ACCESS

Advancing Capacity for Climate and Environment Social Science

# Making a Net Zero Society: Follow the *Social* Science

## Full Report

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## Summary

The Economic and Social Research Council-funded ACCESS network drew together an independent task force of experts to consider the role of social science in UK net zero policy. The task force, which ran for one year between 2023-2024, reviewed a range of social science perspectives, analysed examples of government net zero plans and built understanding from case studies of societal change.

We now call upon government to make more consistent and effective use of social science in delivering UK net zero ambitions. Our work shows the huge opportunities, and wide range of benefits, that can be delivered through sustained action to reduce demand for energy. To achieve net zero we need actors from across society to be engaged. Actors that work at the mid-level, between scales, silos and sectors, are especially important. Engaging citizens in meaningful debate about change and generating positive visions of a net zero future will also be essential. We recommend that government establish a Net Zero Social Science Advisory Committee in the Department of Energy Security and Net Zero.



Our members are: Karen Bickerstaff (University of Exeter, Geography), Simone Abram (University of Durham, Energy Institute and Anthropology), Ian Christie (University of Surrey, Institute for Sustainability), Patrick Devine-Wright (University of Exeter, Geography and Environmental Psychology), Steve Guilbert (University of Exeter, Geography), Steve Hinchliffe (University of Exeter, Geography), Alice Moseley (University of Exeter, Politics), Emma Pitchforth (University of Exeter, Medical School), Gordon Walker (Lancaster University, Lancaster Environment Centre) Lorraine Whitmarsh (University of Bath, Psychology).

Peter Bailey (Environment Agency) and Katie Dow (Environment Agency) have provided scientific and technical input to the task force.

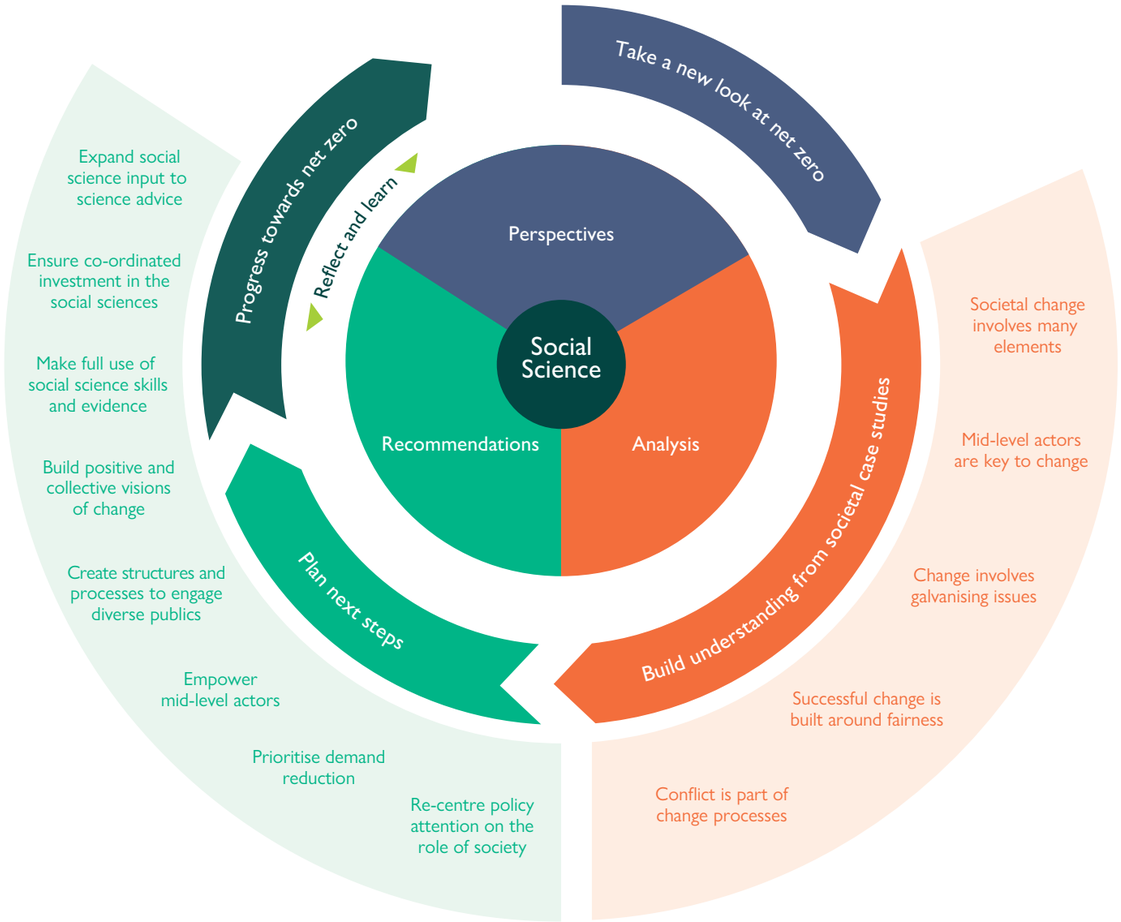

## The Task Force Approach

**This policy advice report is based on the outputs of a dialogue between task force members around:**

- A focused review of social science *perspectives* on societal change, reflecting the diverse expertise of task force members [Annex 1].
- *Analysis* [Annex 2] of the UK Net Zero Research and Innovation Framework (DESNZ, 2021) and associated Delivery Plan 2022-25 (DESNZ, 2023) and the Net Zero Society: Scenarios and Pathways Report (GO-Science, 2023)*. The UK Net Zero Research and Innovation Framework and associated Delivery Plan are cross-government policy papers that aim to provide transparency to the private sector and research community about the research and technologies needed to reach net zero by 2050. They are led by Department for Energy Security and Net Zero (DESNZ). The Net Zero Society report, led by the Government Office for Science (GO-Science), is aimed at policy makers, to help them test the UK's net zero strategy against scenarios for how society could look in future.
- *Analysis* of selected case studies of past and ongoing transition processes of societal change and transition, both successful and more problematic, that offer lessons for net zero policy [Annex 3].

*We subsequently refer to the 'Net Zero Society Report (GO-Science, 2023).

## Steps to Making a Net Zero Society




This diagram summarises important social science capabilities and how they contribute to net zero planning. By drawing on social science **perspectives** (Annex 1), government can **take a new look** at net zero goals and challenges; social science **analysis** can **build understanding from other societal changes;** and these social science inputs can help to **plan next steps** to accelerate **progress to net zero**.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As a task force, we have identified several principles of societal transition. We present recommendations to government that make clear how social science can play a critical role in embedding these principles in net zero policy.

**Take a new look.** Social and technological change is a multifaceted process involving governments, organisations, people, devices and cultural shifts.

**Build understanding from other societal changes.** Understanding processes of societal change is a vital area of net zero research and policy investment.

The social sciences have a long track-record of case histories of substantial as well as more transitional forms of change, and a tradition of conceptual investment in understanding the conditions and contexts for change (cf. Chater and Loewenstein, 2022). Whilst these dynamics of change can seem complex, and even idiosyncratic, exploring differences across issues and between and within countries can provide important insights on how environmental problems can be addressed, and processes of socio-technical change nurtured.

- **Societal change involves many elements: governments, organisations, people, devices and cultural shifts.**

The social sciences provide a wealth of perspectives and insights on these processes and how they interact to deliver, or inhibit, rapid societal change. Many authors have argued for such a multi-pronged approach to net zero that is alert to the need to address systemic drivers of change (e.g. CAST, 2019; Newell et al., 2021; Chater and Loewenstein, 2022; Christophers, 2024). This breadth of knowledge can support decision-makers in reflecting on policy assumptions and dominant policy approaches, identifying barriers to social and cultural change, and in establishing priorities for action.

The findings of the Net Zero Society (GO-Science, 2023) public dialogue process, for instance, highlighted the factors that are important to the public in processes of change: availability of infrastructure (e.g. around transport); the equity implications of interventions; a desire to be consulted and listened to; and trust in institutions designing and implementing policies (GO-Science, 2023). The success of School Streets projects, [Annex 3 A] in the UK and elsewhere, where temporary access restrictions are placed on a road outside a school, reflects multiple factors (though largely not climate mitigation related) including localised congestion, concerns about air quality, child safety and the health benefits of active travel. Similarly, the rapid switch from coal heating to gas central heating in the 1960s and 70s [Annex 3 G] was the result of many elements coming together: technical innovation, market innovation, central coordination, design of contracts and working practices - alongside a popular movement for cleaner and 'decent' homes.

- **Mid-level actors are key to change. Change is rarely simply bottom-up from individual action or top-down from national policy prescriptions.**

If we look across examples of societal change [see Annex 3], change tends to involve people and organisations who occupy the space between top-down policy and bottom-up habits and routines. Following Park et al. (2023), we use the term mid-level actors (also Owen et al., 2020; Wilsdon et al., 2023) to encompass local authorities, service providers, trusted local actors, educational settings, businesses, local employers, community infrastructure, social housing providers etc. Our case studies underline the importance of mid-level stakeholders in establishing and embedding collective understandings of problems [Annex 3 case studies D & E], and building coalitions for change at national [Annex 3 case studies C & G] and local scales [Annex 3 case studies A, B & F]. In the case of School Streets projects [Annex 3 A], the collaborative working of community groups, parent-led organisations, schools and local authorities has been critical in establishing schemes that do reduce emissions, that are widely supported and that fit with local contexts.

Owen et al. (2020) stress the value of a 'middle-out' governance perspective that focuses on agents of socio-technical change that can promote transition in several different directions: upstream to policymakers, downstream to members, clients or citizens, and sideways (e.g. through sharing and enabling new professional norms) to other middle actors. A recent report on a programme of research about the positive opportunities for communities of a net zero transition for (Theminimulle et al., 2024) also calls on government to engage a range of trusted actors. The report notes that to date, these key actors have been largely disconnected from policymakers and are also under-resourced (e.g. Christie and Russell, 2023).

- **Studies of past societal changes have identified that change tends to involve particular 'galvanising issues'.**

Studies of past social changes have identified that societal change tends to involve particular 'galvanising issues' around which coalitions of different actors and publics can form. For instance, the National Health Service (NHS) as a collectively valued institution, and expression of social equity (i.e. publicly funded healthcare), played a significant role in maintaining widespread adherence to COVID-19 restrictions at key moments during the pandemic [Annex 3 E].

Passive smoking, and its collective health impacts, is another widely cited example of an issue that brought together a coalition of actors around change. Whilst legislation (the smoking ban in indoor public spaces in the 2000s) played a critical role, scientific evidence of second-hand smoke being associated with a myriad of conditions served to galvanise widespread public and organisational support for action. Indeed, there has been an internationally agreed treaty on control of tobacco use (adopted by the World Health Organisation in 2003), but it took the galvanising issue of passive smoking and the involvement of mid-level actors to really drive change. Change was not, and cannot, be achieved solely from the top-down. Issues of identity and cultural values had a transformative impact: "a growing recognition (now widespread) of the issue [of smoking] as transcending self-interest, interpreted as being a question of shared responsibility for collective health outcomes, [was] critical" in accounting for the change in society (CAST, 2019).

Whilst technological and institutional changes are needed, they may well be futile without taking into account cultural values and social relations that bring people together around net zero. The notion of a galvanising issue ties in with research, from across the social sciences, which underlines the power of interventions that tap into shared meanings, which in turn play a crucial role in transforming habits and norms (Cass and Shove, 2017; CAST, 2019; Newell et al., 2021; Bulkeley et al., 2016).

Other research highlights the potential of non-market motivations - such as sense of place - to leverage long-term stewardship of the environment (Chapin and Knapp, 2015). Place attachments can drive community participation in local planning and development, enabling people to find common ground (Manzo and Perkins, 2006). However, place bonds can also motivate collective action against unwanted development proposals that are viewed as being unfairly 'done to' communities and that threaten a sense of place (Devine-Wright, 2009) [Annex 3 H]. A key lesson from this research is that policymaking needs to be place-sensitive, inclusive, forward-looking and adaptive, to ensure the successful delivery of sustainability outcomes (British Academy, 2023).

- **Fairness and justice are central to change processes and have a geographical context.**

Social science evidence demonstrates that fairness, in process and outcomes, is crucial for building transition processes and policies that have popular support, are place-sensitive and are locally appropriate.

Notions of a just transition lie at the heart of establishing a social licence for net zero policies. In the Net Zero Society Report (GO-Science, 2023), the importance of equality was identified as a cross-cutting theme that emerged from the public dialogue sessions - it was brought up by participants in every workshop. A key concluding

message from the report was that "[i]f narratives were to emerge around a lack of fairness in how net zero is being delivered […] it would likely create resistance and hold back progress". ( GO-Science, 2023: 149). The Climate Assembly UK report (2020) likewise emphasised the importance of fairness as an underpinning principle for the path to net zero (also HoL, 2022).

There is a tendency, within policy, to focus almost exclusively on equity in terms of income inequality, overlooking other forms of inequality and exclusion (and how they intersect). The language of, and action on, justice and equity must be inclusive. Processes of policy engagement must also be accessible at local and national scales, to include debate on what just outcomes might look like during, and as a result of, a net zero transition (see also Theminimulle et al., 2024). In this way, a just transition must also address barriers to participation around net zero action, such as the price of low-carbon options (e.g. electric vehicles or heat pumps), or the comparatively low cost of high carbon services such as flying. We also know that a just transition will mean different things in different contexts, across different places and communities. This requires a place-sensitive approach that ensures that net zero interventions are locally appropriate, rather than 'one size fits all' [see Annex 3 A, B, F & H].



Furthermore, within research and innovation communities, we note that access to policy influence, in general, is not shared equally. Women and those from ethnic minority backgrounds are the least likely to engage in professionally rewarding impact activities (Cairney and Oliver, 2020: 237), reflecting uneven opportunities, incentives, and payoffs. Scholarship has begun to highlight and respond to demographic barriers to diversity and inclusion in the energy research community (McMaster, 2020; Smith et al., 2019; and two EPSRC networks funded in 2022: IGNITEnet+ and EDI+ Network). Policy-making environments with 'like-minded' people, or those with similar backgrounds, may amplify individual biases, by diluting counter arguments and evidence (Chater and Loewenstein, 2022); they may also fail to anticipate the unintended impacts of interventions. Addressing demographic and cultural diversity in epistemic and policy groups will therefore improve (rather than impede) net zero outcomes.

- **Contests and even conflicts are a part of any change process.**

Differences will exist around how to deliver net zero changes that reflect a range of identities, roles and relationships. Societal problems sometimes persist because of conflicts of interests and if transformation processes damage powerful and concentrated interests, these interests will work to block reform (Chater and Loewenstein, 2023). It is also important to recognise that conflict and resistance can be manipulated for ideological and economic motivations, to weaken support for policy action. This has been seen with climate change denial and with efforts by the tobacco industry [Annex 3 C] to undermine research on the health impacts of smoking (Oreskes and Conway, 2011). Indeed, tobacco companies continue to promote smoking aggressively in many countries around the world. What is critical, in the face of such opposition, is campaigning and building social and political coalitions and partnerships around change, aligned with popular support (Chater and Loewenstein, 2023).

We can look to the history of technology projects (Nuclear, Carbon Capture and Storage (CCS), Direct Air Capture (DAC), Greenhouse Gas Removal (GGR), Hydrogen) to see how conflict and contestation are often intrinsic to change. How these conflicts are handled by policy and industry actors will have lasting influences on processes of transition. The experience of the Dutch town of Barendrecht is a widely cited example of policy failure in relation to establishing a site for a Carbon Capture and Storage (CCS) facility [Annex 3 H]. Concerted local public and government opposition (during the period 2007-10) to the proposed CCS scheme led to the cancellation of the project and a subsequent ruling by the Dutch government that no CCS projects would take place on its shores (see Brunsting et al. 2011). Social science research has highlighted a series of issues raised by such cases of energy infrastructure siting: the lack, or tokenism, of the engagement process; how matters of risk and uncertainty were discussed and communicated; the actions of industry stakeholders; and the broader socio-political and geographic context – in particular, trust relations (e.g. also Whitmarsh and Xenias, 2017).

A consistent feature of social science research on conflicts over infrastructure siting is that lack of trust in developers or government bodies is associated with objections to proposals (Devine-Wright et al., 2016; Whitmarsh and Xenias, 2017). Some have proposed that the impact of low trust is particularly strong when the technology is less familiar. Active protest may follow if publics doubt that their opinions are genuinely listened to, or that their input will lead to tangible changes to infrastructure proposals (Devine-Wright et al., 2016).

Creating opportunities for differences to be aired and debated and seeking forms of deliberative resolution (e.g. through citizen assemblies and dialogue processes), should be integral to steering social and technological change. Addressing and exploring these contestations, including political-economic and place-based motivations, is critical to developing successful pathways to change. The social sciences have much to offer in terms of lessons about the appropriate design of institutions to facilitate public dialogue on climate-related issues, including how to move beyond one-off consultation exercises or deliberative dialogues, to create more enduring processes of engagement (Abbas et al., 2023).

