate change, says sacked COP 26 head. Access here.

[33] OBR, 2019. Fiscal risks report – July 2019. Access here.

[34] For a perspective piece on the implications of COVID-19 for the politics of decarbonisation in energy see: Kuzemko et al., 2020. COVID-19 and the politics of sustainable energy transitions. Access here.

Lastly, much is still to be negotiated with the EU post December 2020. If a deal is struck it is likely to be easier to keep talking about wider relations but, if not, there is a risk that the UK enters a cycle of recriminations with the EU that lasts some time. Brexit related delays to key energy decarbonisation policies do not augur well for the UK's global climate leadership in the run up to COP 26, which the UK is hosting jointly with Italy. Outside of the EU, the UK will have to submit its own Nationally Determined Contribution (NDC) as part of the Paris Agreement. The extent of the UK's ambition within its own NDC will be seen as an important signal for collective pledges to meet the objectives of the Paris Agreement, and the UK will also be open to scrutiny in relation to meeting current targets.

On balance, given upward pressure on energy prices, delays to policy, and uncertainty surrounding new rules, the overall effects of Brexit are not positive for UK energy decarbonisation. The Government will need, therefore, to make a concerted effort to ensure that 'taking back control' does ultimately enable the UK energy system to make meaningful and sustained progress in terms of the transition towards net zero.

Heat in the UK: a decade of delay

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Heating, including that used in industry, is the largest part of UK energy demand, equating to 44% of UK energy consumption.[35] Currently fossil fuels dominate – around 85% of UK homes and many businesses use natural gas, and a substantial number of off-gas homes use heating oil. The legislation for net zero means by 2050, fossil fuels currently used for heating, will need to be replaced with a low-carbon alternative.

As mentioned previously in this review, the UK's relatively inefficient housing stock represents a particular issue for heat decarbonisation, exacerbating issues around fuel poverty and energy costs. As well as considering technology pathways, policy makers must focus on equity and co-benefits of the heat transition. Treating energy efficiency as a priority would provide carbon, cost and economic benefits. However, the required rate of change is mammoth and supply must be decarbonised at the same time as demand reduced.

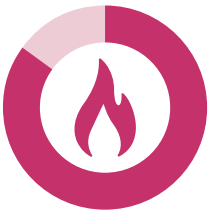
A recent UKERC report showed an important role for building fabric energy efficiency improvements, electrification of heat demand, growth in heat networks, and a potential but uncertain longer-term role for hydrogen.[36] Rapid technology deployment, large-scale trials, and an open debate about the impacts, costs and benefits of heat decarbonisation should be an immediate policy priority.

Why are we waiting?

Heat decarbonisation can deliver significant co-benefits, these include more comfortable homes, improved internal air quality, new green jobs and increased energy security. Despite the benefits, it is considered a major challenge due to the high carbon abatement cost compared to other sectors, the potential for disruption, and questions over who pays. These challenges may explain why despite having decarbonisation targets for well over a decade, UK progress on heat, particularly in homes, is limited. The recent interest in hydrogen to decarbonise the gas supply means that policy makers view action on heating as not just disruptive, but also uncertain.[37]

What should the UK be doing?

The Climate Change Committee (CCC) recommends energy efficiency measures and a roll-out of technologies including heat pumps and district heating potentially in conjunction with hydrogen, such that by 2035 all replacement systems are low-carbon or suitable for the use of hydrogen.[38, 39] This is consistent with UKERC modelling, which demonstrates a strong role for heat pumps and district heating if a carbon tax makes natural gas heating uneconomic.[40]



around 85% of UK homes and many businesses use natural gas

[35] BEIS, 2018. Clean Growth - Transforming Heating Overview of Current Evidence. Access here.

[36] Rosenow et al., 2020. The pathway to net zero heating in the UK. Access here.

[37] Lowes et al., 2019. Policy change, power and the development of Great Britain's Renewable Heat Incentive. Access here.

[38] This briefing went to press before the CCC 6th Carbon Budget was published. Access here.

[39] Climate Change Committee, 2019. Net Zero The UK's contribution to stopping global warming. Access here.

