



**UK Research
and Innovation**

Public attitudes on clean growth

**A Sciencewise Programme Social Intelligence
Report**

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May 2019**



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Executive summary

The research undertaken as part of this Social Intelligence Report highlighted several consistent themes in terms of public attitudes toward *clean growth*, a term defined by the Department for Business, Energy and Industrial Strategy (BEIS) as “[growing our national income while cutting greenhouse gas emissions](#)”. These themes are also reflected in the results of the public engagement activities that this report has examined.

As clean growth is a very broad topic (and one that is subject to constant change, development and innovation), this Social Intelligence Report should not be considered as exhaustive. Instead, as described in the following section, the report represents an ‘up-to-date baseline of our current understanding’. Given that this report is a ‘snapshot’ view of the topic, we would welcome any suggestions for further reading, discussions, or data sources. Any recommendations should be directed to [Sciencewise](#) on 0203 745 4334 or info@sciencewise.org.uk.

Given the breadth of ‘clean growth’ as a topic, and the low level of public awareness towards this term, the primary focus was on public views on responses to climate change, and energy and power sources in the UK. The following top-level conclusions therefore refer, in several cases, to climate change in general rather than clean growth. The conclusions are nevertheless relevant to both terms:

1. There is a broad level of public agreement on the existence of climate change, and the (at least partial) human influence on it. However, there is notably less agreement on the seriousness of the consequences of climate change.
2. Public awareness of ‘clean growth’ remains consistently low; the term itself is not widely known. The effectiveness of future public engagement, in general, may be influenced, to a considerable degree, by the level of public awareness and knowledge of ‘clean growth’.
3. Public awareness of clean growth varies according to demographic and socioeconomic factors, as shown by the BEIS Public Attitudes Tracker. It is likely that the effectiveness of future public engagement will depend on its capacity to appeal to different social groups, and tailor its approach accordingly.
4. There is a widespread desire among the public for leadership and direction on climate change mitigation; leadership from businesses, but most notably from Government. There is a considerable public desire for decisive, ambitious, and ethical action.
5. Public engagement activities on climate change have thus far focused on individual or societal responsibility (for present circumstances and solutions), rather than the responsibilities of Government.
6. Existing critiques of public engagement on clean growth frequently recommend a more holistic approach from Government.
7. These critiques also stress the importance of clear consumer benefits to public engagement efforts, based on tangible results rather than more general environmental benefits. For much of the public, climate change is consistently viewed as distant or ‘abstract’.

8. For this reason, the more visible aspects of climate change (such as extreme weather conditions)¹ are recommended throughout the available research as a basis for public engagement, since it encourages the public to consider climate change as ‘local’ and immediate.

The points above inform our *General recommendations for public engagement* at the end of this report. These recommendations relate to:

1. Understanding the public *and* engagement: not to *generate* public enthusiasm on this topic but instead to *engage* the enthusiasm that already exists, with the caveat that public understanding on several key terms and themes remains low.
2. Promoting a holistic approach to engagement: one that is not necessarily uniform, but guided by clear, consistent and interconnected principles that reflect the nuances and particularities of different social groups.
3. While taking a more holistic approach will take time to develop across Government, it should not prevent individual departments exploring specific issues with the public as required.

1. Introduction

1.1 – Structure of the Social Intelligence Report

This Social Intelligence Report discusses public views and attitudes toward clean growth and related topics and technologies, as listed below. This report aims to support policy-makers in developing future deliberative dialogue and public engagement activities to support policy development by providing an up-to-date baseline of our current understanding of public attitudes in this area.

The Department for Business, Energy and Industrial Strategy (BEIS) defines ‘clean growth’ as “growing our national income while cutting greenhouse gas emissions”. This Social Intelligence Report focuses primarily on public views on responses to climate change, and energy and power sources in the UK.² The report is therefore structured according to relevant topics such as climate change, heat, and electricity.

For each of these topics – which can be read in isolation (according to areas of interest or activity), or collectively – we present and address the following questions:

- What is the public’s awareness of the topic, and how much does the public understand about it?
- What hopes and concerns do the public have?
- What do the public see as barriers to progress?

¹ Though modelling suggests such events may become more common, tracing particular extreme weather events to climate change remains problematic and contentious; see ‘Public attitudes on climate change and decarbonisation’.

² Wider topics on clean growth would include: embedded energy in the products consumed in the UK via import, and the topic of ‘green finance’.

- What trade-offs are the public willing to make?
- What safeguards and conditions do the public want to see?
- What do the public expect from the Government and how much progress do they think the Government has made?
- What ethical and social considerations do the public raise?

The report discusses recent public engagement and dialogue on these topics (and the technologies associated with them), as well as social research. In compiling the report we have focussed on three principle sources of information:

- *Literature Review*: published literature on public engagement with (and attitudes to) the above topics in the last 3-5 years, e.g. surveys, focus groups, public dialogues
- *Activity Review*: public engagement events and science communication activities that have been carried out; especially those that fall outside formal literature and/or reporting
- *Parliamentary evidence*: the submission of evidence to relevant public inquiries, which addresses public attitudes and views to the above topics

This report discusses legislation and government policy, public attitudes, and public engagement efforts in the context of several key topics, which form the structure of the report:

- *Clean growth*: awareness of the term, and governmental efforts to spread awareness of it
- *Heat*: attitudes toward specific heat technologies, and key considerations for public engagement and future behavioural change
- *Electricity*: perspectives on renewable energy, and discussions of the UK's transition to a low carbon energy system
- *Additional carbon mitigation measures*: debates around the practical, economical and ethical elements of new carbon mitigation technologies, as well as lifestyle changes

This structure reflects the specific, focused nature of public engagement campaigns, as well as the nuances in public attitudes on clean growth and climate change (i.e. dependent on the topic in question). Nevertheless, the report will draw upon the conclusions from each of these topics in order to identify common themes and propose recommendations for future research.

Climate change – specifically, the debate around whether it is a real phenomenon, and how to tackle it – is an important part of the overall context for public engagement on clean growth. It is therefore an essential topic for contextualising this report. The following sub-sections will discuss legislation, policy, and public attitudes on climate change, as well as relevant public engagement efforts.

1.2 – Legislation and Government policies on climate change

Although the Paris Agreement³ is not legally binding, a large and increasing number of countries have put in place national legislation that ensure their own commitments have legal structures. In the case of the UK, the [2008 Climate Change Act](#) provides a legal basis for the UK's emissions

³ See [Paris Agreement: essential elements](#).

reductions and its contribution to international frameworks. An independent climate watchdog, the Committee on Climate Change (CCC), was also created under the Act, in order to provide advice to the UK Government on its targets and related policies.

The Department for Business, Energy and Industrial Strategy (BEIS) defines ‘clean growth’ as “growing our national income while cutting greenhouse gas emissions”. Clean growth is now a key element of the UK Government’s [Industrial Strategy](#). This is a highly significant commitment, making clear the Government’s responsibility for clean growth policy, and laying the foundation for greater public engagement on this topic.

In July 2017, the Government published an air quality plan proposing to end the sale of all conventional petrol and diesel cars and vans by 2040 as part of a commitment “to be the first generation to leave the environment in a better state than we inherited it”.⁴ The plan indicated an intention to “set a clear national framework” for local authorities,⁵ including elements that could underpin public engagement. These included encouraging public uptake of Ultra Low Emission Vehicles (ULEVs) and the use of public transport (see Section 5; ‘lifestyle and behaviour changes’).

‘Connecting people with the environment’ was one of the key tenets of the Government’s 25-year Green Plan, published in January 2018.⁶ As well as outlining commitments to sustainability and resource efficiency, the Green Plan made several references to public engagement objectives and activities. These activities included:

- The use of green spaces by mental health services
- Encouraging children’s engagement with nature (especially in disadvantaged areas)
- Creating green infrastructure and planting one million urban trees

The Green Plan also proposed to make 2019 a ‘year of action’ for the environment, with the intention of creating an environmental theme for the [#iwill](#) campaign in 2019.⁷

1.3 – Public attitudes on climate change and decarbonisation

Previous studies of climate change – specifically, public attitudes towards it – have noted substantial political divisions on climate change. Political engagement is a key factor, with those found to be disengaged being less likely to acknowledge the existence of climate change.⁸ In the case of the United States, there have been different levels of concern about climate change between Republican and Democrat voters.⁹

⁴ Department for Environment, Food & Rural Affairs, and the Department for Transport, 2017. [UK plan for tackling roadside nitrogen dioxide concentrations: An overview](#), p.4.

⁵ Ibid, p.8.

⁶ HM Government, 2017. [A Green Future: Our 25 Year Plan to Improve the Environment](#).

⁷ Ibid, p.71.

⁸ Poortinga et al., 2011. [‘Uncertain climate: An investigation into public scepticism about anthropogenic climate change’](#). *Global Environmental Change*, vol.21, no.3, pp.1015-1024.

⁹ Dunlap et al., 2016. [‘The Political Divide on Climate Change: Partisan Polarization Widens in the U.S.’](#). *Environment: Science and Policy for Sustainable Development*, vol. 58, no.5, pp.4-23.

