Supplementary Material I Chapter 5: Social Science Primer

The Supplementary Material for Chapter 5 (Social Science Primer) aims to present multiple fundamental frameworks and concepts that help explain the variety in social aspects of demand-side responses to climate mitigation. It does not aim to resolve any debates about the diversity in perspectives and approaches on this topic in the literature. Instead, its goal is to describe more fully some common concepts and terminologies that are mentioned in this first-ever full chapter (Chapter 5) in an IPCC report on demand-side, energy-service, and social aspects of mitigation. Chapter 5 uses social science perspectives to examine societal level challenges and opportunities for mitigation options that involve end-users, with an eye on policy relevant insights about the drivers, processes, and potential of demand-side solutions. Glossary definitions provide insufficient background information for new concepts used in this IPCC report to present social science perspectives. The Social Science Primer provides the theoretical underpinnings for these concepts, drawing from various social sciences (see also (Creutzig et al. 2018; Hayward and Roy 2019; Jorgenson et al. 2018; Hess and Sovacool 2020). This primer is not meant to be complete and comprehensive but is an easily accessible short handbook and a living document in the IPCC process.

There has been continuous advancement in the way demand-side choice processes have been viewed and modelled in the IPCC and energy and carbon mitigation policy community. From AR1 to AR4, rational decision making as defined by microeconomics was the implicit assumption, where homogeneous individual agents maximise self focused utility/ expected utility, with the only consequential variations of this *homo economicus* relating to income, wealth, risk attitude, and time discount rate (Persky 1995). AR5 (Kunreuther et al. 2014) introduced a broader range of goals that are held by *homo sapiens* (material goals like those of *homo economicus*, but also self- and other-regarding social goals, and psychological goals such as confidence and feeling in control). It also considered a broader range of decision processes (calculation-based but also affect-based, and role- and rule-based processes) designed to allow timely decisions within a context of bounded rationality as the result of attentional and processing limitations. AR5's perspective on decisions and action, like the rational choice perspective, remained individual- and agency-focused and thus did not explicitly address the role of structural, cultural, and institutional constraints and the pervasive influence of physical and social context beyond simple choice-architecture interventions that modify the context or format in which choice alternatives are presented (Thaler and Sunstein 2003).

AR5 (Kunreuther et. al 2014) reviewed how experts and the general population differ in their responses to risk and uncertain climate information and the importance for experts/scientists/policy makers to understand and predic the public's reaction in order to communicate climate risks and uncertainties effectively. Its introduction of a broader range of goals and decision processes than those of *homo economicus* has important implications for IPCC scenarios by introducing additional uncertainty about the effects of climate change (e.g., temperature increases or extreme weather) on human behaviour and hence future GHG emissions (Beckage et al. 2018). At the same time, an agency-based framework that includes the many influences on individual decisions that go beyond rational choice and rational expectations (e.g., responses to extreme events, perceived behavioural control, perceived social norms, and social role-based constraints) explains many anomalies observed by social ecologists (Schlüter et al. 2017; Beckage et al. 2018) and generates a broader set of demand-side policy options and more effective ways of implementing them.

This Social Science Primer provides frameworks for understanding the challenges of systemic change, emergent transition phases and patterns, and the drivers of technological choice in light of some of the themes of AR6: assessing growing social inequity, the need for participation in managing the global common good, and the need for increased use of energy and materials to bridge the gap in well-being in some parts of the world while reducing wasteful consumption and production systems in other parts. The societal perspective in Chapter 5 of AR6 very broadly focuses on human society and human agency, where political power structures, infrastructure, and technology interact to deliver services that provide dignified living for all, irrespective of geographic location, which is compatible with cosmopolitan justice theories.

Modelling and Systematic Review of Demand-Side Mitigation

Figure SM5.1 on demand-side literature summarises key results of papers in the social science literature with the highest topic score (the topic score measures how well any given paper matches a topic model, vectors of 10 co-occurring keywords, highest amount of references to key social science topics) and/or highest citation count, organised by mitigation sector. It builds on 34 search queries on demand-side climate change mitigation and 99,065 unique papers, which were fed into a machine learning algorithm to identify 60 topic models (vectors of 10 co-occurring keywords) (Creutzig et al. 2021a). Expert judgement identified the 24 topic models most relevant to demand-side climate change mitigation (see also Figure 5.2). In the next step, the key papers from the topic models were summarised, selected from the ten most cited of each topic model with topic score > 0.1 and the 10 with highest topic score . This resulted in a wide array of insights, ranging from the importance of consumption-based carbon footprints, to sectoral interventions, to policy instruments, and the key insight that demand and supply are interdependent and require joint consideration. Figure SM5.1 further condenses these insights into headline statements in a clustered summary.