**Plan next steps.** The net zero transition needs to be informed by an understanding of social and cultural dynamics. It needs to go beyond economic, supply-side and narrowly framed consumer-based perspectives. The social sciences have a unique set of skills to bring to this task.

Policy in the UK [Annex 2] is currently defined by the use of economic models and analysis to generate net zero pathways to change that prioritise supply-side and efficiency technology, with people primarily referenced as economic units (Christie and Russell, 2023; Willis, 2022).

Efforts to address long-term energy goals often build on system models that simulate the performance of aspects of the energy system under specified conditions. It is exceedingly difficult to make such long-term evaluations (20 years or more) in an environment determined by complex interactions between technological, economic, social, cultural, and institutional spheres (Willis 2022; Silvast et al., 2020). Modelling of net zero pathways tends to prioritise supply-side solutions (including negative emission technologies like CCS) in meeting emissions targets, which bake in current expectations about needs and growth, with far more limited attention to reduced demand and climate mitigation (Li et al., 2023).

The Net Zero Research and Innovation Framework (DESNZ, 2021) and Delivery Plan (DESNZ, 2023), both target transformation in sectoral (power, transport etc.) areas, with an emphasis on deployment and scaling up of technology and infrastructure. Research and Innovation (R&I) investment is focused on optimising technologies or undertaking demonstration/pilot projects (e.g. DAC & GGR, CCS, Hydrogen). Government intervention is positioned as a response to high capital costs associated with novel technology projects, to ultimately support 'viable markets', though doubts have been raised about the market viability of many supply-side solutions (e.g. Christophers, 2024).

Research and innovation also prioritises market and consumer led approaches to transformation that aim to modify individual or consumer behaviour. Where barriers are seen to exist to behaviour change or technology adoption, these are largely addressed through nudges and persuasion. Whilst the Research and Innovation (DESNZ, 2023) plans do, at times, offer a more robust engagement with the complexities involved in societal change, these aspirations are not reflected in funding commitments (cf. Wilsdon et al., 2023). Consumer-based behaviour change approaches cannot, alone, deliver the scale of change required and may be relatively short-term or subject to rebound effects (e.g. Chater and Loewenstein, 2022; CAST, 2019). As noted by the House of Lords Environment and Climate Change Committee (HoL, 2022: 5), this approach of "enabling behaviour change to meet climate and environment goals is inadequate to meet the scale of the challenge".

Drawing on all elements of the task force dialogue, we advocate five areas of priority for policy going forward:

- **A richer understanding of change and society is needed.**

In the broader social science literatures, there is a tradition of conceptual investment in understanding the conditions for societal change. We suggest that a solid evidence base on different approaches to understanding and steering change is essential for navigating the scale and complexity of net zero [see perspectives on societal change reviewed in Annex 1]. While net zero requires the input of many disciplines, the key challenges to rapid emission cuts are fundamentally social and political. We need to understand them better. Rapid societal change also requires a recognition of the many different roles and identities people hold in relation to aspects of policy and action, e.g. as citizens, consumers, employers, employees, leaders, parents, investors, activists and members of communities.  An understanding of these identities and associated social relations - including conflicts and distributional issues - will be key to delivering lasting change (Hampton and Whitmarsh, 2023) [see Annex 3 for examples].



The research underpinning the Net Zero Society Report (GO-Science, 2023: 3) offers a good example of how approaches that incorporate social science evidence, at an early stage, can steer policy choices in new directions around net zero. This report (GO-Science, 2023: 3) starts from the opening position that a 2050 society "will be very different from today", leading to the development of four scenarios, or different visions of the future, with diverging implications for meeting net zero goals. The scenarios were constructed and explored through a review of recent societal trends, a societal change evidence review, energy system modelling and a public dialogue. They are presented to policymakers as a tool to 'stress-test' strategies and plans "against a wider set of assumptions" to enable the UK Net Zero Strategy to be "more resilient and ready to address risks and opportunities as they arise" (Ibid.: 5). It is disappointing that the Net Zero Society Report (GO-Science, 2023) hasn't had greater impact or traction on government policy given the innovative approach to anticipating the socio-technical conditions through which society could transition to net zero.

- **Demand reduction is urgently needed. Supply-side change alone is not sufficient.**

Social science research has highlighted the limits of an asymmetric reliance on supply-side technological innovations to deliver decarbonisation at the scale and pace needed to meet the UK's goals (Christie and Russell, 2023; HoL, 2022; Fankhauser, et al., 2022; Royston et al., 2018). There is also considerable risk associated with over-reliance on supply-side and speculative technologies such as CCS and DAC (see GO-Science, 2023; also HoL, 2022) and not addressing the demand that drives emissions. The 2022 IPCC ARG WG3 report (Creutzig et al., 2022) recognised the central importance of demand reduction to climate mitigation, with demand reduction actions potentially reducing emissions globally by 50-80% by 2050. As the Net Zero Society Report (GO-Science, 2023: 6) makes clear, there is also a strong economic case for swift action to reduce demand: "if societal changes reduce energy demand, meeting net zero could be cheaper than failing to do so".

We distinguish, here, between demand-side strategies that seek to reduce consumption through technological efficiency or persuading individuals to consume less, which take existing interpretations of need for granted, and an approach to demand reduction which addresses questions of resources, expectations and how needs, and patterns of consumption, are politically and economically constituted and sustained (Royston et al., 2018). Whilst there are some references to the former reading of demand reduction strategies in the UK Net Zero Research and Innovation Framework documents (DESNZ, 2021 and 2023), there is no direct recognition of this second definition (also Barrett et al., 2023; Christie and Russell, 2023). There are no cross-cutting policy drivers associated with influencing long-term patterns of energy consumption (also Royston et al., 2018; HoL, 2022). The Net Zero Society Report (GO-Science, 2023), by contrast, draws the conclusion that changing our conceptualisation of demand must be a critical part of energy and net zero planning.

Research makes clear the huge scope for developing a comprehensive programme of demand-oriented innovation and action that is low-cost and low-risk. For instance around reducing the need for travel, enabling active travel and making the timing of demand more flexible and responsive to the needs of the energy system (Barrett et al., 2023; Martiskainen et al., 2023). The Avoid-Shift-Improve framework has been used successfully in other countries to structure and prioritise policy measures that reduce the environmental impact of transport (see Creutzig et al., 2018).

The Net Zero Society Report (GO-Science, 2023) also concludes that the public are open to potentially significant changes in lifestyles. One of the necessary conditions for acceleration of mitigation, and translation of this latent support through to demand-side measures, is wide and equitable participation from all sectors of society. Effective measures must also be in place to address the root causes of access inequalities – notably in relation to fuel and transport poverty [see Annex 3 B].

Crucial too, is recognition of the wide-ranging societal benefits from social and behavioural changes (e.g. health improvements from changing travel or dietary habits). A key finding from the IPCC ARG WG3 report is that "there is high evidence and high agreement that demand-side measures cut across all sectors and can bring multiple benefits" (Creutzig et

al., 2022: 512). Demand-side interventions can also enhance human wellbeing and be effective tools to reduce wellbeing gaps (cf. Nature Climate Change, 2022). These social benefits are missed by relying on supply-side net zero technologies alone.

- **Recognise the role of mid-level actors.**

The social science community has repeatedly identified governance gaps that are actively frustrating our ability to transition to a net zero society.

There are barriers to joined-up working across government. For mid-level actors to deliver change, improvement could be made in the extent and clarity of mechanisms that support net zero delivery, including the devolution of more powers and responsibilities.

Research demonstrates that collaboratively and consistently delivered government policy is a key driver of social transformation (CAST, 2024: 22; Jordan et al., 2015). Cross-cutting policy priorities are needed, to support change in society, and to ensure joined-up work across government agencies and public bodies (Royston et al., 2018). Social science research demonstrates the benefits of devolved responsibilities and resources and knowledge sharing to enable mid-level partnerships that make the conditions for sustainable action possible e.g. UK 100, ADEPT, Climate Commissions (see also HoL, 2022; Christie and Russell, 2023; Shove and Walker, 2014; British Academy, 2024). As the House of Lords Environment and Climate Change Committee (2022; cf. Theminimulle et al., 2024) make clear, to achieve environment and climate goals, government must support and celebrate the role of mid-level actors - civil society organisations, faith communities and local authorities - in delivering local projects that challenge established product, service and consumption norms. These actors can also be key to mobilising different public roles and identities in relation to aspects of net zero policy and action, e.g. as citizens, consumers, employers, employees, leaders, parents, investors, activists and members of communities. An understanding of these identities and associated social and place-based relations, will be crucial to delivering lasting change.

There are ways that central government can intervene beyond hands-off market policies, which have serious limits in terms of delivering a rapid shift to low-carbon infrastructure (e.g. Christophers, 2024 on decarbonising energy) and exclude other opportunities and business models (e.g. not-for-profit organisations such as community-owned businesses, an expanded role for local authorities in service delivery). An important factor shaping public acceptance of energy infrastructure is the model of ownership (Devine-Wright et al., 2016). De-centralised, shared ownership models for energy production and delivery have proven very successful at generating local social co-benefits, and empowering communities as energy producers and investors. They can also be cost-effective [Annex 3 F]. Germany's 'Energiewende' (or energy transition), is an example of a national energy narrative that has been constructed about the transition away from nuclear and fossil fuel energies towards renewable energy and energy efficiency that is marked by significant citizen input, for example in the form of citizen share purchase in new wind farms (Devine-Wright et al., 2016).



The social sciences have insights to offer into the workings of markets (e.g. Christophers, 2024) as well as the evolution of alternative business and service provision models that can support mid-level actors.

- **Mechanisms of citizen dialogue are vital to establishing a social license for net zero policies.**

Although the use of deliberative methods in climate policymaking is relatively recent, there is a longer history in planning and other policy areas. Early, and sustained, use of dialogue can reveal areas of contestation and difference, anticipate unintended impacts, and identify the sorts of interventions and galvanising issues that could shift social norms and habits. Examples like School Streets and housing retrofit projects, that work with communities [e.g. Annex 3 A & B], highlight the importance of dialogue to increase public and policymaker understanding, and co-devise solutions that are acceptable, fair and effective.

As well as improving understanding of people's different positions and capabilities, deliberation also has the potential to build support (or a social licence) for net zero action more generally. The Net Zero Society Report (GO-Science, 2023: 152) concludes, on the basis of its public dialogue process, that "policy makers will likely find it easier to chart a course to net zero by working with and listening to citizens".

In Scotland, for instance, the Just Transition Commission - over their two-year term - engaged the public and key stakeholders in meetings, town hall events, and site visits across Scotland, covering a wide set of issues around the economy and society. The Commission's final report to the Scottish Government was submitted in 2021 and its recommendations were accepted in full by the Scottish Government, creating a national Just Transition Planning Framework. The Scottish Government defines their just transition as both an outcome - a fairer, greener future for all - and a process that must be undertaken in partnership (Scottish Government, 2021a).

In France, the 2019 Grand Débat National convention was set up in response to gilets jaunes contestation to "transform, with [citizens], angers into solutions". This two-month-long nation-wide debate was designed as a participatory democratic exercise. Although not without challenges, it worked to develop plans to reduce greenhouse gas (GHG) emissions whilst maintaining equity and justice in both approach and outcomes (Convention Citoyenne pour le Climat, 2020; Dobler, 2019). The emphasis on civic engagement, ensuring experiential knowledge flows through the system, supported the identification of unintended and inequitable impacts of different paths and built greater social trust (adapted from Abram et al., 2022).

Decision-making about technologies like CCS also needs to be part of a wider dialogue that engages with the values, interests, and distributional implications of implementation for different groups at national and local scales. We note here the relevance of the UKRI Framework for responsible research and innovation, which formalises the need for researchers to address the sometimes ambiguous purposes of, and motivations for, innovation and better anticipate its unintended impacts. Early dialogue and deliberation is essential in scrutinising the visions and purposes of innovation, in an "open, inclusive and timely way" (UKRI, 2023, n.p.). Too often dialogue around technologies such as CCS, Hydrogen and Nuclear has been end-of-pipe, suggesting that there is room for improving the flow of learning from the public engagement research literature to those charged with delivering it (cf. Xenias and Whitmarsh, 2018).

Dialogue-based methods have challenges, and building a deeper understanding of issues is often more likely than delivering agreement or consensus. There may be some worries that involving people feels like slowing down change processes; however, forcing through policies without building a base of support risks triggering conflict (CAST, 2023). Social science evidence shows that publics can accept measures if processes are transparent and if 'people like them' are involved in their development (Willis, 2022; HoL, 2022). The intention of these processes is not to replace representative democracy but to supplement it (cf. Climate Citizens, 2022). It is particularly important that mid-level actors can draw on the right expertise to build successful

partnerships for dialogue, including transparent reporting of how dialogue made a difference. The social sciences have much to offer here, with a range of expertise in methods and practices of public engagement, as well as policy learning and evaluation (e.g. Ianniello et al., 2019; Bryson et al., 2012).

- **It is important to recognise and communicate the positive and collective dimensions of net zero transformations.**

The positive aspects and co-benefits of net zero transformation, beyond a narrow focus on economy or growth, will be critical to building and sustaining wider societal engagement in net zero actions. Research indicates public support for a framing of a net zero future in terms of health and quality of life, (for example Fankhauser et al., 2022; CAST, 2021). The Net Zero Society Report (GO-Science, 2023) makes explicit that it was the reduced demand scenarios that had the greatest number of possible co-benefits (health, social and economic). In the report's introductory and overview statements, and in the detail of scenario development, the need to give close attention to the possibilities and multiple co-benefits of demand reduction measures is emphasised. A key finding (GO-Science, 2023: 14) is that: "in scenarios where societal changes reduce energy demand, reliance on carbon removal technologies is reduced, less land is needed for infrastructure, and health co-benefits are higher".

The IPCC A6 WG3 report (Creutzig et al., 2022) conducted a systematic literature review and used expert judgments to demonstrate that most demand-side solutions, such as consumption pattern shifts, active and shared mobility, and dietary changes, have positive impacts on human wellbeing (notably improvements in health, air quality and energy access). The British Academy (2024) report on Governance for Net Zero, stresses the need to present the opportunities of net zero, particularly in the context of challenges that various publics are facing around health, cost-of-living and employment.

Research also supports a view that pursuing multiple Sustainable Development Goals in parallel will lead to positive synergies (Soergel et al., 2021; Chater and Loewenstein, 2022).

School Streets provides a useful example of the power of co-benefits (environmental quality, health and safety) to support a diverse coalition of groups around what has, elsewhere, been a contested policy domain [Annex 3 A]. It was the issue of children's safety, in particular, that functioned to galvanise action across different constituencies. Very little reference is made to net zero or climate change. Notably the impacts of these schemes on mobility and traffic have also extended beyond the immediate vicinity of schools, to include longer-term engagement in active travel modes.

Policy programmes that build coalitions around social justice and fairness principles can also provide lessons for net zero policy. In Scotland, just transition principles are baked into net zero targets. Scotland's climate change plan calls for a rapid transformation across all sectors of the economy and society while "ensuring the journey is fair and creates a better future for everyone - regardless of where they live, what they do, and who they are" (Scottish government, 2021b n.p.).

The Government has a vital role to play in building meaningful alliances and goals, particularly with mid-level actors, that incorporate positive change from the outset, build policy around demand reduction and frame a just transition as an opportunity, not a threat. The social sciences can inform this process (Christie and Russell, 2023).

Problems and genuine concerns will also exist and need to be understood and addressed (e.g. shortages of skilled labour, visual impacts and problems in installing net zero technology). Social science can help to show how such issues might be approached in ways that recognise their causes and avoid them being dismissed as merely obstacles.



We make **eight recommendations to government**, based on the weight of social science research evidence. They present opportunities for the social sciences to contribute more fully to policy development on net zero and the challenges posed by rapid societal transformation.

1. **Re-centre net zero policy attention on the role of society**. This is critical to a fully socio-technical approach to net zero transformations and will bring important new opportunities for intervention around the drivers of, and roadblocks to, societal change.

2. **Prioritise interventions to reduce demand for energy.** Net zero will not be achieved by supply-side options alone and demand reduction offers many wider benefits. There is considerable scope for developing and mobilising demand-side knowledge, innovation and action.

3. **Empower mid-level actors** (e.g. local government, civil society, businesses, schools) to deliver place-sensitive, locally appropriate, net zero interventions. Enabling these actors - through funding, legislation and devolved powers - is crucial to realising their potential roles in net zero, as is ensuring they have access to expertise and know-how. It is important that central government agencies support trusted intermediaries (e.g. community energy organisations) to work in partnership with others to deliver interventions that fit with local contexts. Mechanisms that strengthen connections, build partnerships and share learning, across scales and sectors, will also be important.