[40] Broad et al., 2020. Decarbonising the UK residential sector: The dependence of national abatement on flexible and local views of the future. Access here.

the CCC recommend the insulation of 545,000 lofts, 200,000 cavity walls and 90,000 solid walls each year

The deployment of energy efficiency measures in buildings needs to accelerate. The CCC recommend the insulation of 545,000 lofts, 200,000 cavity walls and 90,000 solid walls each year - in 2019 deployment was 5%, 21% and 12% of these targets, respectively.[41] In contrast to low-carbon technologies, energy efficiency measures are better understood, may have short payback periods, and can reduce bills as well as carbon. The roll-out of energy efficiency has reduced by 90% since the closure of the Carbon Emissions Reduction Target scheme in 2012[40] and the policy gap left by the 'Green Deal' has still not been filled.[42] The challenge here appears primarily one of political will.

The deployment of heat pumps, widely seen as a key technology, remains below the level suggested by the CCC[40] and new homes continue to be connected to the gas network at a far greater rate than buildings are being decarbonised. The Renewable Heat Incentive, currently the key policy to deploy low carbon heat across Great Britain, has delivered well below expectations.[43] It is due to close in April 2021 for non-domestic systems,[44] with no apparent replacement. BEIS plans to extend the domestic RHI to April 2022 and then replace it with a 'Clean Heat Grant', but analysis suggests that its ambition is well below what is required.[45]

Heat networks are considered a low regrets option for areas of high heat density and diversity, but developments remain small and slow, and limited UK expertise restricts their current value as a net zero contributor – analysis suggests deployment rates need to triple to meet net zero goals.[36]

The £320 million Heat Networks Investment Project (HNIP), announced in 2018 for England and Wales, was a major step, but thus far only £53 million has been allocated.[46] The March 2020 UK Budget also included £270 million for a Green Heat Network Scheme,[47] whether this is repurposing HNIP budget is not yet clear. Scottish Government has led the UK with area-based heat and energy efficiency planning, and regulation and licensing of district heating is now proceeding to legislation.[48] Overall UK progress on heat networks remains limited, despite recognition of the carbon saving value of economically-viable networks.[49]

The importance of evidence based policy-making

The idea of using hydrogen to decarbonise the gas grid continues to rise up the UK energy policy agenda. Although this hydrogen strategy should not be dismissed, there is a need for independent appraisals of feasibility studies and the nature of any transition to hydrogen. Clearly, vested interests are challenged by decarbonisation – it is unsurprising that political lobbying is happening and pro-gas coalitions are forming.[50] The size of the incumbent industry provides both capacity for political engagement and the development of feasibility studies and analysis.

41 Climate Change Committee, 2020. Reducing UK emissions Progress Report to Parliament. Access here.

42 We note some regional variation in energy efficiency deployment

43 National Audit Office, 2018. Low carbon heating of homes and businesses and the Renewable Heat Incentive. Access here.

44 A six month application extension is being considered. BEIS 2020. Changes to RHI support and COVID-19 response: further government response. Access here.

45 Lowes, 2020. Heat: a policy chasm on the route towards net-zero. Access here.

46 Triple Point Heat Networks, 2020. Access here.

47 HM Treasury, 2020. Budget 2020, pgs 63 and 81. Access here.

48 Scottish Parliament. Heat Networks (Scotland) Bill. Access here.

49 BEIS, 2020. Heat networks: building a market framework. Access here.

50 Lowes and Woodman, 2018. Incumbency in the UK heat sector: implications for low-carbon heating. Access here.

This highlights the importance of evidence-based policy making for reasons of consumer and environmental protection. We encourage open policy making around this and other energy issues to ensure that decisions are based on the best available evidence. Greater transparency around political lobbying would support this aim.[36]

Time for action

The multi-decadal nature of heat transitions,[51] the lack of progress and the effects of incumbency make it increasingly unlikely that heat will be decarbonised by 2050. Even cost-effective energy efficiency solutions, which reduce carbon are not being prioritised by policy makers.

Rapid progress is needed across all elements of heating. The energy efficiency policy vacuum must be filled, heat networks deployed in areas of high heat density, and heat electrification prioritised in off-gas areas.

While the recently announced £2 billion for low carbon heat and energy efficiency is welcome, analysis by the CCC suggests £10 billion is needed each year to 2050.[39]

Meanwhile an in-situ hydrogen conversion project should be prioritised to reduce the uncertainties and uncover costs, but should not be used as an excuse for lack of progress on known low carbon heat technologies.

The Prime Minister's 10 point plan, if followed through, may fill some of the current heat policy vacuum. However, UK energy policy around buildings, such as that associated with zero carbon homes and energy efficiency, has a poor track record of moving from target to deployment. Further still, the proposals say little about heat networks and energy efficiency, despite their known decarbonisation value.