Figure SM5.1 Cluster-oriented summary of key demand-side messages drawn from academic publications in social science literature.

Source: (Creutzig et al. 2021a)

Demand and Services, in Mitigation Context

Services are activities that help satisfy human wants or needs. While they usually involve interactions between producers and consumers, services are less tangible and less storable than goods, and may involve personal relationships(Arent et al. 2015; Millonig and Haustein 2020).Well-being needs are met through services. Provision of services associated with low-energy demand is a key component of current and future efforts to reduce carbon emissions. Services can be provided in various culturally-appropriate ways, with diverse climate implications. People demand services for dignified survival, sustenance, mobility, communication, comfort and material well-being (Nakićenović et al. 1996; Johansson et al. 2012; Creutzig et al. 2018). Access to services is fundamental, rather than only physical resources (biomass, energy, materials, etc.) and technologies (e.g. cars, appliances). Three key concepts for evaluating the efficiency of service provision systems are: resource cascades and exergy (Grubler et al. 2012) as well as energy (Ulgiati et al. 1995). These concepts provide powerful analytical lenses through which to identify and substantially reduce energy and resource waste in service provision systems both for decent living standards (see section in the main chapter) and higher well-being 5.3.3 .levels

Low-carbon ways of producing the services that are necessary for everyone's well-being are the foundation of the post-carbon societal transition. Advancing this transition depends not just on progress indicators that measure well-being, equity, and sufficiency in relation to emissions and ecological health, but also on technological innovations and access to them, evolving social norms, policy frameworks, and global networking to share successful ways of building global socioeconomic equity while reducing global emissions. The tight links between equity, well-being for all, and emissions reductions are demonstrated in growing interdisciplinary literatures, (also outlined in AR6 Chapter 5, Section 5.2).

From an economics perspective, for example, expanding concepts of value to include nonmarketed social and ecological factors, unpaid work, care, and informal-sector production makes possible a broader understanding of economic participation and a more inclusive view of economic activity along with its total benefits and costs. Individual and collective choices, including not only what to consume but how best to foster local contexts for well-being are reflected in new literatures on relative provisioning, sufficiency, decent standards of living for all, and the costs of socioeconomic inequality. Sufficiency in economics (also discussed in AR6 Chapter 9 of this report, GEA 2012 Chapter 21 on lifestyles, well-being and energy) expresses the idea that ecological limits necessitate restraint to prevent overconsumption; short and longterm risks including those related to climate change can only be mitigated by going beyond cooperation and efficiency to sufficiency (Princen 2003; Mongsawad 2012; Bierwirth and Thomas 2019; Fawcett and Darby 2019; Monyei et al. 2019; Hayward and Roy 2019). Depending on policy contexts, and with wide variations in the literature on methods, assumptions, and data, behavioural changes that reduce energy consumption can lead to rebound and spillover effects that can partially counter the benefits, reinforce them, or enhance welfare (Chakravarty et al. 2013; Brockway et al. 2017; Van Lange et al. 2018; Rogelj et al. 2018; Shao et al. 2019; Vita et al. 2019b; Yan et al. 2019; Court and Sorrell 2020; Sorrell et al. 2020; Saunders et al. 2021). For example, policies are more successful in minimizing rebounds, reducing emissions and increasing welfare when they consider the step-wise interactions among invention and diffusion of energy-efficient low-carbon technologies, changing social norms, infrastructures, and institutional transformation (van den Bergh 2010; Roy et al. 2013a; Safarzadeh et al. 2020; Perrot and Sanni 2018; Vivanco et al. 2018; Pigato et al. 2020; Freire-González 2021). Intersectional inequities related to geography, gender, race, Indigeneity, ethnicity and other factors interrupt the fair distribution of income, resources, energy access and emissions, restricting the margin of manoeuvre for climate action and the urgency of operationalising sufficiency norms. One way to foster this is through multi-dimensional affordability, which includes not only economic affordability but also social, motivational, and institutional/environmental affordability, as part of consumption choice processes-all influenced by policies (Spangenberg and Lorek 2019). Information for consumers, communities and policy-makers about the equity and emissions implications of their decisions, such as that provided by the Ecological Footprint (Kopp and Dorn 2018; Lin et al. 2018; Yunani et al. 2020) and the Carbon Footprint (Wiedmann and Minx 2008), can facilitate multi-dimensional choice processes (Beattie and Sale 2009; González-García et al. 2018; Wood et al. 2020).