4. **Create structures and processes that engage diverse publics** in conversations about the changes required - recognising not only the benefits of net zero measures but also the concerns and challenges they can raise. The purpose and scope of these engagements must be clearly laid out. Climate Commissions and Climate Citizens Assemblies have been successfully applied to supporting place-based climate policy. Such mechanisms can help to deliver a transition that is smoother, faster and more equal.

5. **Build and communicate positive and collective visions of a net zero future** that can galvanise widespread support for net zero changes, and that recognise the many benefits of action beyond reducing emissions - including better health, new jobs, technological innovation and a fairer society.

6. **Embed the critical, reflective and analytical skills of the social sciences** in net zero institutions and policy, as exemplified by the work the Intergovernmental Panel on Climate Change and the Government Office for Science Net Zero Society Report.

7. **Ensure concerted and coordinated investment in social science expertise** across all aspects of the next UK Net Zero Research and Innovation Framework Delivery Plan. It is vital that social science expertise is part of systemic upstream planning for net zero, including sectoral research and innovation priorities.

8. **We recommend that the UK and devolved governments include more social science expertise in science advisory committees looking at net zero. We suggest establishment of a Net Zero Social Science Advisory Committee within the Department for Energy Security and Net Zero (DESNZ)**, with terms of reference to include diverse social science disciplines and topics of net zero expertise. This team should be an expert focal point for using social science analytical techniques (such as foresight, deliberative approaches, policy evaluation and evidence synthesis) and be available to support net zero decision-making in DESNZ.

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# Annex 1: Perspectives on Societal Change in Climate and Net Zero Policy

Meeting the UK's net zero targets depends on significant changes across society - in what we do and how we do it. This is primarily an issue of transforming patterns and systems of demand but also extends to structural factors that, more or less directly, shape the organisation of everyday life.

Understanding how societies change is core business for the social sciences and, in this regard, we suggest that there is no one Theory of Change that can, or should, hold a privileged position in steering net zero policy and action. This Annex reviews six perspectives, or paradigms, of change that have been used to analyse and develop climate and net zero policy.

Whilst some of these paradigms overlap others differ, in some cases radically, in their conceptualisation of how and where change happens, the relationship between the social and the technical, and the capacities (and responsibilities) of different actors (government, the market, civil society, individuals etc.). What follows is an overview of these perspectives on societal change, making clear the distinction between approaches that train their analytical lens on individuals and those that are oriented to systemic analysis or the social, material and/or political components of change processes. Alongside this, we indicate the sorts of policy interventions that follow from each paradigm. We also highlight some of the limits to, or challenges that have been raised around, these paradigms. This summary draws on existing synthesis pieces, principally Cass and Shove (2017), Newell et al., (2021) and CAST (2019). It is meant as a heuristic rather than a comprehensive synthesis of what is a very large and diverse body of literature.

These six perspectives are: societal change as an outcome of a) behaviour and choice; b) technological intervention; c) socio-technical structures and systems; d) changing social practices; e) deeper structural political economic processes; and f) publics in governance. To date energy and climate policy has focused primarily on a) and b) (see discussion in Willis, 2022; Abram et al., 2022; Fankhauser et al., 2022; CAST, 2019; Cass and Shove, 2017), which has implications for how societal change has been conceived and addressed within policy. Less widely adopted perspectives (c-f) stress the need for systemic approaches that recognise the social and technical characteristics of system-level change, address interactions between physical infrastructure, and the social conditions within which people act and think (CAST, 2019), and foreground the power and politics of decision-making. This is not to say that people, as individuals, do not have agency, and a role to play, but rather that these choices are influenced and constrained by system features (infrastructural, economic, political, cultural).



**a) Behaviour and individual choice (BIC):** This paradigm of behaviour change posits that change is mainly an outcome of the individual choices that people make, given certain levels of information, time and money.

The central policy lever that flows from this paradigm, and widely applied in practice, is to 'help people make better choices'. From this point of view, the role of the state and other policy actors is to influence or steer consumer choices in particular directions through policy instruments, including information, marketing, economic incentives and behavioural nudges. In these accounts, the public is framed as a set of individuals who tend to seek relatively easy outcomes and can be influenced as consumers (of products and services). There is an implicit understanding that change is cumulative, through the actions of individuals, and somewhat divorced from cultural values, the development of shared meanings and contests over knowledge and agency. In this way behavioural scientists have framed policy problems as individual (or 'i-frame') rather than as systemic ('s-frame') problems (Chater and Loewenstein, 2022; Park et al., 2023). It has also been argued that promotion of behavioural nudges, in effect, diminishes support for more substantive reforms (Chater and Loewenstein, 2022).

Efforts to predict and 'nudge' habits and other forms of behaviour have also raised questions about the democratic legitimacy of policy interventions that are capable of editing choices beyond the gaze of public debate and scrutiny (Shove, 2014). Ultimately, the impact of BIC interventions has been disappointing and often yielded small results (Chater and Loewenstein, 2022; Park et al., 2023).

**b) Technology induced social change (TISC):** The central proposition with TISC is that social change for net zero can be achieved through greater carbon and energy efficiency of appliances and infrastructures – an approach that leads to a focus on technology/innovation policy and promoting uptake in domestic and other settings. Where there are 'choices' to be made, the aim is to persuade consumers to select the most cost-effective and efficient option on offer. The focus here is to promote "support of new technologies" (DESNZ, 2023: 88), rather than to see technologies as needing to be designed and implemented with a social context in mind and with involvement of people in all their variety of circumstances (cf. Strengers, 2013). As with BIC, there is limited recognition that individuals are often unable to exercise choice in the way that it might be assumed (Newell et al., 2021; Abram et al., 2022; Park et al., 2023; Cass and Shove, 2017).

**c) Socio-technical change (STC):** Socio-technical perspectives on change recognise that what people do is shaped and formed by established and novel socio-technical arrangements of transport, leisure, heating, power etc. These approaches focus on the influence of different system components such as technology, infrastructure, financial rules, regulations, industry networks, markets and user practices, with system change the result of a cascade of events. One prominent STC approach, the multi-level perspective (MLP) on sustainability transitions (Geels, 2011), developed from analysis of historical socio-technical shifts. The MLP emphasises more controlled 'transitions', involving interlinked processes at levels of the 'niche' (particular settings where novelties emerge), the 'regime' (the rules and institutions ordering a system) and the 'landscape' (the deeper patterns shaping social and technological change). Some suggest that deliberate 'tipping' or steering can be used strategically to precipitate or speed up a wider system change, such as government support for 'niche' innovations in order to reform wider 'regimes' and so generate socio-technical transitions (Scoones et al., 2020). However, STC approaches have been criticised for over-emphasising the role of technology in transition pathways and overly generalised system models that do not sufficiently attend to the non-technical. Notably they miss forms of social innovation, and the social, political and geographic factors that mean that interventions can have varying effects in different contexts. (e.g. Shove and Walker, 2014).

**d) Social change as an outcome of social practices (SCSP):** A fourth perspective is to conceptualise patterns of energy demand and consumption (e.g. commuting to work and daily showering) as the outcome of shared social practices that are socially and materially constituted through physical infrastructure or hardware, skills and norms (Shove et al., 2012; Spurling et al., 2013; Shove and Walker, 2014). Rather than trying to understand habit as a form of behaviour that people adopt, authors such as Shove (2014) are concerned with how habits capture and retain cohorts of committed practitioners. Trying to change behaviour by modifying only one aspect of practice (e.g. new hardware) will not stimulate a shift to new practices if other elements of practice remain the same. Interventions by upstream or mid-stream actors would therefore centre on changing the elements of resource-intensive practices (such as driving, home heating, flying etc.) through a range of intervention points and scales. For instance, data indicates that young people are less committed to the concept of car ownership. Such shifts, already happening, can be nurtured by (national and local) government and other non-governmental actors, operating at different scales. Interventions might address infrastructure provision for new car ownership models (e.g. through incentives to providers) as well as alternative transport modes, such as cycling (e.g. cycleways that connect to key nodes, safe parking, workplace showers); promote new norms (road priority schemes, making clear financial and health benefits etc.) and ensure competences in different demographic groups (e.g. cycle training/ use in schools). Identifying relevant forms of policy intervention depends on thinking about how proposed measures might have a bearing on those practices through which demand is constituted.

However, theories of practice do not concretely address the role of collective social and political projects, ideologies and cultural discourses. As such there can be a disconnect between the minutiae of everyday performances of practices and the macro-institutional context. The role of inequalities in access to resources can also be underplayed.

**e) Political economy (PE):** Political economy approaches challenge mainstream transition policies that place emphasis on technological innovation and market-based solutions and rather stress the structural elements of the problem (Newell et al., 2021; Li et al., 2023; Abram et al., 2022). Researchers, broadly aligned to a political economy perspective, argue that approaches to societal change must address questions of environmental limits, power relations and social justice in order to appreciate how responsibility and agency are unevenly distributed within and between societies and to address the structural roots of unsustainable consumption. As Newell et al. (2021: 9) argue, this presents a more holistic understanding of behaviour, "as just one node within an ecosystem of transformation" that bridges individual and systemic approaches. It is a perspective that links personal action to other forms of collective activities, social practices and political influence (Newell et al., 2021)

Political economy scholars address relations between capital and the state, business practices and vested interests that reproduce the status quo and as well as civic disruptors to these (dominant) practices and relations, e.g. in building alternatives such as prosumer and alternative food networks. Some political economy approaches point to the need to foreground the role of the state in debate about sustainable behaviours, as the actor(s) with a specific mandate and means to advance and protect the public interest. Chater and Loewenstein (2022, 2023), both behavioural scientists, present an analysis of the institutionalisation of behaviour change policy through such a political economic lens. They suggest that i-frame (individual focused behaviour change) interventions are increasingly being accepted by political actors as alternatives to s-frame (systemic) change. In part, they connect this to political pragmatism – avoiding legislative complexity and controversy. Their central argument, however, is that this tendency reflects the sway of powerful interests opposed to regulatory reform, who see i-frame changes as an opportunity to maintain the political-economic status quo. The authors conclude: "In short, we had mistaken deep systemic problems of political economy and conflicts of interest, for problems of individual human folly and responsibility" (Chater and Loewenstein, 2023: 12).



Other PE researchers call for a 're-commoning' of resources, to socialise control over the provision of key services (such as energy and transport) (Newell et al., 2021). We have also seen significant interest in wellbeing, sustainable prosperity (Jackson et al., 2016), prosperity without growth (Jackson, 2009) and de-growth (Hickel, 2020; Kallis et al., 2020) as cornerstones of sustainability and decoupling carbon mitigation from GDP. Researchers working on degrowth, for instance, argue that high-income economies do not need more aggregate production and consumption; instead, they can support strong social outcomes without growth, through, for instance, living wages, shortening the working week to prevent unemployment, and guaranteeing universal access to public services (Jackson et al., 2016; Vogel et al., 2021). Some polls show popular approval of degrowth policies, such as reduced working hours (Li et al., 2023; YouGov, 2020), and evidence suggests that reducing consumption in high-income countries is associated with maintaining or even increasing wellbeing (Hüttel et al., 2020). PE approaches do, however, underemphasise the role of cultural traditions, established practices, beliefs and diversity. In some cases, they make overly grand assumptions about the state as a benign actor with the interests of the citizens as paramount.

**f) Publics in governance (PG):** Researchers from across the social sciences have stressed that achieving transformative social change requires innovations in governance; to enhance coordination, broaden representation and foster meaningful engagement in discussions about the complex trade-offs in getting to a net zero society (Newell et al., 2021; Abram et al., 2022; CAST, 2019). This requires a reciprocal and dynamic process between citizens, private sector actors and governing institutions at different scales – where all parties learn and are listened to. Evidence suggests that a more decentralised approach can also broaden the scope for 'rapid and deep' household transitions to sustainability, promoting inclusion, accountability and equity (Sovacool and Martiskainen, 2020).

Others emphasise how participatory and deliberative approaches can advance legitimacy and help ensure broad social ownership (Chilvers et al., 2021; Dryzek et al., 2019).

Authors also stress that equity principles - key to ensuring a sense of solidarity, collective ownership and political buy-in, and thus enhancing the chances of real action and impact (Fankhauser et al., 2022) - can only be realised by sustained and meaningful citizen engagement. Participation and deliberation are essential to ensure that policy choices reflect a diversity of experiences, perspectives, and knowledges. Such participatory arrangements need to be considered both in developing strategies and in designing interventions (Abram et al., 2022). Participatory and deliberative methods can also contribute to better climate and net zero policy making by: increasing trust in the policy process; increasing politicians' confidence that there is a social mandate for action; and ensuring representation and defusing conflict, even if consensus is not always achieved (cf. Climate Citizens, 2022).

However, PG approaches have less to say about the process by which public participation flows through other governance processes and influence in the context of established decision-making structures, and how they can avoid 'capture' by vested interests or reflect social and cultural diversity within and between communities. Nor do they always account for, or mitigate, emergent conflicts that can be exposed through public deliberation. Political and planning theorists (Mouffe, 1999; Barry, 2019) have, for instance, challenged the drive for participatory consensus (over conflict) as de-politicising and discounting the structural and power-laden differences that are at the root of major environmental policy contestations. Agonistic planning, by contrast, sees political transformation arising through adversarial engagement and creative planning intervention.

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# Annex 2: Policy Document Analysis

## 1. Introduction

This annex provides details of a content analysis of three net zero documents:

1. UK Net Zero Research and Innovation Framework (DESNZ, 2021)
2. UK Net Zero Research and Innovation Framework: Delivery Plan 2022-2025 (DESNZ, 2023)
3. Net Zero Society: Scenarios and Pathways Report (GO-Science, 2023)

The reasons for undertaking a content analysis were two-fold: i.) to evidence and illustrate a number of key points that emerged out of the early explorative stage of the task force process; and then ii.) to act as a stepping off point for a broader task force engagement with, and commentary on, the way the UK government frames the challenge of net zero and associated policy solutions and the type of research and evidence needed to inform and shape those policy solutions.

This document outlines the methodology employed and provides a summary of our key findings.

## 2. Method

The method we employed to examine the three documents was a form of qualitative textual analysis based on the identification and frequency occurrence of individual key words. The process involved three stages.

### Identifying Key Documents

Three policy documents were selected for analysis that offered different perspectives on the UK Government's framing of net zero policy and the type of research needed to inform and shape policy solutions. The first two, the UK Net Zero Research and Innovation Framework (RIF) and associated UK Net Zero Research and Innovation Framework: Delivery Plan 2022-2025 (DP), are cross-government documents led by the Department for Energy Security and Net Zero (DESNZ), which aim to provide "transparency to the private sector and research community about the research and technologies needed to reach Net Zero by 2050". The third, the Net Zero Society: scenarios and pathways (NZS) was produced by the Government Office for Science (GO-Science) and is aimed at policy makers, to help them test the UK's net zero strategy against scenarios for how society could look in future.

Whilst other net zero policy documents were considered for analysis, this selection was both current and also included some breadth in terms of authorship and intended audience.

### Document Analysis

This process involved a two-step content analysis:

1. Categorisation of the content of each document according to either a 'techno-economic' or 'social' frame. To do this we identified seven key words and related derivations associated with a techno-economic framing/approach: 'Technology*'; 'Industry*'; 'Economy*'; 'Finance*'; 'Business*'; 'Sector*'; Science. And seven key words and related derivations associated with a 'social' framing approach: 'Society*'; 'Social'; 'People'; 'Behaviour*'; 'Behavioural Science'; 'Social Research'; Social Science. We analysed the full text of each of the three documents to determine how many times each of these fourteen words appeared.

2. Analysis of key social science themes (including absences) that emerged across the three documents. To do this, we first collectively identified six priority themes, then subdivided these into six smaller groups, with each sub-group taking responsibility for directing and synthesising the content analysis of their theme.[1] Each theme group identified the key terms and phrases to search for.

Table 1: Content analysis themes

| Social Themes | Examples of Search Terms/Phrases |
|---|---|
| A. Whole Systems Approach | Growth, Economic Efficiency, Technology (Techno Centrism/Optimism), Economic Advantage/Opportunities, (Viable) Market, Supply |
| B. Conditions for Social Change | Behaviour (change), End-users/Consumers, Practice/Culture, Societal/Social change), Social Norms, Socio-technical/Social and Technological, Acceptance/Acceptability |
| C. Demand Reduction | Demand Reduction, Demand-side Barriers, Demand-side Flexibility, Demand-side Efficiency |
| D. Equity (Just Transition) | Equity, Equality, Inequality, Social Justice/Justice. Just Transition, Fairness, Levelling/Levelled-up, Vulnerable |
| E. Civil Society | Participation, Dialogue, Civic, Democracy, Citizen, Empower[ment], Trust |
| F. Place | Place/Place-based, Region*, Local*/Location*, National*, Community*, Identity, Other Geographical terms |

The results of the thematic analysis were then used to inform the next stage of the task force process and the completion of six thematic templates. These templates - an example of which can be found in Appendix 2 - presented the findings of the thematic analysis, summarised key academic literature, identified emerging 'key messages' and suggested possible, related, case studies. These templates informed subsequent task force discussions and decisions.