These divisions tend to be less apparent in Europe and the UK.¹⁰ Previous British Social Attitudes (BSA) surveys have found only modest differences between Conservative, Labour and Liberal Democrat voters on this topic; “[n]ot only are the main partisan divisions on climate change beliefs and concerns relatively modest, but partisan divisions on climate change mitigation policy tend to be even smaller. There is little...to suggest that, for example, a Labour government would be pressured by their own voters for much stronger climate change mitigation policy than the Conservatives.”¹¹

This Social Intelligence Report will therefore incorporate ethical and social considerations, which – more so than partisanship – constitute a consistent means by which the public ‘frames’ key issues such as climate and environment. Taking the example of vegetarianism and its relevance to environmentalism, Nathan Manning’s research finds it to be “couched within a moral/ethical order, instead of the political.”¹² Ethical questions are central to public engagement. After all, “whether to engage with communities or not is an ethical question”, and “engagement itself has ethical implications.”¹³

Another important component to consider is public attitudes toward institutions, which are directly responsible for policy and for public engagement. Therefore it is highly significant that “while the public are largely supportive” of a transition to a low-carbon energy system, “trust in the government and energy companies to be able to deliver it is currently low”.¹⁴

Recent literature on public attitudes toward climate change demonstrates broad awareness of its importance, its existence, and (at least partially) the role of humans as a cause of it. There is also a consensus that climate change concerns have *not* been exaggerated.¹⁵ The consequences of climate change (i.e. their seriousness) is now the more divisive discussion in the UK, rather than its *existence*. However, there is broad disagreement as to how climate change can be mitigated, and many options for mitigation (e.g. increased government regulation) attract considerable public negativity.¹⁶

Extreme changes in weather were the most commonly-cited effects of climate change in the *ClientEarth’s Climate Snapshot* study. Moreover, there was significant worry about the future of food and water supplies, as well as conflicts, national security risks and immigration caused by climate change.¹⁷ This supports the findings of recent YouGov research; that Britons are less likely now than in 2012 to blame drought on the actions of water companies, and more likely to focus on climate change as the cause.¹⁸

¹⁰ McCright, 2016. ‘[Examining the Effectiveness of Climate Change Frames in the Face of a Climate Change Denial Counter-Frame](#)’. *Topics in Cognitive Science*, vol.8, pp.76-97.

¹¹ British Social Attitudes Survey 35 (2018), [chapter 7](#), p.21.

¹² Manning, 2013. ‘[‘I mainly look at things on an issue by issue basis’: Reflexivity and Phronêsis in young people’s political engagements](#)’. *Journal of Youth Studies*, vol.16, no.1, p.27.

¹³ The Wellcome Trust, 2011. [Community Engagement – Under the Microscope](#), p.5.

¹⁴ Energy Research Partnership, 2014. [Engaging the public in the transformation of the energy system](#), p.4.

¹⁵ YouGov, 2018. [Have climate change concerns been exaggerated?](#)

¹⁶ Campbell & Kay, 2014. ‘[Solution aversion: on the relation between ideology and motivated disbelief](#)’. *Journal of Personality and Social Psychology*, vol.107, no.5, pp.809-824.

¹⁷ ClientEarth, 2018. [ClientEarth’s Climate Snapshot](#).

¹⁸ YouGov, 2018. [Britons increasingly likely to blame climate change for ‘drought’](#).

Research published by the National Centre for Social Research (NatCen) in 2018 observed three top-line issues regarding climate change:¹⁹

1. Most people think that climate change is at least partly caused by humans
2. The young and educated are more worried about climate change
3. There is a lack of optimism about reducing climate change

Older and less-educated respondents were typically less worried about climate change and believed its consequences would be less severe. Expanding on the second top-line issue (that the young and educated are more worried about climate change), previous research has found that younger age groups, those with a higher educational level, and those in higher socio-economic grades exhibit more pro-environmental attitudes.²⁰

The first top-line issue – a widespread belief that climate change is at least partly caused by humans – reflects the results of a similar Ipsos MORI study published in 2017, in which 84% of UK respondents acknowledged that human activity was at least partly responsible for climate change.²¹ They also reflect the European Social Survey’s report on European Attitudes to Climate Change and Energy; 93.6% of UK respondents agreed that the climate was probably/definitely changing, while 91% believed that climate change was (at least partly) caused by human activity.²²

The European Perceptions of Climate Change (EPCC) project similarly found a clear majority of respondents, across Europe, believing that climate change was at least partly caused by human activity.²³ However, the NatCen results suggest that relatively few citizens agree with the Intergovernmental Panel on Climate Change’s (IPCC) conclusion that climate change is *primarily* caused by humans.²⁴ In addition, UK respondents typically did not view climate change and environmental issues as priorities. They saw issues such as immigration, unemployment, the economy, and the EU referendum as much more urgent. Moreover, despite climate change being acknowledged as an *immediate* threat, it was typically seen to primarily affect other countries.²⁵

This mindset – of climate change as a *distant* phenomenon – has repercussions for the public’s moral position on this topic, and the degree to which this can be expected to change. Markowitz and Shariff identify a consistent trend across the research on this topic; that the more socially or temporally distant (e.g. faraway communities or future generations, respectively) the perceived victims of climate change, the less the public feels a moral obligation to act.²⁶

The basis for this trend, as Markowitz and Shariff conclude, is the difficulty in feeling intuitive, emotional reactions to phenomena that are perceived as distant and/or unconnected. Achieving action in this context “requires cold, cognitively demanding and ultimately relatively less motivating,

¹⁹ NatCen, 2018. [British Social Attitudes 35: Climate Change](#).

²⁰ Ipsos MORI, 2016. [COP21: Putting the climate agreement into action: do the public support it?](#)

²¹ Ipsos MORI, 2017. [Have we had enough of climate experts? Does it matter?](#)

²² European Social Survey, 2018. [European Attitudes to Climate Change and Energy](#), p.4.

²³ European Perceptions of Climate Change (EPCC), 2017. [Topline findings of a survey conducted in four European countries in 2016](#), p.36.

²⁴ IPCC, 2013. [Climate Change 2013: the Physical Science Basis](#).

²⁵ European Perceptions of Climate Change (EPCC), 2017. [Topline findings of a survey conducted in four European countries in 2016](#), p.36.

²⁶ Markowitz & Shariff, 2012. [‘Climate change and moral judgement’](#). *Nature Climate Change*, vol.2, no.4, p.245.

moral reasoning.”²⁷ Similarly, previous research has shown a positive relationship between altruistic (‘self-transcendent’) values and the likelihood of reporting concern on climate change.²⁸

Addressing this perspective, an EPCC study emphasised a need to “explicitly localise climate change and its impacts for people, in order to motivate them to act”.²⁹ The study asked if respondents had ‘moral concerns’ about climate change. In the case of the UK, “respondents reported experiencing hope (20%), fear (19%) and outrage (20%) to similar degrees, reflecting a more ambivalent mix of emotional reactions to climate change” than participants in France or Germany.³⁰

The EPCC study also found that while most people in the UK (as well as France, Germany and Norway) were worried to some extent about climate change, very few expressed a high degree of worry.³¹ YouGov research found a majority of UK respondents to be ‘somewhat’ (rather than ‘very’) concerned about climate change,³² a low level of concern in comparison to the rest of Europe. Similarly, a smaller proportion of UK respondents (53%) described climate change as a ‘very serious problem’ than the EU28 average (69%).³³

Nevertheless, there are indications that this mindset of climate change being distant and (perhaps resultingly) ‘not very’ worrying may be changing. The EPCC found that, alongside ambivalence toward climate change, “people are increasingly ‘joining the dots’ between periods of extreme weather and climate change”.³⁴ For this reason the EPCC advocated public engagement focused on sharing experiences of (increasingly apparent) extreme weather in the UK,³⁵ to ‘localise’ climate change and address public attitudes of ‘distance’ (see Section 6; ‘general recommendations’).

ClientEarth’s *Climate Snapshot* survey made several observations regarding institutional responsibility for climate change policy. For example, more than three in five respondents felt that the government was not doing enough in preparing for and adapting to climate impacts. Moreover, almost half of respondents believed it would be acceptable for UK citizens to take the government to court if it failed to keep its Paris Agreement pledges.³⁶

²⁷ Ibid, p.244.

²⁸ Corner et al., 2014. [‘Public engagement with climate change: the role of human values’](#). *WIREs Climate Change*, vol.5, pp.411–422.

²⁹ European Perceptions of Climate Change (EPCC), 2017. [Topline findings of a survey conducted in four European countries in 2016](#), p.19.

³⁰ Ibid, p.20. As the study points out, emotions such as “outrage and guilt are based on moral evaluations; outrage implying that others are seen as culprits whereas guilt results from self-blame”.

³¹ Ibid, p.36.

³² YouGov, 2018. [Are you concerned about climate change?](#)

³³ TNS, 2015. [Global problems - where does climate change rank?](#)

³⁴ European Perceptions of Climate Change (EPCC), 2017. [Six Recommendations for Public Engagement](#), p.5.

³⁵ See Demski et al., 2017. [‘Experience of extreme weather affects climate change mitigation and adaptation responses’](#). *Climatic Change*, vol.140, no.2, pp.149–164. The authors discuss the relationship between direct experience of flooding and the prominence of climate change as a source of emotional response. See also: Fischer & Knutti, 2015. [‘Anthropogenic contribution to global occurrence of heavy-precipitation and high-temperature extremes’](#). *Nature Climate Change*, vol.5, pp.560-564. For a discussion of the frequency of extreme weather occurrences (and human influence on this trend), see: Met Office. [How is climate linked to extreme weather?](#)

³⁶ ClientEarth, 2018. [ClientEarth’s Climate Snapshot](#).

These findings reflect the EPCC projects' observation of high levels of support for the 2015 Paris Agreement, and public support for sanctions on countries that refuse to be part of it.³⁷ They also support the results of a recent YouGov survey, in which the majority of respondents felt that the UK Government was not doing enough to tackle climate change.³⁸ The *Climate Snapshot* also found that investment in renewable energy and reducing industry emissions were the most popular UK Government policy recommendations. Seven in ten respondents also believed that fossil fuel companies should help pay for damage caused by extreme weather events.³⁹

1.4 – Public engagement efforts

The Government has displayed an awareness of the link between extreme weather and climate change discussed in the previous section; specifically, the importance of discussing this link within future public engagement initiatives. In describing the “major risks that will be exacerbated by climate change, such as flooding and overheating”, the Government acknowledged the engagement potential of “embedding climate change impacts and adaptation more strongly as an inherent consideration within the existing awareness raising activities of individual departments.”⁴⁰

A recent report from the UK Energy Research Centre stated that the transition to a low carbon energy system is a social and technical challenge that will not be achieved without the meaningful engagement of wider society.⁴¹ It also concluded that a broader, ‘joined-up’ approach to public engagement with energy was needed, in order to build on major advances in the theory and practice of participation in recent years.

Sciencewise has supported several public dialogues on climate change mitigation, on behalf of the independent Committee on Climate Change (CCC). These include a 2014 dialogue on emissions reduction,⁴² and a public dialogue in 2016 on decarbonising heat.⁴³ In both of these dialogues, the cost of measures to combat climate change was clearly a concern for participants, who felt that the associated costs should be managed, and action incentivised, so that the required steps would also be possible for those in low income households, or those who did not believe action was necessary (and would therefore be unlikely to accept a cost element).