Empirical social sciences research is addressing earlier discrepancies in methods and challenges in estimating these indicators across global supply chains, income levels, energy technologies, time frames, and systems boundaries (Matthews et al. 2008; Chen et al. 2016; Kanemoto et al. 2016; Bello et al. 2018; Fenner et al. 2018; Lenzen et al. 2018; Pichler et al. 2019; Zheng and Suh 2019).

Decent Living Standards (DLS), as described further below, is another way to express the socio-political goal of prioritising necessities over luxuries while limiting emissions (Darby 2007; Gorge et al. 2014; Rao and Pachauri 2017; Otto et al. 2019; Rao et al. 2019; Millward-Hopkins et al. 2020). Like the early footprint indicators, DLS omits intermediate service provision and some important components of well-being such as collective, land-based cultural values (Ikuenobe 2016; Bullock et al. 2018; Choy 2018; Richardson et al. 2019; Raymond et al. 2019) in its focus on material prerequisites of well-being (Rao and Min 2018). Socially-determined and contextual measures of value and individual/collective well-being also interrelate with social norms regarding acceptable or expected consumption levels, as shown in Figure SM5.2. This has implications for emissions, since appropriate modes of service provision within different cultural contexts, and in situations of changing social norms and preferences, can facilitate the effective decoupling of service provision from energy use (Jackson 2005; Akenji 2014; Komiyama 2014; Brand-Correa and Steinberger 2017; Mastrucci and Rao 2017; O'Neil et al 2018; Rao and Min 2018a; Mastrucci and Rao 2019; Vita et al. 2019a, 2020; Wiedenhofer et al. 2020).