1 Task force members could belong to more than one theme group. Groups were largely self-selecting based on interests and expertise.

## 3. Results

The following two sections provide a summary of the results of the two-step content analysis described above.

### 3.1. Whole Document Analysis

**A. DESNZ (2021) UK Net Zero Research and Innovation Framework**

- Type of document: GOV.UK – Guidance: "a guide to the research and technologies needed to reach Net Zero by 2050"
- Length: 129 pages
- Lead: DESNZ
- Foreword by: Government Chief Scientific Adviser and National Technology Advisor
- Target audiences: "provides information for businesses and academics working on Net Zero related research"

**B. DESNZ (2023) UK Net Zero Research and Innovation Framework - Delivery Plan (DP) 2022-2025**

- Type of document: GOV.UK – Policy paper "areas of government priority"
- Length: 93 pages
- Lead: DESNZ
- Foreword by: None
- Target audiences: "the Framework and Delivery Plan aim to provide transparency to the private sector and research community"

Fig 1: UK Net Zero Research and Innovation Framework – Key Term Frequencies

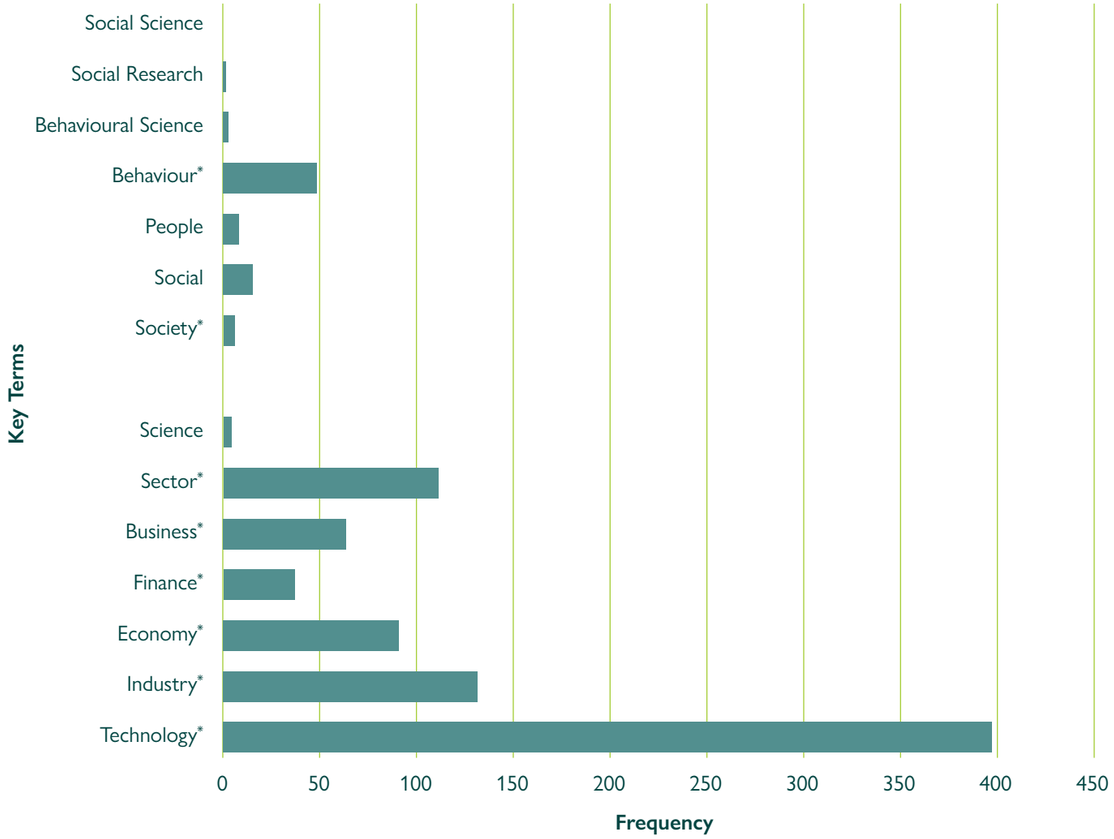
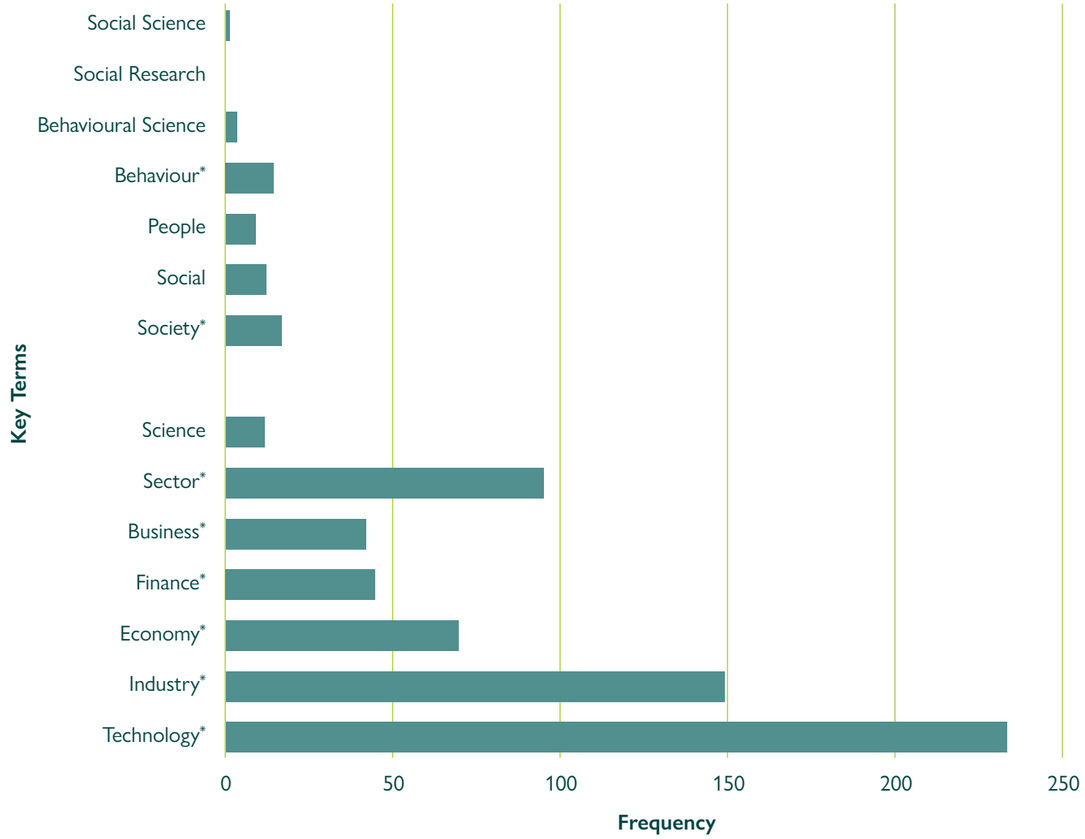


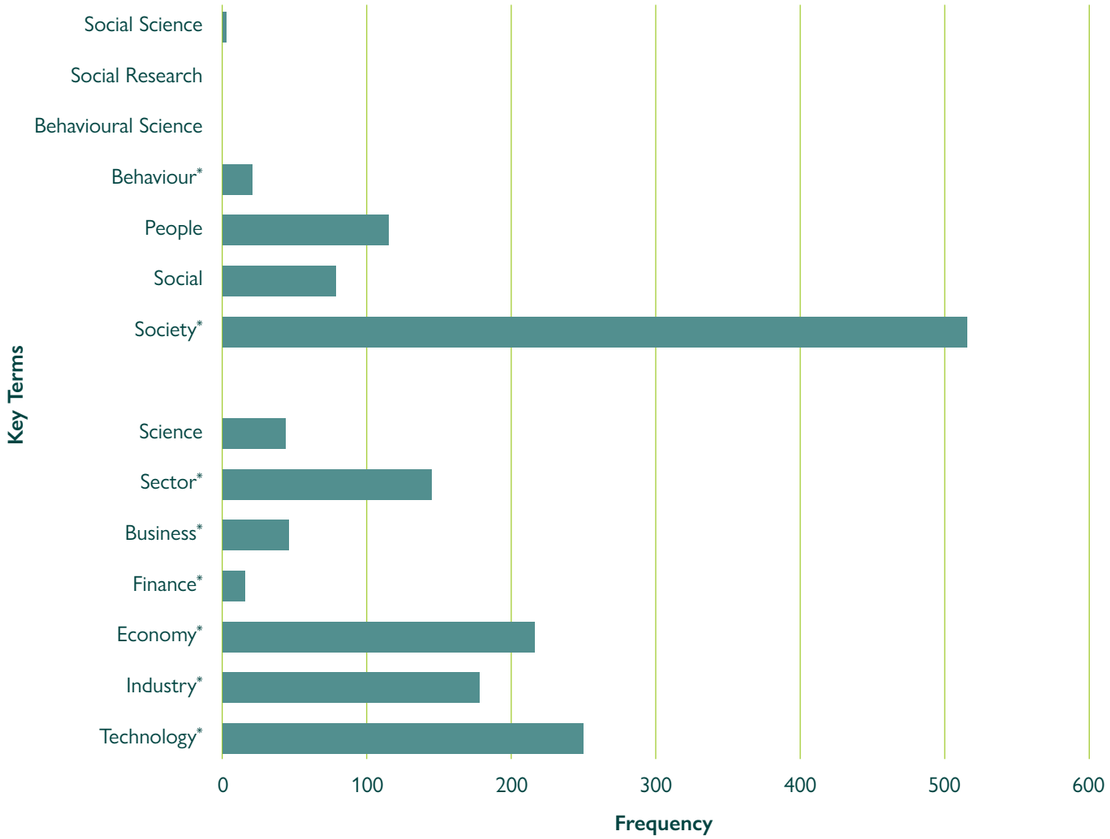

Fig 2: UK Net Zero Research and Innovation Framework - Delivery Plan 2022-2025 – Key Term Frequencies



**C. GO-Science (2023) Net Zero Society: Scenarios and Pathways**

- Type of document: GOV.UK (NZS) – Research and Analysis
- Length: 194 pages
- Lead: Government Office for Science
- Foreword by: Government Chief Scientific Adviser
- Target audiences: government and other stakeholders

Fig 3: GO-Science (2023) Net Zero Society: Scenarios and Pathways – Key Term Frequencies






Both the RIF (Fig. 1) and associated DP (Fig. 2) documents show similar key word frequency occurrence profiles, with a much greater number of 'techno-economic' frame related words appearing in the text than those associated with a 'social' frame. In the RIF document (Fig. 1) compare, for example, the number of times the word(s) 'technology*' appears (n395) relative to references to 'people' (n15). Also compare, in the DP document (Fig. 2), the 70 times the word(s) 'Economy*' with the 11 times the word(s) 'Society*' appears. It is noteworthy too that across both the RIF and DP documents 'Science' is mentioned a total of 21 times, whereas 'Social Science' is mentioned just once.

In contrast to both the RIF and DP word frequency profiles, there is a more obvious balance in the NZS document between the number of 'techo-economic' and 'social' frame related words. References to technology and the economy are still prominent, but so are references to people and society. Compare, for example, the 20 times the word(s) 'society*' appears across the combined 232 pages of the RIF and DP documents with the 520 times it appears across the 194 pages of the NSZ document.

This distinction between the language used in the RIF and DP documents on the one hand and the NZS society on the other, is also illustrated in the two word clouds below (Fig. 4). They offer an insight in to the relative emphases of the RIF and NZS documents, with 'technologies', 'emissions', and 'innovation' to the fore in the RIF and 'public', 'society' and 'government' to the fore in the NZS.

Fig 4: Word Clouds – RIF document (left) and NZS document (right)


### 3.2. Thematic Analysis

While each thematic team analysed the RIF, DP and NZS documents (see Appendix - Thematic Table), given the similarity between the RIF and associated DP document, we restrict our presentation here to a comparative analysis of the DESNZ led UK Net-Zero Research and Innovation Framework (RIF) and Go-Science led Net Zero Society: Scenarios and Pathways (NZS) documents. The summary below takes each of the six social themes (A-F) in turn and provides some illustrative examples of the content analysis of the RIF and NZS documents (key term frequencies and contextual analysis).

**A. Whole Systems Approach**

This section presents an analysis of the framing of a Whole Systems Approach to Net Zero in the three documents. It was particularly critical in identifying key principles and paradigms. Key themes centred on the technological and economic framing of change, the role presented for the social sciences and social science questions, and the primarily consumer-focused approach to societal change.

DESNZ RIF

- Key Term/Phrase Frequencies: Technology* mentioned 11 times in the Foreword alone; 395 times in total.

- Ostensibly subscribes to a 'systems approach', stating upfront:

  "…the transition will involve complex interactions between technology, infrastructure, people, data, institutions, policy, and the natural environment. By taking a 'systems approach' Government can help to navigate this complexity." (p. 13)

- However, in practice employs a narrowly defined system centred on technological development and diffusion. There's a strong emphasis on inter-sectoral (e.g. transport/energy/land-use) linkages (a system of sectors) but very little engagement with elements of a broader [social] system.
- There are also a limited reference to, and a narrow conception of, 'people' within the system as 'end-users' or individual consumers of technologies (as opposed to citizens) (see also Themes B and E). And a focus on understanding (and changing) responses to new technologies ('end-of-pipe'), and managing (mitigating) socio-economic impacts.

GO-Science NZS

- Key Term/Phrase Frequencies: Technology* mentioned 248 time.
- Describes and employs a broader conceptualisation of 'a system'.
- For example, in the 'Introduction' it states: "Societies are extremely complex systems made up of millions of individuals, each driven by their own values, needs and ambitions." (p. 22)
- And in the 'Our Approach' [methodology] section:

  "In addition to considerations for individual sectors, we used qualitative systems thinking maps to explore interactions between sectors to ensure the scenarios were represented as coherently as possible." (p. 52)

**B. Conditions of Social Change**

The purpose of this theme was to identify the key drivers and barriers to societal change discussed in each of the documents. Our analysis identified different 'paradigms of change' for the DESNZ and GO-Science documents, which we situated in a review of existing social science literature on paradigms of societal change (Annex 2) This work also provided the starting point for exploring potential societal transition case studies and the sorts of criteria we might use for selection (Annex 3).

DESNZ RIF

- Key Term/Phrase Frequencies: End-users (x45); Consumer* (x19); Acceptance (x14); Social Norms (x1).
- Theory of Change is closely related to the conception of the system (to be changed) – see Theme A. While acknowledging complexity, there is little development of the 'social' beyond 'end of pipe' responses to new technologies. There is also no direct reference to cultural change or social norms or regulation, or changing infrastructure, land-use policy etc. Engagement with social science research and evidence is thus quite bounded and limited.
- There is no explicitly articulated Theory of Change but a strong emphasis / focus on economically optimised routes to net zero. There is minimal engagement with ideas of equity/just transition.

GO-Science 'NZS'

- Key Term/Phrase Frequencies: End-users (x0); Consumer* (x11); Acceptance (x0); Social Norms (x10).
- Exploring different societal change scenarios and their implications for net zero policy is the primary aim of the report.
- There are only a couple of references to behaviour change but a much more consistent engagement with ideas of the social and cultural and with issues of equity.
- There is an explicit recognition of, and multiple references to, the significance of social norms and their implications for the development and success (or not) of net zero policies/pathways.
- The report includes an evidence review which explores:

  "how change in complex systems (which UK society can be considered) works and what factors can drive change. It explores cases studies from previous societal changes to show how system change can be initiated at various levels (including through top-down government policy and bottom-up social movements) and how various factors may interact to produce different results" (p. 34).



**C. Demand Reduction**

This theme responded to the emphasis of the RIF documents on maintaining current supply systems and infrastructures (around energy, consumption and transport). Energy demand reduction had a more marginal role – largely in relation to achieving demand flexibility (for electricity) and demand-side response. The theme analysed references to, and the scope of, demand reduction and related ideas. The analysis was linked to a substantial body of research within and beyond the social sciences that makes clear that energy demand reduction is a crucial part of achieving net zero goals.

DESNZ RIF

- Key Term/Phrase Frequencies: Demand Reduction (x1); Demand-side Barriers (x2).
- There is a recognition within the document that the transition to net zero will also involve some demand-side reductions:

  "Improving energy and resource efficiency across the economy, including moving to a circular economy approach "reduce, reuse, repair, recycle", to reduce increasing demand for energy and carbon-intensive resources". (p. 13).

- However, there is no sustained engagement or call for reduced energy consumption. Rather there is an emphasis on 'smart' consumption:

  "New business models and smart technologies, informed by behavioural research, will give end-users the opportunity to match consumption patterns to times of cheap low carbon electricity and gain greater control over their energy usage." (p. 37).