The public participants were positive toward individual household changes (e.g. insulating homes or installing heat pumps), and the value of safe renewable technologies (wind, solar, and wave power). They demonstrated concern about technologies which they did not believe were well enough tested (e.g. carbon capture and storage) or felt to be unsafe for society, such as nuclear power.

³⁷ European Perceptions of Climate Change (EPCC), 2017. [Topline findings of a survey conducted in four European countries in 2016](#), p.37.

³⁸ YouGov, 2018. [Renewable UK Survey Results](#).

³⁹ ClientEarth, 2018. [ClientEarth's Climate Snapshot](#).

⁴⁰ HM Government, 2015. [Government response to the Committee on Climate Change: Progress on Preparing for Climate Change](#), p.23.

⁴¹ UK Energy Research Centre (UKERC), 2017. [Public engagement with energy: broadening evidence, policy and practice](#).

⁴² Sciencewise, 2014. [Trajectories for carbon emission reductions](#).

⁴³ Sciencewise, 2016. [Decarbonising heat](#).

Many participants also advocated a strong role for government in providing independent and accessible advice and information about accreditation and quality assurance schemes for low-carbon heat technologies, as well as in providing financial incentives to support uptake. In addition, many felt that it was necessary for the Government, and businesses, to demonstrate that they were leading the way in using and installing the technologies.

Participants highlighted a moral and ethical dimension to climate change and its mitigation. Global change was advocated, as well as a clear ethical policy from the Government; demonstrated, for example, through education campaigns.⁴⁴ Climate change policy (e.g. dependence on oil-supplying countries) was also discussed in terms of the UK's "moral obligation as a civilised society".⁴⁵

2. Clean growth

2.1 – Legislation and Government policies

The Government's Strategy on Clean Growth describes a 42% cut in UK emissions, and a growing of the economy by two-thirds, since 1990.⁴⁶ Based on these figures the UK has cut emissions faster than other G7 nations and is leading the group in terms of economic growth over that period. These two indicators – emissions and national income – are directly relevant to BEIS' definition of clean growth.

The Strategy also concluded that target emission reductions in the UK's first carbon budget (2008-12) had been outperformed by 1%, while the second and third budgets (2013-22) were projected to be outperformed by 5% and 4% respectively. In addition, the Strategy stated that the economy would grow by an expected 12%. Clean growth therefore began from "a position of strength".⁴⁷

The Government's Autumn Budget 2018 was referred to in a statement by the Renewable Energy Association (REA), as part of a broader call for supporting renewable energy deployment and clean growth.⁴⁸ The statement emphasised the need for clarity on key issues, such as alternative support for decarbonising heat post-2020/21. These calls for governmental clarity and leadership – in order to capitalise on the UK's 'position of strength' – are directly relevant to public engagement strategy, as we will discuss.

2.2 – Public attitudes on clean growth

⁴⁴ Sciencewise, Committee on Climate Change & Hopkins Van Mil, 2013. [UK Response to Climate Change, Final Report: Findings Public Dialogue](#).

⁴⁵ Ibid, p.99.

⁴⁶ HM Government, 2017. [The Clean Growth Strategy](#).

⁴⁷ Ibid, p.5.

⁴⁸ REA, 2018. [Concern over lack of support for renewable energy industry in Autumn Budget](#).

Despite its significance within UK governmental strategy, public awareness of the term ‘clean growth’ remains consistently low. The December 2018 wave of the BEIS Public Attitudes Tracker found that 82% of the public had not heard of the term before the survey.⁴⁹

Those more likely to claim awareness of ‘clean growth’ included men (21%, compared with 15% of women) and those in ‘higher’ or ‘intermediate’ managerial, administrative and professional roles (23%, compared with 13% for semi-skilled and unskilled manual workers, state pensioners, casual and lowest grade workers, and those who were unemployed with state benefits). The term was also more likely to be familiar to those with household incomes of £50,000+ (28%, compared with 15% for those under £16,000) and those living in London (28%, compared with 8% for the North East).

Establishing public attitudes on clean growth is therefore limited at this stage by the fact that a vast majority of UK citizens have little or no knowledge of the term. This is an important consideration for any public engagement efforts (discussed in further detail below). Another consideration is that public knowledge of ‘clean growth’ differs considerably according to location, household income, ‘social grade’ and (to a lesser extent) the gender of the respondent. This is highly relevant to the ways in which public engagement on clean growth should be designed, communicated and targeted.

2.3 – Public engagement efforts

BEIS launched the first ever ‘Green Great Britain Week’ in October 2018. The week-long series of events (15-19 October) aimed to showcase the UK’s leading role in responding to climate change, as well as marking ten years since the Climate Change Act. The Green Great Britain Week involved businesses and civil society groups across the country with the aim of spreading awareness of clean growth, and showing climate change mitigation to be a shared endeavour.

This approach to climate change mitigation as a shared endeavour is consistent with the recommendations for a more holistic approach to engagement, to which this Report draws attention. The Government may also benefit from a greater acknowledgement of public awareness of clean growth (or lack thereof) in its own public engagement efforts, in order to maximise their effectiveness.

3. Heat

3.1 – Legislation and Government policies

Natural gas is the primary source of heating in the UK; with 85% of households using it, it is a major contributor to atmospheric CO₂.⁵⁰ A recent report from the Committee on Climate Change

⁴⁹ BEIS, 2018. [Public Attitudes Tracker December 2018 Survey](#), p.6.

⁵⁰ Committee on Climate Change, 2018. [Cleaning up the UK’s heating systems: new insights on low-carbon heat](#).

recommends that from 2025 (at the latest), no new homes should be connected to the gas grid. It recommends the heating of houses through low-carbon alternatives, and ultra-high levels of energy efficiency alongside appropriate ventilation with timber framing wherever possible.⁵¹

The Government's Renewable Heat Incentive (RHI) was set up in 2011 to encourage a switch from fossil fuel heating systems to renewable and low-carbon alternatives in homes and business premises in the UK.⁵² It supports the aim of meeting EU renewable energy obligations (by 2020) and UK statutory carbon reduction targets (out to 2050). The RHI pays people and businesses in the form of a tariff for each unit of heat produced from renewable sources. The UK was the first country in the world to use this type of financial incentive.

The Government has restated its commitment "to laying the groundwork in this Parliament to prepare for decisions in the first half of the next decade about the long-term future of heat. This includes continuing to invest in innovation and test different technologies and approaches which have the potential to decarbonise heat at scale. We are also continuing to take decisive action in the near term to decarbonise heat in areas less dependent on the long-term infrastructure decisions."⁵³

On renewable heat, the UK Parliament's Energy and Climate Change Select Committee registered its concern "that the UK is at risk of failing to meet the targets not because they are impossible, but because Government departments have not cooperated effectively." While acknowledging that the creation of BEIS "may enable more joined-up thinking", the Committee emphasised the Government's need to "take advantage through deeper analysis of how best to use scarce resources to achieve renewables and decarbonisation targets across different policy areas".⁵⁴

3.2 – Public attitudes on heating

The Chancellor's Spring Statement 2019 confirmed the Government's introduction of the Future Homes Standard by 2025, 'future-proofing' new builds "with low carbon heating and world-leading levels of energy efficiency".⁵⁵ In February 2019, the Committee on Climate Change (CCC) concluded that "low-carbon heat is now cost-effective in all new build homes by 2025 or earlier. On this basis, no new homes should connect to the gas grid from 2025 at the latest. Instead, new homes should make use of low-carbon heating systems such as heat pumps and low-carbon heat networks."⁵⁶

Regarding heat pumps specifically, a separate academic study concluded that "enabling measures can be put in place to manage uncertainties related to public perception for technologies such as heat pumps and heat networks."⁵⁷ In managing and addressing these uncertainties, the study

⁵¹ Committee on Climate Change, 2019. [UK Housing: fit for the future?](#), p.9.

⁵² See [Domestic Renewable Heat Incentive \(RHI\)](#).

⁵³ Department for Business, Energy and Industrial Strategy, 2018. [A future framework for heat in buildings \(call for evidence\); government response](#), pp.4-5.

⁵⁴ Energy and Climate Change Committee, 2016. [2020 renewable heat and transport targets](#), p.3.

⁵⁵ HM Government, 2019. [Spring Statement 2019: what you need to know](#).

⁵⁶ Committee on Climate Change, 2019. [UK housing: Fit for the future?](#) p.53.

⁵⁷ Chaudry et al., 2015. ['Uncertainties in decarbonising heat in the UK'](#). *Energy Policy*, vol.87, p.638.

recommended the use of ‘exemplars’ (maintaining high standards in design and installation) by the Government and industry. This reinforces a consistent theme: calls for leadership and direction.

A 2016 YouGov survey found that only 1/5 of respondents would consider installing a heat pump for their own property. In terms of heat-generating renewable energy devices, they were most likely to consider installing solar thermal panels.⁵⁸ However, research by the Energy Saving Trust, focusing on the users of heat pumps, found that 80% of respondents were either satisfied or very satisfied with its space heating performance, while 77% stated they would recommend it to a friend.⁵⁹ This suggests that (low) awareness may be a factor in public inclinations to install heat pumps.

CCC research found that hydrogen was a viable replacement for natural gas, when electrification was unfeasible or prohibitively expensive. Examples included providing heat on colder winter days, industrial heat processes, and back-up power generation. However, the report diagnosed a low level of public awareness of the reasons for using low-carbon alternatives. It recommended public engagement on future heating choices in the UK but stressed that the window for this is closing.⁶⁰

The necessity of public engagement on this issue is reinforced by CCC-commissioned research on the public acceptability of hydrogen in the home, which found that heat pumps and hydrogen heating were widely-perceived to offer no, or limited, additional consumer benefits when compared to current natural gas heating systems. Additionally, there are significant concerns about the effort and costs that will be required by the public to install and use the new heating technology.⁶¹

In the absence of clear consumer benefits, preferences toward heating technologies tended to be driven by which had the fewest perceived drawbacks. People typically referred to the ‘least-worst’ option rather than ‘positive’ factors of a particular technology. However, the potential utility for heat pumps to cool homes, as well as heat them, had some positive impact on preferences.