A strategic approach and a combination of policy measures is needed to support the UK's heat transition. The recent UKERC briefing 'The pathway to net zero heating' considered specific policy requirements including: levelling up the cost differential between gas and electricity; using building regulations to encourage certain technology choices; using financial tools including taxes and grants to balance decision making with consumer protection; and providing long term policy signals.

In light of net zero timescales, developing a combined package of equitable heat decarbonisation policies should be prioritised.

[51] Gross and Hanna, 2019. Path dependency in provision of domestic heating. Access here.

Societal engagement with energy and climate change beyond the citizens' assembly

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The changing climate for engagement

The last 12 months have seen unprecedented changes in how citizens engage with energy and climate change. This is set within an already rapidly changing climate for engagement with the rise of social movements for climate action, like Fridays for the Future and Extinction Rebellion, through to the mainstreaming of citizens' assemblies. The COVID-19 pandemic is having profound impacts on society, dramatically changing consumption, energy use and travel, shifting participation online, and revealing inequalities that prompt reflection on our own collective futures.

With these developments it seems people are waking up to the importance of societal engagement with energy and climate change. This view is shared by the Climate Change Committee (CCC), which recently advised the Scottish Parliament that *"It will not be possible to get close to meeting a Net Zero target without engaging with people"*,[52] reiterating its advice to governments of the UK that *"Over 60% of the abatement in our net zero scenarios to 2050 involve some degree of change from consumers"*.[53]

While the increased recognition of citizen participation is promising in terms of just transitions, recent events expose the limitations of dominant approaches to engaging society. A common diagnosis for those steering low-carbon transitions or responses to COVID-19 is that 'the public' is neither sufficiently engaged nor informed. The standard prescription that flows from this is for better forms of communication and institution-led engagement to shift behaviours or capture public views at fixed moments in time. The CCC sum up this approach as *"Government leads, people act"*.[52]

At best this is only half right. While education and public consent are important, so too is the flipside – "People lead, Government acts". In other words, people are already engaged and government (and other actors) must listen and respond. UKERC research has shown that people are not simply uninformed but rather are already engaged with issues relating to low-carbon transitions in multiple and diverse ways.[54, 55] We are seeing that public participation can no longer be reduced to discrete isolated moments, but is rather continually ongoing, dynamic and interconnected.[56] This calls for new ways of seeing, doing and responding to diverse societal engagements with energy and climate change.

[52] Climate Change Committee, 2020. Reducing emissions in Scotland 2020: Progress Report to the Scottish Parliament. Access here.
[53] Climate Change Committee, 2019. Net Zero – The UK's contribution to stopping global warming. Access here.
[54] Chilvers, et al., 2017. Public engagement with energy: broadening evidence, policy and practice. Access here.
[55] Pallett et al., 2019. Mapping energy participation: a systematic review of diverse public engagements in the UK energy system. Access here.
[56] Chilvers et al., 2018. Ecologies of participation in socio-technical change: The case of energy system transitions. Access here.

The many assemblies of citizens

The UK's first nationwide citizens' assembly on climate change was a significant moment in 2020. Climate Assembly UK brought together 108 UK citizens over six weekends to provide recommendations on the question: "How should the UK meet its target of net zero greenhouse gas emissions by 2050?"

The assembly members produced wide-ranging recommendations on topics spanning from what we buy and eat, to how we should heat our homes and remove greenhouse gases from the atmosphere. They identified cross-cutting principles of education, fairness, freedom and choice, co-benefits, and nature, that should guide the UK's approach to net zero.[57] These recommendations were welcomed by many politicians as a mandate for bold action. Select committees are now looking into the findings but questions remain over whether Government will listen and respond.

While the organisers went to great lengths to ensure the citizens' assembly was "*representative of the UK public*", there is a danger that Climate Assembly UK is simply taken to equal "*the views of the UK Public*".[58] Rather it is one representation of public views, formed in a particular way, for particular purposes, at a particular moment in time. There are many other publics and forms of participation with energy and climate change which offer alternative visions of the transition, ways of framing the problem, directions of travel, views on governance, and so on.[59, 58] A key challenge for those in power, therefore, is not only to represent individual citizens through a citizens' assembly (or other means), but also to ensure that the many other assemblies of citizens are represented, listened to and allowed to act on energy and climate change.