GO-Science NZS

- Key Term/Phrase Frequencies: Demand Reduction (x11); Demand-side Barriers (x2).
- The NZS report/process was informed by the work of CREDS (Centre for Research into Energy Demand Solutions). Demand reduction identified as a key variable.
- Reductions in demand play a role in a three of the four scenarios/pathways:

  "It is notable that demand reductions in the atomised society level off around 2035 and energy demand increases slowly after 2045, as efficiency improvements begin to be offset by increases in demand (particularly due to reshoring of manufacturing). The self-preservation and metropolitan societies show similar levels of demand reduction overall, but for different reasons: the metropolitan society has higher demands (largely due to economic growth), offset by greater efficiency improvement" (p. 112).

**D. Equity (Just Transition)**

Justice and equity matter fundamentally to both how decarbonisation should be taken forward and to the success of measures taken. The need to decarbonise in fair and inclusive terms is widely accepted across many stakeholder groups, in the UK and internationally, and consistently figures as important in, and to, the outcomes of deliberation with publics. Central to this agenda is having pre-existing social inequalities, and differential vulnerabilities to the impact of both climate change and the 'side effects' of decarbonisation policies, firmly in view. These issues were at the core of our content analysis.

DESNZ RIF

- Key Term/Phrase Frequencies: Equality (x0); Inequality (x0).
- There are very few references to anything associated with examining the processes and outcomes of a 'just transition'
- For example, note the number of times words associated with a just transition and issues of equity and equality are mentioned in the 'equality' (x0); 'equity' (x2); 'just transition' (x0); 'levelling-up' (x2). Compare with the Net Zero Society report: 'Equality' (x23)
- There are two references to 'equity' in the context of "understanding the transport sector's role in improving equity across the UK, including for rural areas". (p. 90)
- A brief mention of the need to include 'vulnerable end-users' in technological transitions (p.30) And two references to 'levelling-up' in the context of understanding the impacts of land-use change on regional/local economic growth (p. 13).

GO-Science NZS

- Key Term/Phrase Frequencies: Equality (x23); Inequality (x15).
- While there is only a singular reference to a 'just transition', issues of equality/inequality are frequently mentioned and to the fore throughout the document.
- For example, 'equality' was identified as one on the key cross-cutting themes that emerged during the 'public dialogue' (see p. 150 and Theme E below).
- There is no mention of or reference to levelling-up.

### E. Civil Society

Public participation across different phases of the net zero policy process (from design to implementation) will be critical to achieving the UK's net zero ambitions. Civic engagement at a place-based (e.g. community, city, regional) level, can help facilitate just transitions by building locally specific and relevant plans with a social mandate. At the same time, national policy needs to be more attuned to the factors impeding and facilitating change. These issues were at the core of our content analysis.

DESNZ RIF

- Key Term/Phrase Frequencies: Citizens (x0); Dialogue (x0); Trust (x0).
- Note that there are 0 references to 'citizens', and 45 references to 'end-users' (see Theme B).
- It is evident that there is a very particular view of 'people' within the system as 'end-users' or individual consumers of technologies (as opposed to citizens). Again there is a focus on understanding (and changing) responses to new technologies (end-of-pipe), and managing (mitigating) socio-economic impacts.

GO-Science NZS

- Key Term/Phrase Frequencies: Citizens (x23); Dialogue (x63); Trust (x77).
- Public engagement and dialogue is a central component of the 'scenario' development and testing process:

  "We could not discuss the future of society without talking directly with the people who shape it: UK citizens." (p. 12)
- Trust (mentioned 77 times), and in particular public trust in institutions (including businesses, local/national governments and intergovernmental organisations), was identified as one of the key variables in the development of different net zero pathways.

### F. Place

This theme is concerned with how 'place' is used as a framing device in policy documents to contextualise 'net zero' in specific geographical locations. 'Place' is increasingly used in policy as a way of thinking holistically and inclusively about development that is climate resilient and fair, and opens up scalar questions about net zero governance spanning international, national, regional and local levels.

DESNZ RIF

- Key Term/Phrase Frequencies: Place-based (x5); Community (x4).
- Taking a 'place-based approach' explicitly stated as one of the key challenges that research and innovation needs to address:

  "A successful net zero transition will be driven by locally and regionally appropriate solutions that vary across the UK. Cities, towns and neighbourhoods will be the locations where integrated cross-sector net zero solutions are delivered. Research and innovation is needed to support these objectives" (p. 30).
- However, it is a particular understanding of place: place as scale, place as local space, place constituted primarily through the lens of economic geographies. There is little about the social and cultural elements of place. There are very few references, for example, to community (x4) and none whatsoever to 'sense of place', 'belonging' or 'identity'.

GO-Science NZS

- Key Term/Phrase Frequencies: Place-based (x1); Community (x12).
- Fewer specific mentions of place or a place-based approach than the DESNZ RIF.
- However, in contrast the NZS shows more evidence of an expansive approach to place, with more references to sense of place, sense of community and to identity.
- There is also repeated reference to a broader range of 'locals' compared with the RIF e.g.: local amenities; local food/produce; local engagement; localised lifestyles; local hubs.



### In Summary

DESNZ RIF

- Recognises the importance of a 'whole systems approach' but has quite a narrow conception of what a systems approach incorporates i.e. narrow boundaries around the social elements of a system, with a focus on consumer attitudes and behaviours.
- Also recognises the need for significant transformation but similarly has very narrow sense of what needs to be transformed, how and where i.e. technology, economy (finance), industry.
- As such, what the RIF outlines is a predominantly supply-side driven transformation. There is very little mention or emphasis on the importance of demand-side reductions.
- There is also limited evidence of any significant focus on equity and a just transition.
- People are primarily referred to as consumers and end-users of technologies whose behaviours are to be understood and changed rather than as citizens to be engaged.
- Subscribes to a place-based approach, but it is an approach that only recognises certain spatial facets of place e.g. locality and scale, and pays little attention to the social and cultural elements of place.

GO-Science NZS

- Describes and employs a broader conceptualisation of 'a system' that acknowledges the importance of technology and the economy but also foregrounds social context, uncertainty and dialogue.
- For example, NZS explicitly recognises the significance of social norms and their implications for the development and success (or not) of net zero policies and pathways.
- Demand reduction is recognised as a key component of net zero pathways.
- Issues of equity are frequently mentioned and to the fore throughout the document; equity is recognised as a precondition for a successful transition process.
- People and public engagement are also identified as a key component of net zero pathways.
- Articulates a more expansive invocation of place, with more references to a sense of place, sense of community and identity.
- Social science inputs (case studies, dialogue) occur at an early stage in conceptualising net zero change.

### Conclusion

This analysis of the contents of three UK Government produced documents has revealed:

- There are different approaches across government when it comes to the framing of the challenge of net zero and the kind of policy solutions and associated research needed to address those challenges.
- The predominant frame, articulated in the DESNZ RIF and DP documents, is a technology/economy/supply-side focused approach.
- There is however an alternative approach within wider government articulated in the GO-Science led NZS report that both recognises and foregrounds these critical social dimensions and draws significantly on the insights of social science.

# 4. Appendix: Example Thematic Table - Table F (Place)

| Key Terms / Framings | DESNZ (2021) UK Net Zero Research and Innovation Framework | DESNZ (2023) UK Net Zero Research and Innovation Framework - Delivery Plan 2022-2025 | GO-Science (2023) Net Zero Society: Scenarios and Pathways Report 2023 |
|---|---|---|---|
| **Place / Place-based** | • Place (x1); Places (x3)<br>• Section 4.5 Transport<br>Transport and Mobility as a System<br>'Key areas for attention include developing a better understanding of system level interdependencies and ensuring that people and **place** are both central to a Net Zero transition'. (p. 89)<br>• Place-based (x5)<br>• Section 4.5 Transport<br>Challenge: Addressing regional needs and place-based approaches<br>Key research and innovation needs:<br>Ensure technological and market changes are built around an understanding of end-users and the communities in which they live and work.<br>Understand local/regional needs and opportunities so that decarbonisation approaches build on existing skills to support local economic growth.<br>Understand transport's role in improving equity across the UK, including equitable solutions for rural areas and maximising potential for new skill development.<br>Understand the benefits of the colocation of transport energy infrastructure, such as marine and aviation refuelling which could share raw materials or other aspects of operations. (p.90)<br>• Section 3: A Whole Systems Approach<br>Challenge: Taking a place-based approach<br>Key research and innovation need:<br>"A successful Net Zero transition will be driven by locally and regionally appropriate solutions that vary across the UK. Cities, towns and neighbourhoods will be the locations where integrated cross-sector Net Zero solutions are delivered. Research and innovation is needed to support these objectives." (p. 30) | • Place-based (x8)<br>• Section: Transport<br>Challenge: 8.4 'Addressing regional needs and place-based approaches' (p. 72)<br>• Section: Whole Systems Approach<br>Challenge: 10.4. 'Taking a place-based Approach' (p. 92) | • Place-based (x1)<br>• Public Dialogue – Cross-cutting Themes – Equality:<br>'Place-based and geographic inequality: Participants were worried that there could be a widening of inequalities between urban and rural areas in the Future' (p. 150) |
| **Local* / Location*** | • Local (x30); Locally (x2); Locality (x0); locational (x4); Location (x2); Locations (x4)<br>• Used in a wide variety of contexts throughout the document e.g.: local economies/growth; local engagement; local testbeds; local level/scale; local area; local communities; local systems; local synergies; local manufacturing; local supply chains; local factors; locally and regionally appropriate solutions; optimal locational configurations for refuelling and charging infrastructure | • See RIF | • Local* (x45)<br>• Used in a wide variety of contexts throughout the document e.g.: local government; local community* (x6); local amenities (x5); local food/ produce; local area; local engagement; localised lifestyles; local level; local economies/business; local hubs |
| **Region*** | • Regional (x8); Regionally (x2); Regions (x2)<br>• Section 4.5 Transport<br>Challenge: Addressing regional needs and place-based approaches<br>• Section 4.6 Natural resources, Waste and F-gases<br>Challenge: Developing a sustainable bioeconomy<br>Key research and innovation needs:<br>'Understand locational / regional impacts on environmental services.' (p.109)<br>• Section 2: Funding for research and innovation<br>"A combination of capital, government guarantees and private investment will enable more than £40bn of investment in areas most prone to market failure and to help deliver on its dual policy focus to tackle climate change and support regional and local economic growth." (p. 22)<br>• Section 4.4: Heat and Buildings<br>"… maximising the potential of local or regional manufacturing" (p.76) | • See RIF | • (x15) |
| **National*** | • National (x20)<br>• Mostly used in combination with 'local' e.g. "Research into whole systems integration for future energy provisions around heat, power and transport and improve coordination between networks and other system participants across local, national and international systems" (p. 46) | • National (x13); International (x44) | • National (x58); International (x49) |
| **Community*** | • Community (x4); Communities (x9)<br>• See place-based approach above | • See RIF | • Sense of (x7)<br>• As a feature (or not) of different scenarios/futures e.g.:<br>• Scenario 2: Metropolitan Society<br>• "Economic growth and technological change have delivered improvements in living standards for most, although inequalities remain. There is a strong sense of community within the growing, diverse urban population and also within rural areas" (p. 68) |
| **Identity** | • Identity (x0) | • Identity (x0) | • (x1)<br>• Scenario 2: Self Preservation Society<br>"Some have been attracted to extreme political positions. People gain a sense of community and identity from these fragmented groups that they struggle to find in wider society." (p. 73) |
| **Other Geographical terms** | UK* (x289); England* (x9); Scotland* (x0); (South) Wales* (x1); Ireland (x0); North, South, Midlands (x0); City* (x3); Town* (x6); Village* (x3); Neighbourhood* (x7); Urban (x5); Suburban (x0); Rural (x2)<br>Specific Places e.g.<br>Grangemouth, Humberside, Merseyside, Southampton, South Wales and Teesside | | City* (x32); Town (x5); Village* (x0); neighbourhood* (x1); urban (x79); Suburban (x5); Rural (x53)<br>• Specific Places e.g.<br>• Mostly in the context of the University of X |

# Annex 3: Case Studies of Societal Change

In this Annex, we present eight case studies of past and ongoing processes of societal change and transition, both successful and more problematic, which offer lessons for Net Zero transitions.

The eight chosen cases were identified and selected by the task force, based on: i.) a survey of examples from the social science literature (e.g. Newell and Simms, 2020; Rapid Transition Alliance, 2018; Nelson et al., 2021; Stabler and Foulds, 2020; Pitchforth et al., 2023; and ii.) the expertise and deliberations of the task force group. Overall, we sought variety in scales (e.g. national and local); policy arenas (environmental and non-environmental); and timeframes (past or current societal changes and transitions).

Analysis of the case studies provides a critical evidence thread underpinning the Report. Through our analysis of the conditions and contexts of change across each case we identified five 'elements' of change:

1. **Multi-factor DRIVERS OF CHANGE** - change, across a range of issues and contexts, occurs through an interplay of numerous social and material factors and processes.
2. **Mid-level ACTORS** - change is rarely bottom-up from individual action or top-down from national policy prescriptions.
3. **Galvanising ISSUE** - studies of past societal changes have identified that change tends to involve particular 'galvanising issues'.
4. **JUSTICE Considerations** - fairness and justice are central to change processes.
5. **CONTESTATIONS and CONFLICTS** - contests and even conflicts are a part of any change process.

Our analysis also sought to identify some of the key lessons for net zero from these historic transition processes.

In each of the eight (A-H) individual case study tables below we present a short narrative summary which provides: brief context; a description of the process of change (with reference to relevant key ingredients) and identifies lessons for net zero. Below each narrative summary we also provide further details/examples of the five key ingredients of change mentioned above, including key references.



Case Studies Summary Table

| Case Study | Reason for Selection |
|---|---|
| A. School Streets (UK) | Consensual change in place-specific contexts |
| B. Housing Retrofit (UK) | Working with communities – people-centred, place-based |
| C. Smoking (UK) | The multiple factors involved in national level decline in tobacco use |
| D. Single-use Plastic Bags (UK) | The multiple factors involved in national switch away from change Single-use Plastic Bags (SUPBs) |
| E. CV-19: Non-pharmaceutical Interventions (UK) | Adherence to nationally imposed restrictions |
| F. District Heating in Denmark | Shift to collective ownership of energy systems |
| G. Gas Central Heating (UK) | The social and technical factors involved in a rapid energy system transition |
| H. Carbon Capture and Storage – Barendrecht, Netherlands | A policy failure in a difficult local context |

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Rapid Transitional Alliance (2020). Lessons from Lockdown: Living with less stuff. https://rapidtransition.org/resources/lessons-from-lockdown-living-with-less-stuff/

Stabler, L. & Foulds, C. (2020). Governing the UK's transition to decarbonised heating: lessons from a systematic review of past and ongoing heat transitions. UK Energy Research Centre. https://ukerc.ac.uk/publications/governing-the-uks-transition-to-decarbonised-heating-lessons-from-a-systematic-review-of-past-and-ongoing-heat-transitions/

# Case Study A - **School Streets**

## Context

A School Street is a road outside a school with a temporary restriction on both school and non-school related motorised traffic at school drop-off and pick-up times. School Street restrictions are implemented under a Local Authority Traffic Management Order and typically enforced using access signs, temporary bollards, and in some cases automatic number plate recognition (ANPR) cameras. Originating in Italy in the 1980s, the first UK School Streets scheme was trialled in Edinburgh in 2015. Following a relatively slow start the number of School Streets schemes in the UK increased significantly during the pandemic period 2020-2021 and continues to grow steadily. As of January 2024, there were 468 School Streets schemes registered with the Streets School Streets Initiative.

Many School Streets initiatives are still in their trial phase but there is a growing evidence base suggesting that these relatively light touch, low-cost approaches can lead to significant and sustained changes to travel behaviours and habits (Davis, 2020; Belcourt-Weir et al., 2022; Thomas, 2022). They have been shown, for example, to be effective at significantly reducing motor traffic around schools and neighbouring streets (Davis, 2020), both during and after closure times (Thomas, 2022) and at increasing active travel among children (Davis, 2020).

## Key Elements of Change

The original, pre-pandemic, impetus for School Streets emerged out of a number of different, but related, concerns associated with road safety, traffic congestion, local air quality, and active travel considerations. These different drivers, or framings, found a common denominator, a galvanising focus, around protecting children's health and safety. The emergence of children's health as a galvanising issue was crucial in terms of it being both an idea around which many agendas could coalesce and a notion and outcome that few would argue with. The broad consensual appeal of children's health also served to mitigate and minimise community contestations and conflicts. While School Streets do face some local opposition, they are proving significantly less divisive than other, similar, but differently framed, traffic schemes.