Therefore, whilst the need to reduce carbon emissions in the UK and switch to alternative low-carbon heating technologies was felt to be important amongst the majority of the respondents, the acceptability of currently available options was tempered once they learned more about the limited improvements to their lived experience in the home and the burdensome installation process.

In terms of public priorities on heat management, research conducted by YouGov on behalf of the Energy Networks Association found that 68% of respondents believed it was important that their heating system had a low carbon footprint. 74% of respondents stated that the cost of the energy bill was the most important factor when considering future changes to their heating system.⁶² In addition, a majority of respondents (57%) believed electricity to be the most expensive way to heat their home. These last two observations are highly relevant to future heating system changes.

3.3 – Public engagement efforts

⁵⁸ YouGov, 2016. [Scottish Renewables Survey Results](#).

⁵⁹ Energy Saving Trust, 2013. [The heat is on: heat pump field trials phase 2](#).

⁶⁰ Committee on Climate Change, 2018. [Hydrogen in a low-carbon economy](#).

⁶¹ Madano, 2018. [Public acceptability of the use of hydrogen for heating and cooking in the home](#).

⁶² Energy Networks Association, 2018. [The Voice of the Networks](#).

The observations discussed previously – on public attitudes regarding heating – reinforces the need for clarity when discussing the consumer benefits of alternative technologies. Without this clarity it appears difficult to encourage willingness and motivation for the switchover based purely on environmental benefits, which are often seen as more ‘abstract’.

Government funded hydrogen gas heating trials are now underway; for example, two field trials (each lasting a year and involving 750 households) will begin this year on public gas networks, blending hydrogen with natural gas. Over the course of the four-year programme, the performance and safety of using hydrogen in this way can be monitored.⁶³ There is potential to use these trials as a focus for public dialogues and engagement.

Research conducted by the Energy Technologies Institute (ETI) provides several proposals for increased public engagement in decarbonising heat, such as emphasising the role that businesses can play. Businesses’ encouragement of innovation, in “apply[ing] resources, skills and economies of scale”, could mean that “consumers might associate low carbon heating with improved energy experiences”.⁶⁴

The ETI research concludes with a set of recommendations for future public engagement, including using the right language “to understand, shape and bound consumers’ service expectations” and “consumer segmentation to design appealing services and suitable service plans”.⁶⁵ As the ETI concludes, the importance of public engagement stems from the fact that “lower carbon heating must appeal to households if the UK is to meet its carbon targets”.⁶⁶

Furthermore, a pilot study conducted by the Energy Saving Trust in 2016 made several key observations in terms of behaviour change, and more general recommendations for future public engagement on heating systems. The pilot recorded substantial behaviour change, with 74% of participants reporting having changed at least one heating-related behaviour during the pilot, and 95% of these participants stating their intention to persist with the change(s).⁶⁷

Pilot participants felt that the advice and support they received supported their behaviour change, through building their understanding and encouraging them to experiment. In instances where participants did not make changes, they were at least reassured that they were already doing the right things within their property. The advisors on the study felt that the iterative (i.e. repeated applications) approach to experiments, and the long term contact with participants, played a key role in encouraging behavioural change. Both of these points relate to a conceptualisation of engagement as an *ongoing* process rather than an isolated or ‘one-time-only’ activity.

The Public Accounts Committee, in examining the RHI, observed that BEIS gave no visible consideration to the reasons for consumer heat choices. PAC also recommended that greater consideration be given to households and businesses that could not pay the high upfront costs of

⁶³ Cadent, 2018. [Hydrogen to heat homes: £14.9m for UK’s first trials on public gas network.](#)

⁶⁴ Energy Technologies Institute, 2018. [How can people get the heat they want at home, without the carbon?](#), p.24.

⁶⁵ Ibid, p.24.

⁶⁶ Energy Technologies Institute, 2015. [Smart Systems and Heat; Consumer challenges for low carbon heat](#), p.8.

⁶⁷ Energy Saving Trust, 2016. [The behaviour change pilot: encouraging households to make better use of their heating systems.](#)

renewable and low-carbon heating equipment. This was described as especially pertinent given the cheapness and popularity of gas and oil boilers across the country.⁶⁸

A 2018 report by BEIS identified (from previous studies) several barriers to a more rapid consumer take up of low carbon heating. These barriers included:

- Low levels of awareness and familiarity of low carbon alternatives
- Hassle and disruption involved in switching
- Relatively high costs compared to natural gas heating

BEIS observed that “any successful framework for the long-term decarbonisation of heat will need to address each of these factors.”⁶⁹

It should also be observed that a household would not be able to switch to hydrogen if the wider area was being supplied with natural gas. Thus, there is a key role to be played by government (in leading and facilitating the transition) and suppliers (in organising and undertaking the transition) in this respect. We can relate these factors – addressing low public awareness, clarifying personal benefits, and discussing the potential role of government and business – more generally to public engagement recommendations and considerations throughout this Social Intelligence Report.

4. Electricity

4.1 – Legislation and Government policies

2018 was a significant year for renewables and their total share of Britain’s electricity generating infrastructure. According to a Drax Electric Insights report on the UK’s electricity grid, renewables overtook fossil fuels for the first time.⁷⁰ Over the last five years a third of fossil fuel generating capacity has been retired, while capacity from wind, solar, biomass, hydro and other renewables has tripled.

In November 2015, the government announced its intention to consult on proposals to end unabated coal-fired generation in Great Britain by 2025. In November 2016, BEIS published a consultation on proposals for how to put that into effect.⁷¹ The Prime Minister confirmed on 18 September 2017 that, following the consultation, the government would proceed with action to regulate the closure of unabated coal-fired power generation units by 2025.

In January 2018 the implementation plan for this procedure was published. The implementation plan restated the Government’s objective of ensuring that closure of remaining unabated coal-fired

⁶⁸ Committee of Public Accounts, 2018. [Renewable Heat Incentive in Great Britain](#).

⁶⁹ Department for Business, Energy and Industrial Strategy, 2018. [Clean Growth - Transforming Heating](#), p.97.

⁷⁰ Electric Insights Quarterly, 2018. [Headlines](#).

⁷¹ BEIS, 2016. [Coal generation in Great Britain: The pathway to a low-carbon future](#).

power stations took place with a minimum impact on the electricity system,⁷² while providing certainty for investment in lower-carbon alternatives.⁷³

The importance of the relative prevalence of fossil fuels and renewables was given additional impetus by a 2017 report by the Tyndall Centre for Climate Change Research.⁷⁴ The report stated that governments had significantly underestimated methane emissions from natural gas, and would be required to phase out all fossil fuel, coal and oil by 2035 in order to keep within Paris climate targets to limit global warming to well below 2C above pre-industrial levels.

4.2 – Public attitudes on electricity

ClientEarth’s Climate Snapshot found that consumers ranked gas second last for energy sources the UK government should favour, with solar and offshore wind being the highest-ranked.⁷⁵ A majority of consumers indicated that they would like to install both solar panels and a home energy storage device for their homes, if greater assistance was available (through Government, community or commercial schemes).⁷⁶

There is a high degree of professed support for renewable energy amongst the public. The BEIS Public Attitudes Tracker in September 2018 found that 80% of the public expressed support for its use, a figure that has remained stable throughout previous waves of this study. Opposition to renewable energy remained low at 3%, with only 1% strongly opposed.⁷⁷

Though nuclear power supplies approximately one-fifth of the UK’s electricity supply, its share has shrunk as the contribution of renewables has increased. In addition, “the meltdown of Fukushima in 2011 contributed to weakening global public support for nuclear power.”⁷⁸ The Energy Research Partnership concluded that being able to review progress (through phasing in, or being reversible) may benefit public perceptions of geological nuclear waste disposal and its acceptability.⁷⁹ In acknowledging this point, UK Government’s policy on geological disposal includes a consent-based process of working in partnership with communities.⁸⁰

We must also consider these public perspectives on renewables alongside what the public see as an acceptable ‘cost’ for their implementation. In two YouGov surveys (carried out in 2015 and 2018, respectively), a majority of respondents (57% in 2015, 59% in 2018) stated that they would

⁷² In this context the term ‘unabated’ refers to plants which do not have technology to capture and store carbon emissions.

⁷³ BEIS, 2018. [Implementing the end of unabated coal by 2025: Government response to unabated coal closure consultation](#).

⁷⁴ Tyndall Centre for Climate Change Research, 2017. [Natural gas and climate change](#).

⁷⁵ A 2017 YouGov survey similarly found a majority of respondents (58%) stating that the Government should prioritise offshore wind power (see [Greenpeace UK Survey Results](#)).

⁷⁶ ClientEarth, 2018. [ClientEarth’s Climate Snapshot](#).

⁷⁷ BEIS, 2018. [Public Attitudes Tracker September 2018 Survey](#).

⁷⁸ House of Commons Library, 2019. [New Nuclear Power](#), p.4.

⁷⁹ Energy Research Partnership, 2014. [Engaging the public in the transformation of the energy system](#), p.11.

⁸⁰ BEIS, 2018. [Implementing geological disposal – working with communities](#).

personally be unwilling to see electricity bills rise if the extra money was invested in renewable low-carbon energy sources.⁸¹

As energy companies and government are perceived to have the means and power to effect major change, citizens typically assign them primary responsibility for energy transition costs. Neither energy companies nor government are especially trusted to match the public's contribution in this respect. This factor is highly significant, since public willingness to contribute depends on it.⁸²

Moral and ethical concerns ("procedural and distributive justice") have been described as central to public attitudes on this topic, rather than financial circumstances alone.⁸³ This reflects the findings of a Sciencewise-supported project on community-scale approaches to delivering (and engaging citizens with) low carbon technologies. Perceptions of 'fairness', in the distribution of benefits, were found to be key concerns. In addition, "while financial savings were an important initial 'hook' to engage their local communities (i.e. extrinsic motivations), once involved people were motivated more by a sense of community and social interaction (i.e. intrinsic motivations)".⁸⁴

4.3 – Public engagement efforts

Based on the observations above, it is essential to discuss the public acceptability of certain trade-offs. In investigating these trade-offs, the [2050 Pathways Calculator](#) invited the public to choose a combination of changes to achieve an 80% reduction in greenhouse gas emissions by 2050, while ensuring that energy supply met demand. Consistent themes drawn from subsequent analysis included the need for ambitious per capita energy demand reduction, since the greater the constraint on low carbon energy supply, the greater the necessary reduction in demand.⁸⁵

Around 10,000 citizens took part in 2050 Pathways through the interactive calculator, across a series of updates. Interactive engagement initiatives such as these hold considerable potential for public involvement, specifically in indicating measures of 'public acceptability' with respect to significant uncertainties, realities and trade-offs.