'New normals' for engagement

Whilst Climate Assembly UK undoubtedly represents a critical moment, it should not be seen in isolation. Looking beyond Climate Assembly UK then, undoubtedly the single biggest influence on how society has engaged with energy and climate change over the last 12 months comes from outside the energy sphere: COVID-19.

COVID-19 has dramatically altered the landscape of engagement with energy and climate change. Overnight, as the country was placed under lockdown, there were dramatic changes to people's everyday energy use. With people spending more time at home, behaviour and energy use changed. The first lockdown occurred during spring and summer, negating potential heating bills, but with the further lockdowns heading into winter energy use will undoubtedly rise potentially adding over £100 to annual energy bills.[59] Levels and patterns of mobility also changed and, whilst car use has almost bounced back to pre-COVID-19 levels, flights and use of public transport remain low. These changes have already led to increased concern over energy bills and a rise in those seeking help and support from suppliers or other support services,[60] and there is considerable fear over a significant rise in fuel poverty as increased energy use combines with lost or squeezed incomes this winter.[61]

Beyond these personal and domestic engagements in everyday life, COVID-19 is changing the ways people participate in communities, politics and public debate. Up and down the country, community energy initiatives have not only had to develop new ways to support often struggling communities, but also rapidly develop ways of doing so in a COVID-secure fashion.

[57] Climate Assembly UK, 2020. The path to net zero: Climate Assembly UK Full report. Access here.

[58] Extinction Rebellion, 2020. Extinction Rebellion welcomes Climate Assembly UK, but mourns its lack of urgency and agency. Access here.

[59] Ambrose, 2020. Working from home in UK over winter 'will add £100 to fuel bills. Access here.

[60] Ofgem, 2020. Consumers' experiences with energy during the Covid-19 pandemic: Summary of research findings. Access here.

[61] National Energy Action, 2020. UK Fuel Poverty Monitor 2019-20. Access here.

New forms of protest have also emerged as COVID-19 has pushed some activism online. Indeed, wholly new foci of protest have emerged as, in some areas, responses to newly introduced Low Traffic Neighbourhood (LTN) plans have led to at times fierce resistance.

Over the longer-term, even if energy use and mobility rebound to pre-COVID-19 levels, we must now get to grips with a range of 'new normals' for societal engagement. Ongoing attempts to 'build back better' for a green recovery must grapple with new migrations away from cities, the need for housing suitable for home-working, all in the context of rising inequality, a reduction in social cohesion,[61] and falling trust and confidence in science and government.[62]

A new way of SEEing and doing public engagement

There is no easy response to this highly dynamic, interconnected and uncertain landscape of societal engagement revealed by Climate Assembly UK and COVID-19. What it does show, however, is the inadequacies of the discrete, static and one-off approaches that currently predominate. Communication, behavioural change and citizens' assemblies (amongst other invited approaches) have a role to play, but will not be enough on their own. The engagement mix for energy and net zero transitions needs to be much more ambitious, diverse, joined-up and system-wide. It needs to be ongoing and responsive to how public values and actions are constantly morphing, including in response to issues that are seemingly well outside of the energy system.[63]

What is needed is a whole-systems approach to track, trace and test societal engagement with energy and climate change on an ongoing basis. This must be capable of tracking diverse forms of societal engagement as they emerge and change over time. It involves tracing their interconnections and the different public visions, values and actions produced. It means developing and testing new systemic practices and institutional arrangements for public engagement that embrace and are responsive to this vibrancy, rather than seeking solely to control, suppress or eliminate it.

We have recently developed such a capability in UKERC in the form of an Observatory for Societal Engagement with Energy (SEE).[64] The Observatory is developing new approaches to map and monitor diverse forms of public participation and engagement with low-carbon transitions on an ongoing basis. It is connecting different communities from across this societal engagement mix, serving as a platform for reflective learning and a more joined up approach. With the social intelligence produced being translated with partners in government, business and civil society to help make low-carbon energy transitions more just, responsible and responsive to society.

[62] POST, 2020. Life beyond Covid-19: What are experts concerned about? Access here.
[63] Fancourt et al., 2020. The Cummings effect: politics, trust, and behaviours during the COVID-19 pandemic. Access here.
[64] Royston et al., 2020. Invisible energy policies: A new agenda for energy demand reduction. Access here.
[65] Societal Engagement Observatory. Access here.

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