The involvement and consent of local residents and community groups is critical, but the success of School Streets schemes is also dependent on a broad coalition of mid-level actors whose collective efforts contribute to their development and implementation. Schools (staff and boards) and parents (PTA and other groups), for example, play a crucial role in advocating for and supporting the development of local School Streets schemes. Local authorities, who are largely responsible for planning, designing, and implementing the physical changes to the streets surrounding schools, play an important role too, as do a range of other supporting mid-level actors including: transportation and road safety experts; health professionals; police and traffic enforcement authorities; and non-government organisations such as Sustrans.

## Lessons for Net Zero

School Streets are being shown to be successful at reducing overall levels of traffic around schools and neighbouring streets both during and after closure times. They are also proving effective at increasing active travel among children which, evidence suggests (DeWeese et al., 2022), has long-term positive, habit-forming effects. Both these changes will lead to reductions in greenhouse gas (GHG) emissions. The success of School Streets schemes also has two other potentially important lessons for similar traffic reduction initiatives. Firstly, Davis' (2020) research shows that people's (negative) attitudes towards the schemes change once evidence emerges, anecdotally and empirically, that many of their negative assumptions (particularly in relation to the spatial displacement of traffic) do not materialise. Secondly, it is notable that in the development of, and discussions around School Streets, net zero was very rarely mentioned. In the context of other initiatives, this demonstrates the value of emphasising various other (non-net zero) co-benefits, and the crucial role of a galvanising, not polarising, focal issue around which to build schemes.

## Case Study A - School Streets: Elements of Societal Change

| | |
|---|---|
| **Multi-factor DRIVERS OF CHANGE** | • Road safety concerns<br>• School run traffic congestion<br>• Local air quality concerns<br>• Active travel considerations<br>• Nb: climate change/carbon emissions very rarely explicitly mentioned |
| **Mid-level ACTORS** | • Local authorities<br>• Parent groups<br>• Teachers and school staff<br>• Community groups<br>• Sustrans |
| **Galvanising ISSUE** | • Health and safety of local school children |
| **JUSTICE Considerations** | • Potential inequality in geographical distribution of schemes |
| **CONTESTATIONS and CONFLICTS** | • Commuters/motorists vs. children/parents<br>• Right to drive vs. right to clean air/safe streets |
| **REFERENCES** | • Belcourt-Weir et al. (2022). School Streets and Traffic Displacement: Technical Report – Sustrans<br>• Davis, A. (2020). School Street Closures and Traffic Displacement: A Literature Review and Semi-Structured Interviews. Transport Research Institute, Edinburgh Napier University: Edinburgh, UK<br>• DeWeese, R. S., Acciai, F., Tulloch, D., Lloyd, K., Yedidia, M. J. & Ohri-Vachaspati, P. (2022). Active commuting to school: A longitudinal analysis examining persistence of behavior over time in four New Jersey cities. Preventive Medicine Reports, 26, 101718<br>• Hopkinson, L., Goodman, A., Sloman, L., Aldred, R. & Thomas, A. (2021). School Streets Reducing children's exposure to toxic air pollution and road danger<br>• Thomas, A. (2022). Making School Streets Healthier: Learning from temporary and emergency closures |

## Case Study B - **Housing Retrofit**

### Context

The United Kingdom has one of the oldest existing housing stocks in Europe (Grey et al., 2017), and with energy performance generally correlating with building age (Karvonen, 2013), it also has one of the most energy inefficient.

UK homes account for 29% of total UK energy demand (BEIS, 2020) and around 22% of UK greenhouse gas emissions (CCC, 2019). Poor quality, energy inefficient housing is also a key and enduring cause of hardship for low income and vulnerable households. To reach our 2050 net zero ambitions and address the issue of fuel poverty we need to radically and quickly decarbonise the housing stock and make it more energy efficient. However, at current housing replenishment rates of around 2% per year we will be left with 80% of existing stock by 2050 (CCC, 2019.) If we are not going to build new, more energy efficient homes, then we must extensively retrofit our existing stock.

Over the past two decades there have been numerous policy initiatives and programmes designed to improve the energy performance of existing housing in the UK, which to varying degrees have focused on fuel poor households (see Karvonen, 2013 and Putman and Brown, 2021).

Flagship schemes such as Warm Front (2000-2013) and the Green Deal (2013-2015) are among the most prominent features of a complex and fragmented landscape of different policies and actors. Collectively, these initiatives, while suggesting an acknowledgment of the necessity and wider benefits of retrofitting (see below), have nevertheless largely 'failed to deliver' the scale and speed of change required to the UK's housing stock that our commitment to net zero necessitates (Putnam and Brown, 2021: 1). Why might this be?

### Key Elements of Change

Retrofitting is a complicated and challenging technical, economic and social process. Part of the issue has been the predominance of a techno-economic framing of the problem and an accompanying emphasis on top-down, regulatory and technical/material, 'fabric first' focused solutions. While these approaches have delivered some quick and 'easy wins', with respect to the 'low hanging fruit' (see DECC, 2011), they are insufficient to realize the scale of change required. As Karvonen (2013: 568) argues, developing a systemic domestic retrofit agenda in the UK, requires "thinking beyond the technical and economic aspects of domestic energy use".

Karvonen is among a number of researchers (see also Jankel, 2013; Putnam and Brown, 2021) who have identified and advocated for an alternative framing of retrofit, one that pays greater attention to the social, and one that emphasises a local, community or 'people first' approach. These area or place-based approaches attend to issues of procedural justice by empowering households to become active participants in the retrofit process rather than passive targets. Distributive justice is also enacted in enabling fuel poor households with fewer resources and less agency to be included. By involving communities, such approaches are also able to offer solutions that recognise both the physical diversity of housing stock and the distinctiveness of household energy/heating social practices, habits and behaviours that take place within them. While households are at the forefront, area-based approaches involve a host of supporting and enabling local mid-level actors including local authorities, environmental groups, architects and builders, local fire services etc. Playing a particularly critical role are what Karvonen (2013: 571) refers to as intermediaries. These local intermediaries "bridge the gap between distant government carbon reduction targets and the rhythms of domestic life by developing trust and confidence in the tools, processes and actors involved in domestic retrofit".

### Lessons for Net Zero

Retrofitting homes is key to achieving net zero. It is not an easy solution to reducing carbon and energy demand, but done right, it is one that works. In a large-scale, ex-post evaluation of the Kirklees Warm Zone (KWZ) scheme - an area based community scheme coordinated by the local authority (Kirklees Council) and managed by a not-for-profit local energy company (Yorkshire Energy Services), that ran from 2007-2010 and retrofitted 51,000 homes - Webber et al., (2015) found that retrofitting had a greater effect on domestic energy use in practice than key theoretical models had originally forecast. They calculated that retrofit associated reductions in energy use resulted in a total carbon saving of 25.1 ktCO2/year. Moreover, it had also led to an average annual saving of £125 (or 10%) per year for each participating household. Despite this clear success, the learning from this and other area-based schemes has not been built on within national policy, although the UK's devolved administrations did sustain the funding of area-based retrofit initiatives (see, for example, the Scottish Government's HEEPS schemes and the Welsh Government's Arbed scheme).

The realisable household energy bill savings are significant and illustrate the potential of retrofit to lead to a cascade of other co-benefits, not least of which, is fuel poverty alleviation. In a longitudinal qualitative study of the lived experiences of fuel poverty, before and after an energy efficiency intervention, Grey et al., (2017: 902) found that such schemes can have a "profound positive impact on wellbeing and quality of life, financial stress, thermal comfort, social interactions and the use of indoor space". Local retrofit programmes can also have a range of other local economic benefits too, in terms of employment and boosts to local businesses (Brown et al., 2020).

Collectively, the environmental, economic and social case for retrofit is compelling but significant barriers to its large-scale roll-out remain. Among the most persistent of these barriers are issues of trust. Household attitudes to the principle of retrofit are largely positive but practical uptake is impeded by concerns around reliability, outcome quality, and cost-savings (Wilson et al., 2015). This lack of trust also stems, according to Putnam and Brown (2021: 3), from "homogeneity in policy offerings and contractors' approaches, where measures are chosen without considering the needs of the property and residents". Putnam and Brown (2021: 10) note that grassroots, community-governed, retrofit initiatives offer an "alternative to the centralised policy pathway embodied in programmes such as the Green Deal, which failed to deliver residential retrofit at scale in the UK". Such initiatives, with their emphasis on a place-based, people-centred approach to design and delivery, are proving effective at overcoming many of the trust-related barriers to implementation associated with imposed, top-down schemes. Policy support for locally-led approaches therefore will be critical to advancing the retrofit agenda and unlocking its multiple benefits including those that relate to our net zero ambitions.

## Case Study B - Housing Retrofit: Elements of Societal Change

| | |
|---|---|
| **Multi-factor DRIVERS OF CHANGE** | • Social justice and equity considerations<br>• Public health concerns (cold/damp)<br>• Energy efficiency/consumption |
| **Mid-level ACTORS** | • Local authorities<br>• Local environmental groups<br>• Local building firms<br>• Local energy company<br>• Local Fire and Rescue Service |
| **Galvanising ISSUE** | • Fuel poverty and rising energy costs |
| **JUSTICE Considerations** | • Procedural and distributional Justice |
| **CONTESTATIONS and CONFLICTS** | • Area based vs needs based<br>• Landlords vs tenants<br>• Unequal access to funding<br>• Community vs authority and issues of trust and fear of unintended consequences<br>• Poor quality work and project management |
| **REFERENCES** | • BEIS (2020). Energy Consumption in the UK (ECUK) 1970 to 2019<br>• Brown, D., Wheatley, H., Kumar, C. & Marshall, J. (2020). A green stimulus for housing: The Macroeconomic Impacts of a UK Whole House Retrofit Programme<br>• CCC (2019). UK housing: Fit for the future?<br>• CCC (2019). Reducing UK emissions - 2019 Progress Report to Parliament Committee on Climate Change<br>• Grey, C. N., Schmieder-Gaite, T., Jiang, S., Nascimento, C. & Poortinga, W. (2017). Cold homes, fuel poverty and energy efficiency improvements: a longitudinal focus group approach. Indoor and Built Environment, 26 (7) 902-913<br>• Jankel, Z. (2013). Delivering and funding housing retrofit: A review of community models. Policy report Arup & Centre of sustainability: United Kingdom<br>• Karvonen, A. (2013). Towards systemic domestic retrofit: a social practices approach. Building Research & Information, 41 (5) 563-574<br>• Putnam, T. & Brown, D. (2021). Grassroots retrofit: Community governance and residential energy transitions in the United Kingdom. Energy Research & Social Science 78 102102<br>• Webber, P., Gouldson, A. & Kerr, N. (2015). The impacts of household retrofit and domestic energy efficiency schemes: A large scale, ex post evaluation. Energy Policy 84 35-43 |

# Case Study C - **Smoking**

## Context

Tobacco remains a leading cause of death globally, killing nearly 8 million people each year. The vast majority of these deaths are as a result of smoking (Reitsma et al., 2021). In the UK, smoking, which is most prevalent in deprived groups, remains a leading cause of death (Office for National Statistics, 2023). The Framework Convention on Tobacco Control (FCTC) became the first and only legally binding international health treaty, adopted in 2003 by the World Health Organisation, to mitigate tobacco related harms (Roemer et al., 2005). The FCTC has given the impetus for national governments to develop tobacco control legislation, although the UK was doing so already (Chung-Hall, et al., 2016; Campaign for Tobacco-Free Kids, 2018). The prevalence of smoking in the UK peaked in the post-war period with 82% of men and 65% of women smoking cigarettes in 1948. A steady decline in smoking prevalence has been seen since the early 1970s (Action on Smoking and Health 2023), and the UK is generally regarded as having one of the most comprehensive sets of tobacco control policies globally. Smoking is commonly highlighted as a policy area from which learning around social change and collective action can be drawn (Cairney, 2019; Pitchforth et al., 2023).

## Key Elements of Change

Efforts to introduce and enforce tobacco control began in the 1930s with evidence of a link between smoking and lung cancer. The strength of evidence and a causal link was increased through large-scale studies in the UK and US in the 1960s. Efforts to disseminate this link continued through the 1960s and 70s and international public health networks grew (Reubi and Berridge, 2016). The UK and other countries introduced a range of tobacco control policies through the 1990s to late 2000s, including restrictions to advertising, sponsorship and to whom and where tobacco could be sold. A significant shift in galvanising social change came with increasing evidence of the harms of smoking to non-smokers (Nathanson, 1999). This enabled a shift in the framing of tobacco control measures. Smoking, which had previously been seen as an individual freedom, was then brought into conflict with the rights of non-smokers to remain unharmed by others' smoking habits.

The history of tobacco control efforts is also marked by strong contestations. Actors resistant to tobacco control included the tobacco industry but also the advertising industry and some government stakeholders given that the Treasury relied on revenue from tobacco sales. In the initial decades, some of these actors worked to discredit the evidence of the relationship between tobacco and disease. Where they did engage in control measures this was through 'harm reduction' measures such as altering cigarette contents rather than reducing use (Berridge, 2007). The shift in emphasis to the harms of passive smoking allowed a greater role for mid-level actors, including advocacy groups such as Action on Smoking and Health (ASH), local authorities, representative bodies for health professionals and the hospitality trade (Arnott et al., 2007). A coalition formed by ASH was able to play an important role in bringing about national smoke-free workplace legislation. An important aspect of this was to be able to demonstrate growing public support for smoke-free legislation and to understand the preferences of different stakeholders. The hospitality trade and tobacco industry were aligned in favouring voluntary action rather than legislation but, unlike the tobacco industry, national legislation was the next preferred option for the hospitality trade. The risks of passive smoking thus reframed the problem around collective harm and altered longstanding contestations. Legislation was enabled partly because of already shifting societal changes in support of the rights of workers over the right of individuals to smoke (Arnott et al., 2007).

## Lessons for Net Zero

The example of smoking legislation provides learning for net zero in demonstrating the potential importance of a shift in focus from individual behaviour to collective responsibility and the rights of those not engaging in particular behaviours; a reframing which was key to overcoming contestation and building public support for regulation. The example also shows the need to engage with, and challenge, a range of actors, including those who oppose change, to be able to coalesce around a focal issue. Finally, the role of advocacy groups or social movements are highlighted.



## Case Study C - Smoking: Elements of Societal Change

| | |
|---|---|
| **Multi-factor DRIVERS OF CHANGE** | • Burden of scientific evidence<br>• Health and safety at work (including legal sanction on employers)<br>• Economics of treatment |
| **Mid-level ACTORS** | • Advocacy and campaign groups<br>• Professional bodies<br>• Local authorities |
| **Galvanising ISSUE** | • The health of non-smokers |
| **JUSTICE Considerations** | • The rights of individuals who smoke vs non-smokers<br>• Ongoing inequalities in smoking and related deaths |
| **CONTESTATIONS and CONFLICTS** | • Individual consumer rights vs. right to healthy environments<br>• Vested interests and misinformation<br>• Preferred levels of legislation |
| **REFERENCES** | • Action on Smoking and Health (ASH) (2023). Smoking Statistics<br>• Arnott, D., Dockrell, M., Sandford, A. & Willmore, I. (2007). Comprehensive smoke-free legislation in England: how advocacy won the day. Tobacco Control 16 (6) 423-428<br>• Cairney, P. (2019). The Transformation of UK Tobacco Control, in Paul 't Hart, and Mallory Compton (eds), Great Policy Successes (Oxford, 2019; online edn, Oxford Academic, 24 Oct. 2019)<br>• Nathanson, C. (1999). Social movements as catalysts for policy change: the case of smoking and guns. Journal of Health Politics, Policy and Law 24 421-488<br>• Office for National Statistics (ONS) (released 21 April 2023). ONS website Statistical Bulletin - Deprivation and the impact on smoking prevalence, England and Wales: 2017 to 2021<br>• Pitchforth, E., Gemma-Clare, A., Smith, E., Taylor, J., Rayner, T., Lichten, C., d'Angelo, C., Gradmann, C., Berridge, V., Bertscher, A. & Allel, K. (2023). What and how can we learn from complex global problems for antimicrobial resistance policy? A comparative study combining historical and foresight approaches. Journal of Global Antimicrobial Resistance 35 110-121<br>• Reitsma, M. B. et al. (2021). Spatial, temporal, and demographic patterns in prevalence of smoking tobacco use and attributable disease burden in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019. The Lancet 397(10292) 2337-2360<br>• Reubi, D. & Berridge, V. (2016). The internationalisation of tobacco control, 1950–2010. Medical History 60 (4) 453-472 |

# Case Study D - **Single-Use Plastic Bags**

## Context

In light of growing concern about littering and pollution, particularly from plastics, policymakers have sought to reduce use of single-use plastics and encourage re-use. Carrier bags make up a significant proportion of urban, rural and marine litter; for example, plastic bags account for around 9% of all litter found on the coastline (Ricardo, 2015). A range of policies, including bans, charges, and levies, have aimed to minimise use of single-use plastics. Carrier bag charging schemes have been implemented in many countries and can substantially reduce consumption of single-use plastic bags (SUPBs), with a reduction of 50% to 95% in the short-term (Ricardo, 2015). England has seen a 95% reduction in SUPBs, for example (UK Government, 2021).