In 2016 a team of researchers from the 3S Research Group at the University of East Anglia, and InSIS at the University of Oxford, outlined six contrasting social futures, or 'visions', for transitioning to a low carbon energy system in the UK. This formed part of research funded by the UK Energy Research Centre. The 'visions' were listed as follows:⁸⁶

1. 'Business as usual': using a system similar to the present day
2. 'Large-scale technologies': deploying new technologies to reduce CO₂ emissions
3. 'Deliberative energy society': giving the public a much greater say over energy policy

⁸¹ YouGov, 2018. [Radio 4 Survey Results](#).

⁸² UK Energy Research Centre (UKERC), 2019. Executive Summary: [Paying for energy transitions: public perspectives and acceptability](#).

⁸³ Ibid.

⁸⁴ Department of Energy and Climate Change, 2012. [Low Carbon Communities Challenge](#), p.7.

⁸⁵ HM Government, 2010. [2050 Pathways Analysis](#), p.3.

⁸⁶ University of East Anglia, 2016. *Sustainable energy in the UK? Six visions of where we could be heading*.

4. 'Smart tech society': harnessing smart technology to make the energy system more 'connected' and efficient
5. 'Local energy partnerships': people working together for more localised energy systems
6. 'Off-grid energy communities': decision-making being led by communities rather than government or businesses

Each 'vision' was accompanied by key questions to address. The first 'vision', for example, entailed questions on whether climate change targets can be met, and whether a centralised energy system can be fair and equitable. This is reflected in the importance that the UKERC attaches to "answering questions about the low carbon transition, including: what is it for? Who has control? How do we make it fair and inclusive? What are the benefits to the public? Who bears the risks?"⁸⁷

The significance of the 'visions' and questions outlined by the 3S project (which was envisaged as future material for public engagement) as well as the questions outlined by the UKERC, lies in their emphasis on the role of society. In other words, public engagement in each 'vision' is just as important as central decision-making and technological changes. With this in mind, we can see the relevance of public engagement to each issue and policy recommendation throughout this report, including the following section on 'additional carbon mitigation measures'.

5. Additional carbon mitigation measures

5.1 – Energy efficiency

An Ipsos MORI survey conducted on behalf of the UK Pulse concluded that engaging the public on the topic of home improvements, and energy efficiency, could be made more effective by clearly showing its benefits in terms of value, comfort, and the reduction of damp and mould. It also recommended tailoring the engagement effort to the group in question; for example, acknowledging the especial importance of warmth to older age groups.

The survey also found that the best place to reach homeowners with advice on home energy efficiency upgrades was online. Additional sources of advice (on the benefits of energy efficiency upgrades) that were widely-trusted included architects and local authorities. The survey also recommended targeting people who had just moved into a new home, as that was found to be the key time in which improvements were planned.⁸⁸

5.2 – Insulation

⁸⁷ UK Energy Research Centre (UKERC), 2017. [Public engagement with energy: broadening evidence, policy and practice](#), p.10.

⁸⁸ UK: Pulse, 2016. [Connecting with homeowners: making energy efficiency relevant](#).

The BEIS Public Attitudes Tracker found double-glazing and loft insulation to be the most commonly installed insulation measures in the UK (74% and 63%, respectively). 44% of respondents had installed cavity wall insulation, in comparison to floor insulation (17%) and solid wall insulation (5%). Based on those surveyed, levels of take up across all insulation measures have remained stable, with the exception of double-glazing installations.⁸⁹

BEIS introduced new questions into its Tracker in September 2018 to better understand public attitudes toward insulation measures. These attitudes included finding reasons for the following:

- People are thinking about having measures installed
- People would like to have measures installed but have not done so yet
- People do not or will not have measures installed

The main reasons cited were due to people not owning their property, it not being appropriate for their home, it being too expensive, or it not being a priority. The reasons were consistent across all measures apart from double-glazing, where people were less likely to say that it was not appropriate for their home and more likely to say it was expensive.

Awareness of, and interest in, under floor insulation and solid wall insulation was much lower than for the other insulation measures. For solid wall insulation, one in ten (9%) had not heard of it, two in ten had not thought about installing it (18%), and two in ten did not want to install it (22%). For under floor insulation, a slightly smaller proportion had not heard of it (6%), while two in ten (20%) had not thought about installing it, and a quarter (23%) did not want to install it.

5.3 – Smart technologies

According to a 2017 report by Energy UK, 83% of people with a smart meter think their energy bill is accurate, compared to 65% without one. 8 in 10 people with a smart meter stated that they would recommend them to others. 80% of customers with a smart meter claimed that they were satisfied with it.⁹⁰ These statistics indicate a broad degree of public positivity towards smart meters, at least among those who own them.

However, as discussed in a 2018 House of Commons Library briefing paper, there remain some key public concerns with respect to smart meters and their functionality. These concerns include data protection and privacy, connectivity in areas with low or no mobile coverage, installation visits and doorstep selling, health concerns, disconnection of prepayment meters, and the ability to switch supplier and keep the 'smart functionality'.⁹¹

Citing public engagement work conducted by Smart Energy GB's 2017 Smart Energy Outlook, and online survey data collected by Populus, the Commons briefing paper observed that 97% of people in the UK are aware of smart meters. The public's knowledge of smart meters (at least in terms of

⁸⁹ BEIS, 2018. [Public Attitudes Tracker September 2018 Survey](#), pp.23-24.

⁹⁰ Energy UK, 2017. [Energy in the UK](#), p.26.

⁹¹ House of Commons Library, 2018. [Energy Smart Meters](#), p.3.

their existence) is shown to be very high, suggesting that concerns about smart meters are reduced by ownership of one.

The context of the user and uses of data shared by consumers are strong influences on the acceptability of data access and application; this is a key consideration in any discussion of smart technologies and public perceptions towards them. Ipsos MORI found public support to be dependent on clear cost savings, reducing wastage and preserving resources. These three factors were sufficient, in most cases, for the gaining of public support.

In elaborating these findings, the Ipsos MORI report emphasised the importance of:

- Appreciating that heightened support is associated with improved understanding
- Clearly articulating benefits to citizens
- Demonstrating data being put to effective use
- Addressing key concerns without over-claiming (e.g. risk minimisation)⁹²

Research undertaken by the Energy Saving Trust indicated that in order to achieve wider public take up of smart technologies, a degree of cultural change may be required, based on “a renewed social contract and a sophisticated suite of nudges”. This ‘renewed social contract’ was presented as entailing a shift in focus from individualism to collective consumption and collaboration. This was partly based on facilitating engagement with these technologies in everyday household practices.⁹³

5.4 – Greenhouse Gas Removal (GGR) methods

Reforestation and afforestation

The Independent Panel on Forestry (IPF) recommended in its 2012 Report⁹⁴ that the Government should work with the forestry and land management sectors to offer woodland management advice, “with a view to increasing the area of woodland with a current UKFS [UK Forestry Standard] compliant management plan, from around 50% to 80% of the total, over about the next ten years”. The Government stated an ambition “that this shared woodland management programme could bring around two-thirds of woodland into active management by 2018”.

Active woodland management is the process by which landowners intervene to sustain beneficial conditions in a woodland. This may apply to protecting the woodland from disease, as well as increasing its biodiversity. Examples of active woodland management may involve coppicing; cutting trees down regularly to ground level to stimulate growth and/or provide timber and firewood.

In meeting the target of bringing two-thirds of woodland into active management by 2018, the Environment, Food and Rural Affairs Committee emphasised the importance of effective engagement and communication with the forestry and land management sectors. The Committee

⁹² Ipsos MORI, 2017. [Consumer attitudes to DNO access to half hourly electricity consumption data](#), pp.3-4.

⁹³ Energy Saving Trust, 2015. [Smart Lives: Making smart smart](#), p.6.

⁹⁴ Independent Panel on Forestry, 2012. [Final Report](#), p.8.

also concluded that “public perception also needs to be managed to highlight the benefits in some forests and woodland of cutting down trees which have reached the end of their natural lifespan.”⁹⁵

This last observation raised a pertinent theme relating to public support and awareness; that among some sections of the public, the felling of trees – and its rationale – may not be fully understood and interpreted negatively in all contexts. Public engagement activities, such as the Department of Agriculture, Environment and Rural Affairs’ consultation on a new forestry plan in Northwest Ireland,⁹⁶ may benefit from this consideration.

Joint research conducted by the Royal Society and Royal Academy of Engineering highlights the complexity of forest management as a means of greenhouse gas removal. “For example, replacing natural forests or other natural ecosystems with faster growing or higher biomass tree plantations could reduce biodiversity”, while “replacing cropland or degraded land with forests could enhance biodiversity and have other positive environmental impacts”.⁹⁷

Another complexity relates to public attitudes. In the UK, attitudes on forests are largely positive, while replacing natural forests with plantations of non-native species may generate negativity.⁹⁸ It is also important to acknowledge that landowners and farmers generate income; perceptions of certain land uses (e.g. tree planting without exploitation) as unproductive are therefore influential. This shows the importance of engagement with the forestry and land management sectors.

Carbon capture and storage

Carbon capture and storage (CCS) refers to a suite of technologies that fulfil the following functions:

- Capture CO₂ from the exhausts of power stations or other industrial sources
- Handle and transport CO₂
- Store the CO₂ (for example by injection in deep geological formations)⁹⁹

These functions aim to mitigate the climate impacts of emitting carbon from fossil fuel sources and, by extension, to mitigate some air-quality issues resulting from combustion; especially sulphur dioxide emissions. As Royal Academy/RAE research points out, public opposition may result from disruption caused by planning constructing large-scale infrastructure for CO₂ transportation (one of the suite of technologies mentioned above).

This is particularly relevant in cases where CCS plants are located along shorelines. Similarly, public attitudes may depend to a large extent on whether the storage is on-shore or off-shore. There are also likely to be health and safety concerns about the consequences of serious CO₂ leaks, especially in low-lying areas where the gas may ‘pool’.

⁹⁵ Environment, Food and Rural Affairs Committee, 2017. [Forestry in England: Seeing the wood for the trees](#), p.28.

⁹⁶ Department of Agriculture, Environment and Rural Affairs, 2019. [Scoping a new forestry plan for forests and woodland in the North West](#).

⁹⁷ The Royal Society and Royal Academy of Engineering, 2017. [Greenhouse gas removal](#), p.27.

⁹⁸ Ibid, p.28.

⁹⁹ Ibid, p.39.

More generally, there is a strong moral/ethical element within public perceptions toward greenhouse gas removal. Themes of ‘fairness’ and ‘equity’ are a key example, particularly with respect to risks and benefits (i.e. if they are perceived to be unequally-distributed). Public perceptions of how the world ‘should’ look in the future (and, by extension, their personal values) are highly influential in public engagement on GGR methods.¹⁰⁰

Previous research has found that “under some circumstances, CCS may be perceived as posing uncanny threats to emotionally and ethically significant ecological and geological systems”.¹⁰¹ More broadly, the experience of public engagement efforts on GGR methods are likely to be influenced by highly subjective factors; citizens’ attachment to local landscapes, and their experience of the consultation process, and its organiser(s). Similarly, participants’ level of trust (in the consultation, GGR method, and planner) is a crucial qualifier.

Perceptions of GGR solutions being ‘imposed’ in a top-down fashion, or stemming from a profit motive, are key considerations within public engagement. The concept of ‘risk’ is also central to the hitherto low level of public support for CCS compared with wind power, for example.¹⁰² With this in mind, “concerns over naturalness, social and economic normality should be explicitly addressed in public debates and engagement activities around CCS”,¹⁰³ alongside the observation that “public awareness of CCS...remains low unless there has been some controversy about the technology in the local context.”¹⁰⁴

5.5 – Geoengineering

As described in a report by the Science and Technology Committee in the House of Commons, Geoengineering refers to a wide array of practices but can be split into two main groups:¹⁰⁵

- **Carbon Dioxide removal**
 - This refers to *the removal of Carbon Dioxide from the atmosphere*.
 - This category includes techniques for enhancing natural carbon sinks (the oceans, the forests, rocks and soils), as well as the sequestration of carbon dioxide from the atmosphere (“atmospheric scrubbing”) by chemical means, with the captured carbon deposited in the deep ocean or in geological structures.
- **Solar Radiation Management**

¹⁰⁰ Ibid, p.86.

¹⁰¹ Thomas et al., 2018. [‘Ambivalence, naturalness and normality in public perceptions of carbon capture and storage in biomass, fossil energy, and industrial applications in the United Kingdom’](#), *Energy Research & Social Science*, vol.46, p.7.

¹⁰² Yu et al., 2018. [‘A comparison of public preferences for different low-carbon energy technologies: support for CCS, nuclear and wind energy in the United Kingdom’](#), *Cambridge Working Papers in Economics: 1826*.

¹⁰³ Thomas et al., 2018. [‘Ambivalence, naturalness and normality in public perceptions of carbon capture and storage in biomass, fossil energy, and industrial applications in the United Kingdom’](#), *Energy Research & Social Science*, vol.46, p.7.

¹⁰⁴ Ashworth et al., 2015. [‘Developments in public communications on CCS’](#), *International Journal of Greenhouse Gas Control*, vol.40, pp.449-458. See also the [BEIS Public Attitudes Tracker](#), which observes very little change in awareness of CCS since respondents were first asked about it in 2012 (pp.7-8).

¹⁰⁵ Science and Technology Committee, 2010. [‘The Regulation of Geoengineering’](#), pp.11-13.

- This technique aims to *offset greenhouse warming by reducing the incidence and absorption of incoming solar (short-wave) radiation*.
- Proposals in this category include space-based shades or mirrors to block a portion of incoming solar radiation; and ways of increasing the Earth's albedo (that is, its surface reflectivity of the sun's radiation) by increasing cloud cover, whitening clouds or placing reflective particles or balloons into the stratosphere.

The results of an experimental deliberative study published in 2017 demonstrated the ability of lay citizens to productively deliberate on the dilemmas posed by geoengineering. The study showed that, even with only a cursory introduction to the topic, a vast majority of research participants could engage actively and intelligently with multiple geoengineering research and governance proposals, putting forward arguments that balanced multiple criteria of relevance.¹⁰⁶ The study also highlighted a multitude of other consultation exercises conducted over the last decade, which showed the same level of deliberative capacity.

In addition, the study found that the perceived 'controllability' of a geoengineering experiment is central to its public acceptability. Controllability constitutes four main factors:

1. Experimental containment
2. Outcome uncertainty
3. Environmental reversibility
4. Scientific purity

According to the study, citizens draw on highly technical, institutional and moral criteria to decide whether a particular 'innovation trajectory' is more or less controllable. According to research conducted by Corner et al., the relevance of moral/ethical attitudes to geoengineering is twofold. Firstly "a moral obligation to conduct research and development" is described as one of six overarching arguments about geoengineering. In addition, the very topic of geoengineering is itself seen as a moral argument in many ways, specifically "the morality of interfering with 'natural' systems".¹⁰⁷

A public dialogue exercise undertaken by Sciencewise (which observed a low awareness of geoengineering among participants prior to the dialogue) found a considerable degree of nuance within these moral standpoints. Notably, 'collateral' environmental damage/change (i.e. in the service of tackling climate change) was perceived as more morally acceptable than *setting out* to change an ecosystem or living environment.¹⁰⁸ It recommended that future geoengineering research address moral dimensions such as the 'moral hazard' argument, which posits that researching and/or developing geoengineering technologies may distract attention away from mitigation.

Another study on the 'moral hazard' argument found that levels of climate change scepticism and participants' underlying value orientations influenced the persuasiveness of the moral hazard argument. Individuals who expressed higher levels of climate change scepticism were less likely to

¹⁰⁶ Bellamy et al., 2017. ['Public perceptions of geoengineering research governance: An experimental deliberative approach'](#), *Global Environmental Change*, vol.45, pp.194-202.

¹⁰⁷ Corner et al., 2012. ['Perceptions of geoengineering: public attitudes, stakeholder perspectives, and the challenge of 'upstream' engagement'](#), *WIREs Climate Change*, vol.3, p.458.

¹⁰⁸ Ipsos MORI, 2010. [Experiment Earth? Report on a Public Dialogue on Geoengineering](#).

be persuaded by the moral hazard argument.¹⁰⁹ This suggests that the logic of the moral hazard argument (i.e. its perceived persuasiveness) is moderated by existing views about climate change.

5.6 – Lifestyle and behaviour changes

With respect to lifestyle and behaviour changes, we can see an acknowledgement among scholars that, alongside individual responsibility, there must be a greater institutional effort as well. For example, a recent study conducted by Jason Chilvers, Helen Pallett and Tom Hargreaves argues that

[t]he burden can no longer only be placed on publics to participate, but should equally be placed on institutions to account for the relevance of diverse publics and forms of participation across socio-technical systems...This calls for new forms of institutional listening...to diversities of participation in energy transitions, as well as new ways of seeing public doings that are 'decentred' and excluded. The challenge is to develop systems of governance that can know, respond to and work with these diverse, emerging and ongoing forms of energy participation and not see them as something to be controlled or denied. Such responsiveness to ecologies of diverse and continually emergent public meanings, values and actions is crucial to building more socially sustainable, inclusive, responsible and just socio-technical (energy) transitions.¹¹⁰

The Chilvers et al. study calls for two key changes in public engagement with clean energy (and climate change more broadly):

1. A more *dialogic* form of engagement: public and private institutions clarifying (within their public engagement efforts) their own efforts and ambitions
2. A wider form of engagement: communicating with more marginalised groups

This second point is directly relevant to differing levels of familiarity toward 'clean growth' according to socio-economic status (see Section 2).

According to a Sciencewise public dialogue mentioned earlier (see Section 1), participants accepted behaviour change as a part of carbon emission reduction. Participants were surprised that organisations such as the Committee on Climate Change were not advocating behaviour change as part of their recommendations; similarly, they expressed surprise that current Carbon Budgets could be set without limiting lifestyle factors such as automobile and air travel.¹¹¹

This observation should be considered alongside the findings of a YouGov survey on slowing/halting climate change. 54% of respondents were in favour of backing a climate change strategy that involved reducing consumption of resources, rather than a strategy relying on technological

¹⁰⁹ Corner & Pidgeon, 2014. ['Geoengineering, climate change scepticism and the 'moral hazard' argument: an experimental study of UK public perceptions'](#), *Phil. Trans. R. Soc. A*, vol.372.

¹¹⁰ Chilvers et al., 2018. ['Ecologies of participation in socio-technical change: The case of energy system transitions'](#), *Energy Research & Social Science*, vol.42, p.209.

¹¹¹ Sciencewise, Committee on Climate Change & Hopkins Van Mil, 2013. [UK Response to Climate Change, Final Report: Findings Public Dialogue](#).

solutions. This (alongside the findings of the Sciencewise public consultation) suggests that behavioural changes are a widely-supported prospect amongst the UK population.¹¹²

In a 2017 YouGov-Cambridge poll, 87% of respondents said that they tend to recycle their household rubbish always (69%) or often (18%); a similar portion (86%) reported always (62%) or often (24%) using their own carrier bags when shopping. A majority of respondents claimed they always or often choose energy-efficient appliances when replacing old ones (59%) and switch off electrical appliances instead of leaving them on standby (54%).