SUPB charges tend to be popular with the public, particularly when proceeds are donated to charity rather than kept by retailers or government (Ricardo, 2015). Popularity also increases after charges have been implemented and benefits (e.g. reduced litter) observed; increased public support for more ambitious waste reduction policies has also been seen in the UK following the implementation of plastic bag charging (Thomas et al., 2019).

## Key Elements of Change

Policy drivers for SUPB charges are reducing littering and damage to wildlife, while economic benefits are also cited (UK Government, 2015). The 'plastic problem' is a priority for UK environmental policy. Products which are single-use or disposable are 'low-hanging fruit' to address this problem. That the charge had already been successfully implemented in other countries likely also contributed to confidence in its appropriateness and effectiveness for UK countries (Ricardo, 2015).

Policy, business, and public awareness of plastic pollution and its impacts on wildlife increased substantially in light of the BBC's extremely popular Blue Planet II. This 2018 David Attenborough documentary graphically and emotively highlighted the threat to marine wildlife (e.g. seabirds) by plastic pollution. The 'Blue Planet Effect' is thought to have sparked widespread changes in public attitudes, community action (e.g. beach cleans), non-government organisations campaigns, business investment in reducing single-use plastics, and government policy to tackle plastic pollution (e.g. Dunn et al., 2020; BBC, 2019). Indeed, the documentary is explicitly referenced as a rationale for the UK Government's SUPB charge (UK Treasury, 2018). As an environmental communicator, David Attenborough is unusual in being almost universally trusted across all public segments (Climate Outreach, 2023).

Public support for SUPB charging is likely to be in part due to the visibility of plastic litter, including carrier bags, on streets and beaches, and in rivers; and, since Blue Planet, widespread awareness of its impacts on wildlife. This is in contrast to the less visible and indirect effects of other pollutants, such as greenhouse gases. Similarly, evidence shows that 'reducing waste' is a narrative with near-universal appeal amongst the public (across voter groups), in contrast to other framings or rationales for environmental policy which are more partisan (Whitmarsh and Corner, 2017). Protecting wildlife and biodiversity is also far less politically divisive than net zero or climate change. Consequently, the galvanising issues for SUPB charging are waste and wildlife. Other characteristics of the policy also likely contributed to its public support, including its affordability (e.g. £0.10), limited impacts on lifestyles, and the revenue raised going to charity. This is in line with wider evidence showing perceived effectiveness, fairness and costliness are key drivers of policy support (e.g. Mitev et al., 2023).

The policy has also enjoyed broad support from businesses (retailers) who have reported economic savings, as well as endorsing the environmental rationale for the policy (Ricardo, 2015). Indeed, there has been very little contestation.

## Lessons for Net Zero

Policies which address visible problems (e.g. litter), with identifiable victims (wildlife), and are observably effective (e.g. reducing waste) are more supported, as are those where the needy (e.g. charities) benefit, and the public retain freedom of choice and do not suffer high economic or lifestyle costs. Similarly, businesses saw economic benefits, which ensured their buy-in. Designing net zero policies in these ways is likely to boost public support, but also makes clear the challenges likely to be faced when the issues involved do not allow this.



## Case Study D - Single-Use Plastic Bags: Elements of Societal Change

| | |
|---|---|
| **Multi-factor DRIVERS OF CHANGE** | • Introduction of the single-use plastic bag charge (leading to public support for more ambitious waste policies)<br>• Growing public perception of the issue of plastic pollution (esp. marine litter) in light of BBC documentary |
| **Mid-level ACTORS** | • Environmental non-government organisations (e.g. Greenpeace), retailers and brands offering alternatives (e.g. Bags for Life), |
| **Galvanising ISSUE** | • Wildlife, e.g. seabirds<br>• Litter in towns, rivers, beaches |
| **JUSTICE Considerations** | • Charge is low enough to be affordable to all<br>• Revenue goes to charity |
| **CONTESTATIONS and CONFLICTS** | • Minimal: charging (rather than regulating) preserves freedom of choice, avoiding libertarian critique; businesses saw economic benefits |
| **REFERENCES** | • BBC (2019). Science Focus: Has Blue Planet II had an impact on plastic pollution?<br>• Dunn, M. E., Mills, M. & Veríssimo, D. (2020). Evaluating the impact of the documentary series Blue Planet II on viewers' plastic consumption behaviors. Conservation Science and Practice 2 (10, e280<br>• Climate Outreach (2023). https://climateoutreach.org/<br>• Mitev, K., Player, L., Verfuerth, C., Westlake, S. & Whitmarsh, L. (2023). The Implications of behavioural science for effective climate policy. Report commissioned by the Climate Change Committee<br>• Ricardo AEA / Cardiff University (2015). Evaluation of the impact of the Single Use Carrier Bag Charge in Wales. Report to Welsh Government<br>• Thomas, G. O., Sautkina, E., Poortinga, W., Wolstenholme, E. & Whitmarsh, L. (2019). The English plastic bag charge changed behavior and increased support for other charges to reduce plastic waste. Frontiers in psychology 10 266<br>• UK Government (2021). Carrier Bags: why there's a charge<br>• UK Treasury (2018). Tackling the plastic problem Using the tax system or charges to address single-use plastic waste<br>• Whitmarsh, L. & Corner, A. (2017). Tools for a new climate conversation: A mixed-methods study of language for public engagement across the political spectrum. Global Environmental Change 42 122-135 |

# Case Study E - **Covid-19: Non-Pharmaceutical Interventions (Lock Down, School Closures, Face Masks)**

## Context

In the early stages of the COVID-19 pandemic, with modelling studies predicting a public health emergency and the overrun of already stretched health services, the UK Government announced the first of several non-pharmaceutical measures. They included a lockdown, school closures, face mask orders and social distancing measures. The measures represented a previously difficult to imagine "curtailment of normal life" in order to "contain the rate of infections, thus protecting public health and preserving the National Health Service's (NHS) capacity to treat the anticipated influx of patients" (Halliday et al., 2022: 386). Compliance with the measures was high (though far from being universal) (Denford et al., 2021; Liam et al., 2022; Smith et al., 2020).

## Key Elements of Change

Widespread compliance with these temporary changes to 'normal life' are of interest as they suggest normative reasons for alteration of behaviours and practices. A useful distinction exists between instrumental forms of compliance (where people comply in order to avoid detriment or costs) and normative reasons (contributing to a collective goal or good). The latter implies that less coercive forms of compliance are possible (Tyler, 2007).

While the measures were backed by legal frameworks (including some notable and public sanctions for non-compliance), and detriment was associated with loss of peer approval and possible threats to personal health, compliance was also rooted in normative motivations (Halliday et al., 2022). The laws had public legitimacy and social license.

For Halliday et al., normative mechanisms relate to: agreement with the effectiveness of the rules; obligations to others; consciousness over rights and their suspension; and a sense of procedural justice. All arguably diminished as the COVID-19 pandemic progressed through various waves of strains and infections, with a mounting critique of curtailed rights to mobility, social contact, work, education etc., and a sense of injustice as non-compliance of certain groups were publicised.

Nevertheless, obligations to others were notable. A critical factor here was the government messaging around 'staying at home to save the NHS', introduced in March 2020, relentlessly reinforced by government and health care providers. This galvanised a positive, solidaristic, sense of 'doing your bit' to save the NHS and close contacts (including elderly family and friends) as well as a negative, and more instrumental, aspect of




peer disapproval for non-compliance. A key element here was the shared sense of the value of the NHS as a cherished institution (which had recently celebrated a 70-year anniversary). Culturally, this became a symbolic rallying point, with rainbow insignia and weekly 'giving thanks' becoming a ritualised form of social engagement (even if this backing and thanks were sometimes regarded as tokenistic). It has been suggested that part of the message's success was to communicate a message that 'we are all in this together'.

## Lessons for Net Zero

This example demonstrates the importance of normative reasons and collective obligations that can underpin messaging around policy, particularly interventions which curtail routine habits and choices. It is likely that net zero itself, as a goal, is not enough to deliver societal changes. It also highlights the importance of reinforcement and rearticulation of key messages through mid-level actors (in this case, through interaction with different facets of health provision).

## Case Study E - Covid-19: Non-Pharmaceutical Interventions (Lock Down, School Closures, Face Masks): Elements of Societal Change

| | |
|---|---|
| **Multi-factor DRIVERS OF CHANGE** | • Pandemic infections (health)<br>• Health service capacity (and welfare state heritage)<br>• Poor health outcomes in elderly and already compromised patients<br>• Limited testing capacity<br>• National emergency<br>• Repetition of core message through public information media campaigns |
| **Mid-level ACTORS** | • Health agencies on the ground (GPs, dentists, care workers, opticians etc.) who would have relayed the core 'Stay Home, Protect the NHS, Save Lives' message |
| **Galvanising ISSUE** | • Saving the National Health Service |
| **JUSTICE Considerations** | • These measures had numerous distributional effects, intergenerational unfairness and issues of equity. For example Student and Foundational Doctors and professionals, those with good internet and multiple devices, did better than inner city groups with no access to outdoor space, poor connections, shared devices and so on)<br>• The success of the 'stay at home to protect the NHS' messaging may have had the unintended impact of discouraging some people from seeking medical help from the NHS for other life-threatening conditions<br>• Procedural justice in the form of processing of non-compliance and aspects of flagrant flouting of rules by elites undermined public confidence |
| **CONTESTATIONS and CONFLICTS** | • Individual rights vs. intergenerational and social inequalities<br>• Livelihoods vs. national institution and health of vulnerable |
| **REFERENCES** | • Denford, S., Morton, K. S., Lambert, H., Zhang, J., Smith, L. E., Rubin, G. J., Cai, S., Zhang, T., Robin, C., Lasseter, G., Hickman, M., Oliver, I. & Yardley, L. (2021). Understanding patterns of adherence to COVID-19 mitigation measures: a qualitative interview study. J Public Health (Oxf) 43 (3) 508-516<br>• Halliday, S., Finch, N., Meers, J., Tomlinson, J. & Wilberforce, M. (2022). Why the UK Complied with COVID-19 Lockdown Law. King's Law Journal 33 (3) 386-410<br>• Liam, W., Andrew, S., & Daisy, F. (2022). Patterns of compliance with COVID-19 preventive behaviours: a latent class analysis of 20 000 UK adults. Journal of Epidemiology and Community Health 76 (3) 247<br>• Ridsdale, L. (2020). Covid-19: "protecting the NHS" encourages people with symptoms to stay at home. BMJ 370<br>• Smith, L. E., Amlot, R., Lambert, H., Oliver, I., Robin, C., Yardley, L. & Rubin, G. J. (2020). Factors associated with adherence to self-isolation and lockdown measures in the UK: a cross-sectional survey. Public Health 187 41-52<br>• Tyler, T. (2007). Why People Obey the Law. Princeton University Press |

# Case Study F - **District Heating In Denmark**

## Context

District Heating (also known as heat networks) is the localised distribution of heat from a central source to multiple buildings or homes through a network of hot water carrying underground pipes. The central heat source providing input to a heat network can come from a variety of technologies including:  power stations, Energy from Waste (EfW) facilities, Combined Heat and Power (CHP) plants, heat pumps, geothermal sources and solar thermal arrays. Denmark has been a world leader in district heating for over a century. For much of the twentieth century, driven by a rationale based on energy efficiency and the provision of reliable, affordable heat supplies - and fuelled by municipal waste and then by imported oil - District Heating expanded steadily and organically. The period between 1976 and 2011, however, saw the rapid expansion, decarbonisation and decentralisation of District Heating in Demark (Sovacool and Martiskainen, 2020). This radical transformation occurred in two distinct phases: the first was precipitated by the oil crisis of the 1970s; and the second 'environmental' phase by growing concerns about climate change and other environmental issues during the 1990s and 2000s. Across these two phases CHP use, fuelled primarily by natural gas alongside low-carbon renewable sources such as biomass, straw, and solar, expanded by a factor of four. This transformation in the generation and distribution of heat led to a 20% reduction in carbon emissions (ibid).

## Key Elements of Change

The 'environmental' phase of Denmark's energy and heating infrastructure transformation (post-1990), was predominantly driven by growing environmental concerns and the need to minimise air pollution and reduce carbon emissions. The Danish government published the Energy 2000 Action Plan in 1990, the first low-carbon energy transition strategy in the world, and over the next 20 years successfully phased out coal and converted much of the District Energy system to low-carbon, renewable energy sources.

A crucial galvanising issue that supported the radical restructuring and rapid transformation over the period 1976 -2011 was the idea of decentralised, community control of energy systems, and the localised benefits that this brought. The Danish Government introduced various policies, and legislation, to promote decentralization and local governance. This included incentives for district heating expansion, support for CHP plants and the establishment of energy planning and regulatory frameworks to facilitate local energy initiatives. The rationale for decentralisation of heat infrastructure planning was that increased ownership of local heat-planning initiatives would strengthen the integration of local ideas and initiatives in municipal heat planning practices (Johansen and Werner, 2022). Decentralisation brought into play a broad range of local mid-level actors including municipalities (local authorities), local utility companies, energy cooperatives, local industries and businesses, and various community groups and associations. Collectively, these groups assumed complete responsibility for local District Heating and energy systems governance including planning and community engagement, ownership and operation.

Denmark's commitment to decentralised district heating has also brought with it important justice-related benefits in terms of affordable and reliable energy access to all residents, including low-income households. Municipal powers to support community ownership models for district heating projects, have also empowered local residents to have a stake in energy decision-making processes. Community-owned district heating cooperatives promote democratic participation, transparency, and accountability, ensuring that the benefits of energy projects are shared equitably among stakeholders.

## Lessons for Net Zero

What the rapid expansion and decarbonisation of the Danish District Heating sector over the period 1976-2011 shows is that:

- Deep, wide reaching and transformative energy/ heat transitions are possible within (relatively) short timeframes (see also Case Study G - Gas Central Heating).
- Decentralisation of energy systems, and the establishment of community ownership models, can lead to a range of collective co-benefits, including the embedding of justice priorities, increased transparency and greater community trust and engagement, and increased access to affordable energy. Such models and associated benefits can reduce community resistance to renewable energy projects.
- There are additional economic benefits to localised, non-private sector energy production models. Hvelplund and Djørup (2019), in their study of the Danish electricity distribution sector, for example, argue that consumer ownership of natural monopolies has historically played an important role in keeping prices low and in so doing has provided the financial 'space' for innovation in renewable technologies.

### Case Study F - District Heating In Denmark : Elements of Societal Change

| | |
|---|---|
| **Multi-factor DRIVERS OF CHANGE** | • Political ambitions around energy self-sufficiency (reduce dependency on imported oil)<br>• Environmental concerns – air pollution and carbon emissions<br>• Local employment and economic development<br>• Community ownership and participation |
| **Mid-level ACTORS** | • Municipalities (Local Government)<br>• Local utility companies<br>• Local energy/heating cooperatives;<br>• Community groups and associations |
| **Galvanising ISSUE** | • Collective/Neighbourhood control of energy |
| **JUSTICE Considerations** | • Contribution to increasing access to affordable energy |
| **CONTESTATIONS and CONFLICTS** | • Private sector vs. community ownership models |
| **REFERENCES** | • Djørup, S., Odgaard, O., Sperling, K. & Lund, H. (2021). Consumer ownership of natural monopolies and its relevance for the green transition: The case of district heating. Energy Regulation in the Green Transition 34<br>• Gorroño-Albizu, L., Sperling, K. & Djørup, S. (2019). The past, present and uncertain future of community energy in Denmark: Critically reviewing and conceptualising citizen ownership. Energy Research & Social Science 57 101231<br>• Hvelplund, F. & Djørup, S. (2019). Consumer ownership, natural monopolies and transition to 100% renewable energy systems. Energy 181, 440–449<br>• Johansen, K., & Werner, S. (2022). Something is sustainable in the state of Denmark: A review of the Danish district heating sector. Renewable and Sustainable Energy Reviews 158, 112117<br>• Sovacool, B. K. & Martiskainen, M. (2020). Hot transformations: Governing rapid and deep household heating transitions in China, Denmark, Finland and the United Kingdom. Energy Policy 139, 111330 |

# Case Study G - **Gas Central Heating**

## Context

In 1963, around 70% of UK homes were heated by coal. Only around 10% of the UK market for heating installations was for oil, 'town gas' (carbonised coal) or electric appliances. By 1977, nearly half of homes had natural gas central heating. This rapid transformation was well organised and centrally promoted, supported by legislation and investment. But it was also enabled by technical innovation and spurred on by the discovery of methane gas resources in the North Sea. So how was such a rapid and widespread transition from coal to gas, and from room-based heating to central heating achieved?