However, the same poll – citing estimates that the livestock sector accounts for more greenhouse gas emissions than the entire transport sector – found that 9% of the respondents described themselves as vegetarian (5%), vegan (1%) or pescatarian (3%). 86% of those who reported eating meat said that they did so several times a week or more, while a quarter said they ate it daily, and 10% said they ate meat more than once a day. It also stated that “voters may overestimate how green they really are, perhaps owing to a mixture of unawareness and the value-action gap – i.e. the difference between what we preach and practice”.¹¹³

Nor is there a consensus among the UK public that environmental benefits are (or should be) the key driver for eating less red meat. As shown in a YouGov study published earlier this year, UK citizens are twice as likely to cite health benefits as a reason for cutting back than helping the environment.¹¹⁴

6. General recommendations for public engagement

Several recommendations for public engagement, derived from the literature on this topic, are relevant across the many aspects of clean growth that have been discussed above. This section presents general recommendations (taken from the literature research that contributed to this Social Intelligence Report) for public engagement on energy policy.

6.1 – Understanding the public *and* engagement

Much of the cited research acknowledges a great deal of diversity, action, and ingenuity in public engagement with energy policy. From this perspective the task is not to *generate* public enthusiasm on this topic but instead to *engage* the enthusiasm that already exists, with the caveat that – as the Report has shown – public understanding on several key terms and themes remains low.

This constitutes a recommendation for future public engagement inasmuch as it advocates a nuanced, tailored approach. This recommended approach would, for example, take account of differences across different social groups in terms of typical attitudes and levels of understanding

¹¹² YouGov, 2018. [How should we combat climate change?](#)

¹¹³ YouGov-Cambridge Centre, 2017. [Environmentalism and the value-action gap.](#)

¹¹⁴ YouGov, 2019. [One in four Britons want to cut back on red meat this year.](#)

toward key concepts. It may also take into account different ‘times’ during which public engagement may be most effective (see Section 5; energy efficiency).

As a means of complementing the “formal, invited and discrete public engagement processes” that that policy makers have relied upon thus far, a report from the UKERC¹¹⁵ proposes several methods for examining the growing diversity of public engagement with energy,¹¹⁶ such as:

- Issue mapping
- Controversy mapping
- Sentiment analysis
- Social network analysis

As the report concludes, these techniques could contribute to a more informed *and* experimental set of participatory practices, which take account of public diversity on the topic of energy as well as the relative effectiveness of different engagement techniques. As argued in another UKERC publication, “effective mapping aids the transfer and translation of good practice...and develops an understanding of the effects [engagement methods] have in different contexts”.¹¹⁷

This is argued to have considerable potential for better understanding the effects of engagement *on* the public, and developing new ways of framing ‘energy’ and engaging citizens. This links back to the proposition that the diversity of public engagement in energy can be better understood and engaged, rather than curtailed, compartmentalised or controlled. A greater awareness of this diversity, and of levels of public knowledge toward the concepts and methods discussed in this report, may benefit the ability of Government to take a leading role in clean growth.

In examining public engagement efforts on the topic of ‘heat’, the nature of the interaction(s) between citizens and the organisers of deliberative public dialogues can exert a considerable degree of influence over energy consumption behaviours. Citizens also respond positively to the amount they learn from the experience, even if their behaviour remains unchanged at that point.¹¹⁸

These observations are important in consideration of two consistent themes in the literature:

1. “Engagement breeds engagement”, as observed in the UKERC’s example of the Back Balcombe Group, whose remit broadened from anti-fracking protest to solar panel installation and lower carbon energy production.¹¹⁹

¹¹⁵ UK Energy Research Centre (UKERC), 2017. [Mapping energy participation: a systematic review of diverse practices of public participation in energy transitions 2010-2015](#).

¹¹⁶ To take just a few examples of the diverse engagement channels detailed in the UKERC report [see above]: “consultation processes, opinion polls, behaviour change programmes, social marketing campaigns, social media, planning protests, activism and public demonstrations, lobbying, investment decisions, the co-design of energy technologies, participatory energy modelling, visioning exercises, open innovation processes, citizen science initiatives, hacker spaces, smart energy technologies, eco-homes” and “community energy schemes”. See p. 14.

¹¹⁷ UK Energy Research Centre (UKERC), 2017. [Public engagement with energy: broadening evidence, policy and practice](#), p.9.

¹¹⁸ Energy Saving Trust, 2016. [The behaviour change pilot: encouraging households to make better use of their heating systems](#), p.5.

¹¹⁹ UK Energy Research Centre (UKERC), 2017. [Public engagement with energy: broadening evidence, policy and practice](#), p.9.

2. Engagement is not necessarily to be thought of as an activity or program, but as a dynamic process of engagement between public(s) and institutions. As such it is “never complete” but *ongoing*.¹²⁰

The benefits of engagement, from the perspective of the literature we studied, can therefore be understood to be *ongoing* and *broadly applicable*, i.e. beyond the scope of the engagement activity in terms of time *and* in terms of the topic. This is especially relevant to engagement with the environment, having a demonstrable benefit on individual (and community) well-being.¹²¹

A consistent recommendation, across the literature and research that this Report has studied, is for a tailored approach to engagement that understands public attitudes within a wider context. As described in the Introduction, these attitudes toward climate change cannot be understood solely in partisan terms. This is reflected, for example, in the UKERC’s recommendation for a “UK observatory of public engagement with energy” in order to supply information (in real time) to decision-makers in government as well as industry, civil society and research communities.¹²²

6.2 – Promoting a holistic approach to engagement

A consistent theme across the literature we have discussed is the prospect of a more *holistic* (i.e. tailored/contextualised *and* interconnected) engagement. Climate change encompasses a wide spectrum of policy areas (and, by extension, engagement activities). A holistic approach to engagement would contextualise tailored engagement activities within a wider context, which would demonstrate overlaps with other policy areas. The interconnected nature of these policy areas (climate change mitigation, clean growth, energy sources) could be effectively reflected in the nature (and scope) of the engagement activities that they address.

The Scottish Government’s public engagement strategy for a ‘Low Carbon Scotland’ demonstrates an awareness “that much of the engagement will be led and delivered by others. The Scottish Government cannot, and would not wish to, centralise engagement”.¹²³ This distinction shows that ‘interconnected’ cannot (and should not) be conflated with a uniform, or centralised, strategy. The Scottish Government strategy instead posits that interconnection (building on existing networks) and employing a range of approaches (in awareness of context) can be effectively combined.

As concluded by the Energy Research Partnership, the ‘transformation of the energy system’ encompasses a considerable degree of public engagement in terms of the number of stakeholders involved and the timeframe over which it will (or can) be delivered. This, it is argued, “requires a long-term narrative that can provide coherence to the actions that will be undertaken to deliver the objectives.”¹²⁴ This ‘strategic narrative’ is advocated as descriptive rather than prescriptive; as a ‘reference point’, rather than instructions that presuppose a single effective approach.

¹²⁰ Ibid, p.10.

¹²¹ Woodland Trust, 2011. [Community participation in urban tree cover in the UK](#), p.204.

¹²² UK Energy Research Centre (UKERC), 2017. [Public engagement with energy: broadening evidence, policy and practice](#), p.10.

¹²³ The Scottish Government, 2010. [Low Carbon Scotland: Public Engagement Strategy](#), p.8.

¹²⁴ Energy Research Partnership, 2014. [Engaging the public in the transformation of the energy system](#), p.18.

This call for a ‘strategic narrative’ reinforces recommendations observed throughout this report (from the UK Energy Research Council and the Energy and Climate Change Committee, for example) for a ‘joined-up’ approach to public engagement on clean growth. This concept of being ‘joined-up’ suggests a holistic approach that is guided by clear and consistent principles that reflect the nuances and particularities of different social groups and engagement audiences.

According to the Energy Research Partnership, “the government’s role in defining the national long-term objectives and policies” means that “they should be responsible for the [strategic] narrative and provide the leadership to sustain it”.¹²⁵ This reflects a consistent theme; recommendations for the Government to take a leading role in clean growth and climate change mitigation.

BEIS (and the Government) have already set out an *Approach to Public Dialogue on Science and Technology* (to be facilitated by Sciencewise) that encapsulates many of the key points discussed here, and elsewhere in the report. This report concludes that the principles outlined in that document – relating to public engagement in the form of *dialogue*, and avoiding “one-way communication ‘to’ the public¹²⁶ – are highly significant.

Previous research by Involve has already discussed the importance of dialogue as a form of ‘two-way’ engagement. In the context of consumer engagement, a previous Involve report conceptualised an ideal model of engagement as “a mutually beneficial relationship between consumers and companies [which] enhances their social license to operate”.¹²⁷ This relates back to the observation – made within the previous recommendation – that engagement can be thought of as *ongoing*.

This relates back to the notion that ‘engagement breeds engagement’, and means that the public’s level of understanding could prove highly influential to public engagement and the achievement of its objectives. In calling for “more education and access to research and information”, participants in a Western Power Distribution stakeholder workshop argued that inclusiveness in this respect would be mutually-beneficial, since “more and more diverse voices might lead to greater innovation”.¹²⁸

The significance of these recommendations is likely to increase in the present environmental context, in which the effects of climate change are increasingly visible, local, and immediate.

¹²⁵ Ibid, p.18.

¹²⁶ Sciencewise & BEIS, 2018. [The Government's Approach to Public Dialogue on Science and Technology](#).

¹²⁷ Involve, 2018. [Strengthening the Consumer Voice in Energy Network Company Price Controls](#), p.33.

¹²⁸ Western Power Distribution, 2018. [Stakeholder Workshops: Summary Report](#), p.13.

Appendix 1 - Methodology

Overall focus

To establish an understanding of public views and attitudes towards clean growth and related topics and technologies, to support policy-makers in developing future deliberative dialogue and public engagement activities for emerging policy needs. BEIS' definition of the term 'clean growth' ("growing our national income while cutting greenhouse gas emissions") was used consistently. As clean growth is a very broad topic, the primary focus was on public views on responses to climate change, and energy and power sources in the UK, rather than wider clean growth topics (e.g. embedded energy in the products we consume via import and green finance).

Scope

The scope of the study was largely focused on research and dialogues that had been conducted within the last 3-5 years. Earlier dialogues and research were referred to, and cited, as invaluable context and background.

Type of initiative

This Social Intelligence Report encompassed previous and current public engagement, dialogue and social research on relevant topics and technologies through:

- *Literature Review*: published literature on public engagement with and attitudes to the above topics e.g. surveys, focus groups, public dialogues
- *Activity Review*: public engagement and science communication activities and events that have been (or are being) carried out
- *Parliamentary inquiries*: evidence submitted to relevant public inquiries which addresses public attitudes and views to the above topics

Initial sources of information (not exhaustive)

- *Websites*: Sciencewise; ClientEarth; HM Government; BEIS/DECC; House of Commons Library; YouGov; Ipsos MORI; Committee on Climate Change; The Royal Society; The Royal Academy of Engineering; NatCen; The Wellcome Trust; Involve UK; UK Energy Research Centre; Energy Saving Trust; Energy Technologies Institute; Energy Research Partnership; Tyndall Centre for Climate Change Research; Energy UK; The Independent Panel on Forestry; The Woodland Trust
- *Other published sources*: European Perceptions of Climate Change; European Social Survey; Parliamentary Select Committee Reports (e.g. Energy and Climate Change Committee; Committee of Public Accounts; Environment, Food and Rural Affairs Committee); British Social Attitudes Survey

Initial search terms (not exhaustive)

- Public engagement; public; citizens; public dialogue; understanding; public opinion; public attitudes

Combined with:

- Clean growth; climate change; decarbonisation; climate change act; clean budget; heating; gas; electricity; heat pumps; hydrogen; fossil fuels; nuclear power; renewables; smart energy; smart technology; carbon mitigation; insulation; greenhouse gas removal; geoengineering

Appendix 2 – List of public research and engagement activities, and academic studies

The following table contains the public research and engagement activities that this Social Intelligence Report has referred to. It details the type of activity that took place, as well as the commissioning and research organisations responsible. It also specifies the number of participants who took part in each activity.

Project name	Type of research/ engagement	Commissioning organisation	Research organisation	Number of participants
2050 Pathways Analysis (2010)	Online survey; deliberative dialogues	Department for Business, Energy & Industrial Strategy	Ipsos MORI	10,000
Are you concerned about climate change? (2018)	Survey	YouGov	YouGov	4130
British Social Attitudes Survey 35 (2018)	Survey	NatCen	NatCen	3000
Britons increasingly likely to blame climate change for 'drought' (2018)	Survey	YouGov	YouGov	Not specified
ClientEarth's Climate Snapshot (2018)	Survey	ClientEarth	YouGov	2005
Coal generation in Great Britain: The pathway to a low-carbon future (2016)	Consultation	Department for Business, Energy & Industrial Strategy	Department for Business, Energy & Industrial Strategy	5939
Community Engagement – Under the Microscope (2011)	Workshop	Wellcome Trust	Wellcome Trust	50
Connecting with homeowners: making energy efficiency relevant (2016)	Survey	UK Pulse	Ipsos MORI	2022

Consumer attitudes to DNO access to half hourly electricity consumption data (2017)	Focus groups	Energy Networks Association	Ipsos MORI	120
COP21: Putting the climate agreement into action: do the public support it? (2016)	Survey	Ipsos MORI	Ipsos MORI	2175
Decarbonising Heat (2016)	Sounding board	Committee on Climate Change	Sciencewise	17
Energy in the UK (2017)	Survey	Energy UK	YouGov	1951
Engaging the public in the transformation of the energy system (2014)	Workshop	Energy Research Partnership	Energy Research Partnership	33
Environmentalism and the value-action gap (2017)	Survey	YouGov-Cambridge Centre	YouGov-Cambridge Centre	1680
European Attitudes to Climate Change and Energy (2018)	Survey	European Social Survey	European Social Survey	44387
Experiment Earth? Report on a Public Dialogue on Geoengineering (2010)	Public dialogue	Natural Environment Research Council	Ipsos MORI	150
Global problems - where does climate change rank? (2015)	Survey	Kantar	TNS	1306 in UK (27718 across EU28)
Greenpeace UK Survey Results (2017)	Survey	Greenpeace UK	YouGov	1716
Have climate change concerns been exaggerated? (2018)	Survey	YouGov	YouGov	3932
Have we had enough of climate experts? Does it matter? (2017)	Survey	European Perceptions of Climate Change	Ipsos MORI	4048
How should we combat climate change? (2018)	Survey	YouGov	YouGov	2012
Low Carbon Communities Challenge (2012)	Survey; interviews; facilitated discussions	Department of Energy and Climate Change ¹²⁹	GfK NOP; Dialogue by Design	13185
One in four Britons want to cut back on red meat this year (2019)	Survey	YouGov	YouGov	1073
Paying for energy transitions: public perspectives and acceptability (2019)	Online survey; focus groups	UK Energy Research Centre	UK Energy Research Centre	3150
Public acceptability of the use of hydrogen for heating and cooking in the home (2018)	Focus groups; workshop; online survey	Committee on Climate Change	Madano	1058

¹²⁹ In July 2016 DECC was disbanded. It merged with the Department for Business, Innovation and Skills to form the Department for Business, Energy and Industrial Strategy (BEIS).

Public Attitudes Tracker September 2018 Survey (2018)	Survey	Department for Business, Energy & Industrial Strategy	TNS BMRB	4258
Public Attitudes Tracker December 2018 Survey (2018)	Survey	Department for Business, Energy & Industrial Strategy	TNS BMRB	4273
Radio 4 Survey Results (2018)	Survey	Radio 4	YouGov	1843
Renewable UK Survey Results (2018)	Survey	YouGov	YouGov	3609
Scottish Renewables Survey Results (2016)	Survey	Scottish Renewables	YouGov	1013
Smart Lives; making smart smart (2015)	Workshops; participant observation; interviews	The Energy Saving Trust	Goldsmiths, University of London	12
Smart Systems and Heat; Consumer challenges for low carbon heat (2015)	Group discussions; interviews; surveys; focus groups	Energy Technologies Institute	Frontier Economics; Hitachi; NatCen; Peabody; PRP; TTP; University College London	2529
The behaviour change pilot; encouraging households to make better use of their heating systems (2016)	Pilot study	The Scottish Government	Energy Saving Trust	400
The heat is on: heat pump field trials phase 2 (2013)	Field trials	The Energy Saving Trust	The Energy Saving Trust; The Open University	83
The Voice of the Networks (2018)	Survey	Energy Networks Association	YouGov	3314
Topline findings of a survey conducted in four European countries in 2016 (2017)	Survey	European Perceptions of Climate Change	Ipsos MORI	4048
Trajectories for carbon emission reductions (2014)	Public Dialogue	Committee on Climate Change; Sciencewise	Hopkins Van Mil	25
UK Response to Climate Change, Final Report: Findings Public Dialogue (2013)	Public Dialogue	Committee on Climate Change; Sciencewise	Hopkins Van Mil	25

The table below shows the academic studies that were consulted as part of the desk research for this Social Intelligence Report. It includes the name and date of the study, the author(s), and the publication details.

Study	Author(s)	Publication details
‘A comparison of public preferences for different low-carbon energy technologies: support for CCS, nuclear and wind energy in the United Kingdom’ , (2018)	Yu et al.	<i>Cambridge Working Papers in Economics: 1826.</i>
‘Ambivalence, naturalness and normality in public perceptions of carbon capture and storage in biomass, fossil energy, and industrial applications in the United Kingdom’ . (2018)	Thomas et al.	<i>Energy Research & Social Science</i> , vol.46, p.7.
‘Anthropogenic contribution to global occurrence of heavy-precipitation and high-temperature extremes’ . (2015)	Fischer & Knutti	<i>Nature Climate Change</i> , vol.5, pp.560-564.
‘Climate change and moral judgement’ . (2012)	Markowitz & Shariff	<i>Nature Climate Change</i> , vol.2, no.4, p.245.
‘Developments in public communications on CCS’ . (2015)	Ashworth et al.	<i>International Journal of Greenhouse Gas Control</i> , vol.40, pp.449-458.
‘Ecologies of participation in socio-technical change: The case of energy system transitions’ . (2018)	Chilvers et al.	<i>Energy Research & Social Science</i> , vol.42, p.209.
‘Examining the Effectiveness of Climate Change Frames in the Face of a Climate Change Denial Counter-Frame’ . (2016)	McCright	<i>Topics in Cognitive Science</i> , vol.8, pp.76-97.
‘Experience of extreme weather affects climate change mitigation and adaptation responses’ . (2017)	Demski	<i>Climatic Change</i> , vol.140, no.2, pp.149–164.
‘Geoengineering, climate change scepticism and the ‘moral hazard’ argument: an experimental study of UK public perceptions’ . (2014)	Corner & Pidgeon	<i>Phil. Trans. R. Soc. A</i> , vol.372.
‘I mainly look at things on an issue by issue basis’: Reflexivity and Phronêsis in young people's political engagements’ . (2013)	Manning	<i>Journal of Youth Studies</i> , vol.16, no.1, p.27.
‘Perceptions of geoengineering: public attitudes, stakeholder perspectives, and the challenge of ‘upstream’ engagement’ . (2012)	Corner et al.	<i>WIREs Climate Change</i> , vol.3, p.458.

‘Public engagement with climate change: the role of human values’ . (2014)	Corner et al.	<i>WIREs Climate Change</i> , vol.5, pp.411–422.
‘Public perceptions of geoengineering research governance: An experimental deliberative approach’ . (2017)	Bellamy et al.	<i>Global Environmental Change</i> , vol.45, pp.194-202.
‘Solution aversion: on the relation between ideology and motivated disbelief’ . (2014)	Campbell & Kay	<i>Journal of Personality and Social Psychology</i> , vol.107, no.5, pp.809-824.
‘The Political Divide on Climate Change: Partisan Polarization Widens in the U.S.’ . (2016)	Dunlap et al.	<i>Environment: Science and Policy for Sustainable Development</i> , vol. 58, no.5, pp.4-23.
‘Uncertain climate: An investigation into public scepticism about anthropogenic climate change’ . (2011)	Poortinga et al.	<i>Global Environmental Change</i> , vol.21, no.3, pp.1015-1024.
‘Uncertainties in decarbonising heat in the UK’ . (2015)	Chaudry et al.	<i>Energy Policy</i> , vol.87, p.638.