## Key Elements of Change

Several key elements combined to create this rapid energy transition. Until the late 1950s, central heating was based on expensive large bore pipework, available only to the wealthier in larger properties. The invention of small-bore (<30mm) hot water pipework systems driven by small, quiet pumps made water-based heating systems cheaper and easier-to-fit. At the same time, housing standards were starting to be regulated, with the Parker-Morris report in 1961 setting expectations for 'decent housing' with more floor space, well-proportioned rooms and better heating. This emerged from a gradual investment in social housing - from 1931 to 1971, the share of council homes rose from 7 to 31%, making large stocks of housing available for centralised management.

Into this picture, the British Coal Utilization Research Association (BCURA) emerged as a major instigator promoting central heating. BCURA aimed to promote the utilisation of coal and its derivatives, and saw small-bore central heating systems as an ideal opportunity to promote the consumption of town gas (i.e. gasified coal). From 1957, it published information about small-bore systems and their benefits, and simultaneously improved system controls to make them suitable for domestic properties. It also promoted these systems heavily among heating design professionals and in the heating supply chain.

Clean heating systems were increasingly fashionable and were promoted in popular magazines such as 'Ideal Home', even if these promoted a wide range of technologies to its aspirational middle class readers.

Other sectors were equally engaged in promoting clean heating systems, including the Electricity Development Association.

What BCURA could not know then was the scale of natural gas discoveries to come in the 1970s. Conversion to natural gas was centrally coordinated through government legislation and agencies, with a planned transition from 1967 to 1977. Appliance manufacturers were encouraged, fitters were trained, gas board staff ran information campaigns while also installing new pipework systems, developing new contracting systems and industrial relations agreements. The nationalised gas industry brought together several hundred gas undertakings into 12 area boards, and the Gas Act of 1972 was implemented through a single organisation, the British Gas Corporation. Despite great uncertainty at the time, such as over demand for gas, available reserves, and many technological niceties (given the requirement to convert many thousands of kinds of gas appliances from coal to North Sea gas), and enormous levels of complaints, this conversion programme also shook up working practices in the industry. One sales director described the 1969 'Guaranteed Warmth' campaign as the greatest single event to influence the development of central heating. Prices were standardised, making them appear predictable and manageable, and put the management of temperature gradients and other technicalities into the remit of the heating engineer.

## Lessons for Net Zero

A key lesson from the Gas Central Heating (GCH) transition for net zero, is that rapid energy system transitions are possible but that social and political factors play a critical enabling role. In this case, many elements came together – technical innovation, market innovation, central coordination, design of contracts and working practices, alongside a popular movement for cleaner and 'decent' homes, spurred on by nationalised programmes for social housing. The idea of 'decent homes', and the role of GCH in improving heating, offered a collective vision of the future that people and organisations could subscribe to.

Crucial to the 'coming together' of these many components of change, was central direction of the programme aligned with strong government coordination of all those involved.



## Case Study G - Gas Central Heating: Elements of Societal Change

| | |
|---|---|
| **Multi-factor DRIVERS OF CHANGE** | • The development of 'small-bore' hot water pipework systems<br>• Changes in social attitudes (e.g. growing expectations of whole house heating)<br>• Centrally coordinated campaigns for promotion, skills-development, supply chains<br>• The discovery of natural gas in the North Sea |
| **Mid-level ACTORS** | • British Coal Utilization Research Association (BCURA)<br>• British Gas Corporation<br>• Local authorities |
| **Galvanising ISSUE** | • 'Decent' housing<br>• Cheap/Indigenous energy supply |
| **JUSTICE Considerations** | • Equal focus on social housing and home owners<br>• Access to gas already widespread through piped town gas – extended by central investment in bringing North Sea gas onshore to link to existing network. |
| **CONTESTATIONS and CONFLICTS** | • Customers whose existing technologies (infrastructure/appliances) were easily converted to gas vs. those with appliances that were not convertible and deemed obsolete<br>• Natural Gas powered central heating vs. alternative fuels and heating systems e.g. gas, electric, oil and coal fired equipment<br>• Quality of workmanship among fitters |
| **REFERENCES** | • Hanmer, C. & Abram, S. (2017). Actors, networks, and translation hubs: Gas central heating as a rapid socio-technical transition in the United Kingdom. Energy Research and Social Science 34 176-183<br>• Sovacool, B. K. & Martiskainen, M. (2020). Hot transformations: Governing rapid and deep household heating transitions in China, Denmark, Finland and the United Kingdom. Energy Policy 139, 111330<br>• Trentmann, F. & Carlsson-Hyslop, A. (2018). The Evolution of Energy Demand in Britain : politics, daily life and public housing, 1920s-1970s. The Historical Journal 61 (3) 807-839<br>• Carlsson-Hyslop, A. (2016). Past Management of Energy Demand: Promotion and Adoption of Electric Heating in Britain 1945-1964. Environment and History 22 75-102 |

# Case Study H - **Carbon Capture and Storage - Barendrecht, Netherlands**

## Context

Carbon Capture and Storage (CCS), is a technology aimed at capturing and compressing carbon dioxide emissions produced by industrial processes or power generation and storing them underground in saline aquifers or depleted oil or gas fields. The idea of CCS dates back to the 1970s, but it took until the late 1990s for CCS technology to be deployed commercially. The IPCC's 2005 Special Report on carbon dioxide capture and storage (Metz et al., 2005) crystallised interest in the need for, and potential of, CCS. CCS emerged as a key technology and climate change mitigation option during the mid-to-late 2000s, moving to the centre of climate policy debates, and negotiations and identified by many governments as a core component of meeting CO2 emission reduction targets.

The initial promises and ambitions for CCS, however, largely failed to materialise, and there ensued, what Martin-Roberts et al., (2021) refer to as, a 'lost decade'. Over the period 2009-2019, rather than a significant increase in CCS, the global number of facilities actively invested in CCS technology (early development, advanced development, under construction, or operating) declined from 77 to 65 (ibid). One of the main barriers to the deployment of CCS, consistently identified across various countries and contexts, was negative public perceptions and the associated lack of social acceptance or licence in relation to the siting of CCS infrastructure (van Egmont, 2015). A commonly cited example is Barendrecht in the Netherlands where local government and public opposition to a proposed CCS scheme led to the cancellation of the project, and a subsequent ruling by the Dutch government that no CCS projects would take place on-shore in the Netherlands (see Brunsting et al., 2011 and Ashworth et al., 2013).

## Key Elements of Change

In 2007, having positioned CCS as an important part of its climate change and energy policy (Oltra, 2012), the Dutch Government announced a tender procedure for two CO2 storage demonstration projects worth €30 million each. Responding to the tender the Anglo-Dutch oil and gas company Shell proposed the storage of CO2 from its Pernis Refinery in two depleted natural gas fields under the nearby town Barendrecht. Shell's proposal was successful, and in collaboration with national and regional government, it began a process of local stakeholder engagement.

The proposal however encountered significant opposition from various local actors including the local government, representatives from local political parties and citizens active in local politics, and a local protest group called 'CO2 = NEE' (NO to CO2). Central to local concerns and objections were issues of equity and justice. The municipality highlighted that the area had already absorbed its fair share of infrastructural projects. Many also believed that the proposal involved an inequitable distribution of costs and benefits, with the local community bearing all the risks (associated with CO2 transportation and storage) and costs (in terms of the potential negative impacts on health and local property values), while the project developers reaped all the benefits (not least of which the €30 million in government funding) (Oltra et al., 2012).. There was also a strong sense of procedural injustice, and a distrust of both central government and Shell. Many complained, in the first instance, about being consulted far too late in the process, and then, following central government's decision to transfer responsibility for environmental permitting procedures from local to central government, of being excluded from the decision-making process altogether (Terwel et al., 2012). As such, many in Barendrecht felt that their concerns were being ignored and that the project was being imposed against the wishes of the local community.

## Lessons for Net Zero

The Barendrecht case presents an instance where an anticipated socio-technical change did not occur and entrenched public critique and scepticism ultimately led to a policy U-turn. As such it provides some useful lessons in terms of what *not* to do. In Barendrecht, while the 'techno-economic conditions were ideal' (van Egmond, 2015: 3), local socio-political conditions turned out to be far from favourable.  This did not necessarily have to be the case, but a failure both by central government and Shell to really understand local community concerns, and engage in any meaningful dialogue with local citizens, served to strengthen local opposition.

Barendrecht's rejection of CCS was not simply based on fears of the potential risks posed to local health and house prices (though these were rational and legitimate questions) but rather on a range of broader concerns associated with issues of trust, equity and justice, all of which found some common ground around the general idea of [un]fairness. A coalition of local mid-level actors therefore emerged strongly resistant to CCS, based on a sense that it was unfair to be chosen again, unfair to be burdened with all the risks/costs and not the benefits, and unfair not to be consulted or a key part of the decision-making process.

More broadly, the failure of CCS to 'launch', both in the Netherlands and globally over the last decade or so, should serve as a cautionary tale. The deployment of 'supply-side, silver-bullet technological fixes' can be unpredictable, expensive and slow.

## Case Study H - Carbon Capture and Storage - Barendrecht, Netherlands: Elements of Societal Change

| | |
|---|---|
| **Multi-factor DRIVERS OF CHANGE** | • Government policy<br>• Business/Commercial |
| **Mid-level ACTORS** | • Local politicians<br>• Local political parties<br>• Community groups<br>• Local (Municipal) government |
| **Galvanising ISSUE** | • Not as such. A negative galvanising issue can be identified. Distributional injustice and unfair impacts on the local community, however, united local resistance to the siting of a CCS facility. |
| **JUSTICE Considerations** | • Local community: all the risks few rewards<br>• Lack of procedural justice |
| **CONTESTATIONS and CONFLICTS** | • Conflict between energy company and key local community groups and representatives – focused on inequities in process and distribution issues |
| **REFERENCES** | Barendrecht<br>• Ashworth, P., Bradbury, J., Wade, S., Feenstra, C. Y., Greenberg, S., Hund, G. & Mikunda, T. (2012). What's in store: lessons from implementing CCS. International Journal of Greenhouse Gas Control 9 402-409<br>• Brunsting, S., de Best-Waldhober, M., Feenstra, C. Y. & Mikunda, T. (2011). Stakeholder participation practices and onshore CCS: Lessons from the Dutch CCS Case Barendrecht. Energy Procedia 4 6376-6383<br>• Kuijper, I. M. (2011). Public acceptance challenges for onshore CO2 storage in Barendrecht. Energy Procedia 4 6226-6233<br>• Oltra, C., Upham, P., Riesch, H., Boso, À., Brunsting, S., Dütschke, E. & Lis, A. (2012). Public responses to CO2 storage sites: lessons from five European cases. Energy & Environment 23 (2-3) 227-248<br>• Terwel, B. W., ter Mors, E. & Daamen, D. D. (2012). It's not only about safety: Beliefs and attitudes of 811 local residents regarding a CCS project in Barendrecht. International Journal of Greenhouse Gas Control 41-51<br>• van Egmond, S. & Hekkert, M. P. (2015). Analysis of a prominent carbon storage project failure - The role of the national government as initiator and decision maker in the Barendrecht case. International Journal of Greenhouse Gas Control 34 1-11<br>Other<br>• Bäckstrand, K., Meadowcroft, J. & Oppenheimer, M. (2011). The politics and policy of carbon capture and storage: Framing an emergent technology. Global Environmental Change 21 (2) 275-281<br>• Energy and Climate Change Committee (2014) Inquiry Report – Carbon Capture and Storage<br>• Hudson, M. (2023). Relying on carbon capture and storage may be a dangerous trap for UK industry The Conversation<br>• Martin-Roberts, E., Scott, V., Flude, S., Johnson, G., Haszeldine, R. S. & Gilfillan, S. (2021). Carbon capture and storage at the end of a lost decade. One Earth 4 (11) 1569-1584<br>• Medvecky, F., Lacey, J. & Ashworth, P. (2014). Examining the role of carbon capture and storage through an ethical lens. Science and Engineering Ethics 20 1111-1128<br>• Metz, B., Davidson, O., De Coninck, H. C., Loos, M. & Meyer, L. (2005). Cambridge: Cambridge University Press IPCC special report on carbon dioxide capture and storage |

# Glossary

**ACCESS** – Advancing Capacity for Climate and Environment Social Science

**CAST** – Centre for Climate and Social Transformations

**CCS** – Carbon Capture and Storage is a technology aimed at capturing and compressing carbon dioxide emissions produced by industrial processes or power generation and storing them underground in saline aquifers or depleted oil or gas fields

**CHP** – Combined Heat and Power is a system that simultaneously generates electricity and useful heat from the same energy source. CHP plants have often been the preferred heat source for District Heating networks (see DH).

**Citizens' Assembly** – A citizens' assembly is a group of randomly selected citizens who are brought together to deliberate on important public issues. They are provided with information, hear from experts, and discuss the topic in-depth to make recommendations or decisions intended to reflect the informed views of the broader population.

**CREDS** – Centre for Research into Energy Demand Solutions

**DAC** – Direct Air Capture is a process that involves using chemical agents to capture carbon dioxide directly from the air.

**DESNZ** – Department for Energy Security & Net Zero

**DH** – District Heating (also known as heat networks) is a form of localised heat distribution that delivers heat from a central source to multiple buildings or homes through a network of hot water carrying underground pipes.

**DP** – DESNZ (2023). UK Net Zero Research and Innovation Framework: Delivery Plan 2022-2025.

**EDI** – Equality, Diversity and Inclusion

**EPSRC** – Engineering and Physical Sciences Research Council

**EV** – Electric Vehicle

**Fuel Poverty** – Fuel poverty is defined based on whether a household can afford to keep their home adequately warm at a reasonable cost. There are two main measures used to define fuel poverty: the Low Income High Costs (LIHC) indicator and the Low Income Low Energy Efficiency (LILEE) indicator. Fuel poverty definitions and approaches vary slightly across the UK nations. For more information and precise definitions please see https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/howfuelpovertyismeasuredintheuk/march2023

**GGR** – Greenhouse Gas Removal

**GHG** – Green House Gases

**GO-Science** – Government Office for Science

**Hydrogen (Blue)** – Blue hydrogen is produced from natural gas through a process called steam methane reforming (SMR) or auto thermal reforming (ATR), where the resulting carbon dioxide emissions are captured and stored using carbon capture and storage (CCS) technology. This makes blue hydrogen a lower-carbon alternative compared to traditional hydrogen production methods, though not entirely carbon-free.

**Hydrogen (Green)** – Green hydrogen produced through the electrolysis of water using renewable energy sources such as wind, solar, or hydroelectric power. This process generates hydrogen without emitting carbon dioxide, making it a clean and sustainable energy source.

**IPCC** – Intergovernmental Panel on Climate Change (AR6 - Assessment Round 6, WG3 - Working Group 3)

**Just Transition** – A just transition refers to the process of transitioning to a more sustainable and low-carbon economy in a way that ensures fairness and equity for all workers and communities affected by the shift. It aims to protect jobs, provide support and retraining for workers, and address social and economic inequalities. For more information please see https://post.parliament.uk/research-briefings/post-pn-0706/

**Net zero** – Achieving a balance between the total amount of greenhouse gases (GHG) produced and removed from the atmosphere, typically through measures like emission reductions and emission removal

**Net Zero Pathways** – Net zero pathways are strategic plans and frameworks outlining possible steps to achieving net zero greenhouse gas emissions. They can combine reducing emissions through efficiency improvements, renewable energy, and demand-side reductions (like enhanced energy efficiency and reduced consumption), with offsetting remaining emissions via carbon capture, reforestation, or other carbon removal technologies.

**NGO** – Non-Governmental Organisation

**NZS** – GO-Science (2023). Net Zero Society: Scenarios and Pathways.

**R & I** – Research and Innovation

**RIF** – DESNZ (2021). UK Net Zero Research and Innovation Framework

**School Streets** – A School Street is a road outside a school with a temporary restriction on both school and non-school related motorised traffic at school drop-off and pick-up times

**SDGs** – The Sustainable Development Goals (SDGs) are a set of 17 global objectives established by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development. These goals are designed to address a broad range of global challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice. For more information please see https://www.undp.org/sustainable-development-goals

**Social Science** – Social science is the field of study that examines human society and social relationships, encompassing disciplines like sociology, psychology, anthropology, geography, economics, and political science to understand and analyse the structures, behaviours, and interactions within societies. For more information please see https://acss.org.uk/what-is-social-science/ and/or https://www.ukri.org/who-we-are/esrc/what-is-social-science/

**Socio-technical** – Socio-technical is a term used to describe the interrelated social and technological changes required to achieve a low-carbon future. This includes the development and adoption of new technologies, as well as the accompanying shifts in social practices, policies, institutions, and cultural norms that support and sustain these technological innovations

**UKRI** – United Kingdom Research and Innovation

**WHO** – World Health Organization