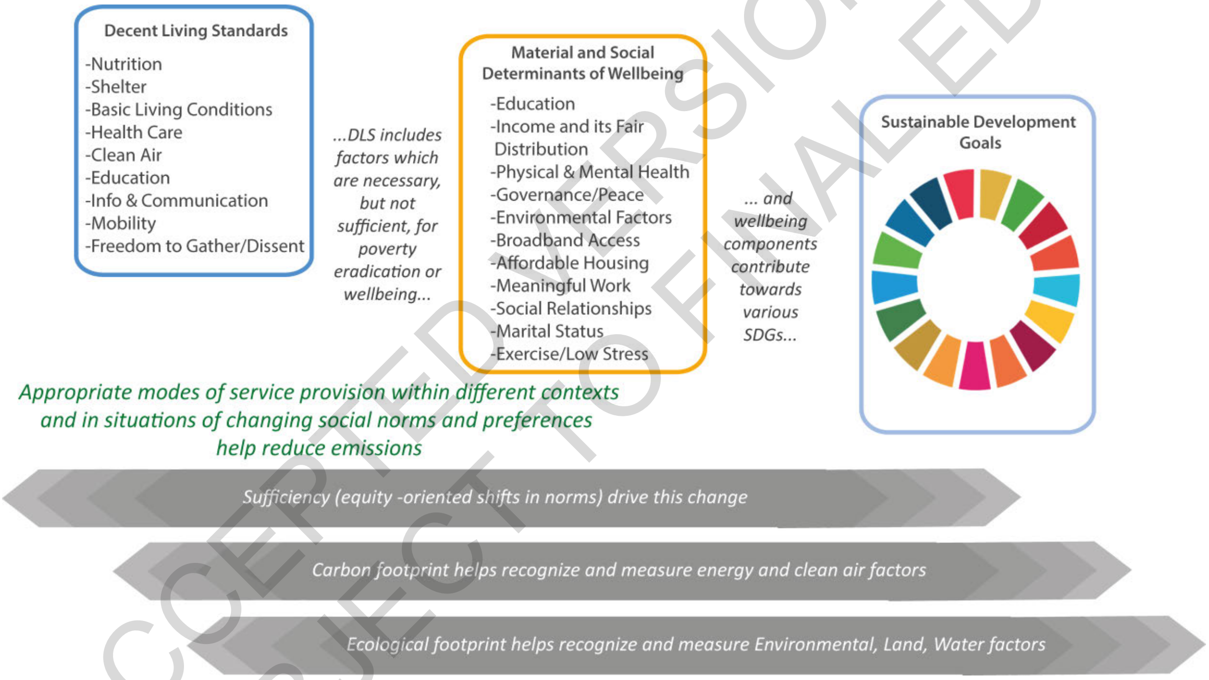

Figure SM5.2 The relationships among indicators of Decent Living Standards, Well-being, Footprints, Sufficiency and the Sustainable Development Goals

Demand-side contributions to mitigation allow consumers/users to select the best way to further their own well-being, making trade-offs across sectors and technologies as best suits their needs and contexts (Creutzig et al. 2021b).

There are multiple components of systemic change, and one way to dynamically represent change in the demand for GHG-emission-intensive products and services is to map it across the key concepts of agency, structure, meaning, relations, and norms (Sovacool and Hess 2017, Hess and Sovacool 2020). This involves the potential of individuals to change their consumption patterns and to act collectively in driving institutional change (agency), the redesign of infrastructures and technologies to foster low-carbon consumption patterns (structure), and the (re)establishment of cultures and social norms in alignment with consumption patterns that have few associated GHG emissions (meaning). Even a broad set of individual-based decision factors accounts at best for 30-40% of the variance in climate action, suggesting that behavioural change is not only a function of individual agency but also depends on other enabling factors, such as infrastructures, social norms, and professional roles (Bamberg et al. 2007b; Whitmarsh et al. 2017). Chapter 5 reflects this more inclusive view of different disciplinary and philosophical perspectives on individual and collective energy decisions (Grubb 2014; Riahi et al. 2015; Grubler et al. 2018; Mundaca et al. 2019; Creutzig et al. 2016, 2018). It broadens the individually focused agency framework of micro- and behavioural economics and psychology by also including considerations of structure and meaning, i.e., the hardware and software of the social, cultural, and physical context studied by disciplines like geography, ecology, sociology, urban planning, and anthropology.

Disciplines vary in their approaches and research questions on demand-side issues. For example, psychologists and behavioural economists focus on emotional factors and cognitive biases in decision making (Poortinga et al. 2019; Mills and Schleich 2012; Niamir et al. 2020a; Bamberg et al. 2007a); economists elaborate on how, under rational decision-making, carbon pricing and other fiscal instruments can trigger change in demand (Ameli and Brandt 2015) and help transitions to low carbon futures (Roy et al. 2013b); normative economics focuses on enabling conditions for sustainable human development; sociologists emphasise every-day practices, structural issues, and socio-economic inequality; anthropologists address the role of culture in energy consumption; urban planners take the role of infrastructures as an entry point; and studies in technological innovation consider socio-technical transitions and the norms, rules and pace of adoption that support dominant technologies. Political scientists consider the roles of ideology, democracy, institutions, and politics in shaping societal transformation. Generally, social sciences share a focus on interpersonal and collective outcomes–how people shape their cultures and livelihoods together across gender and intersectional markers of identity and difference (Woodward and Woodward 2015; Buchanan et al. 2020; Sawer et al. 2020). Social practice theory emphasises interactions between artefacts, competences, and cultural meanings (Shove and Walker 2014; Røpke 2009). The energy cultures framework highlights feedbacks between materials, norms, and behavioural practices (Stephenson et al. 2015; Jürisoo et al. 2019). Socio-technical transitions theory addresses interactions between technologies, user practices, cultural meanings, business, infrastructures, and public policies (McMeekin and Southerton 2012; Geels et al. 2017a) and thus accommodates the five drivers of change and stability discussed in Section 5.4 and 5.5 in chapter 5 of WGIII of AR6.

This primer provides additional information about key concepts and processes described in AR6 Chapter 5. Section SM5.1 elaborates on key concepts from Section 5.2 of Chapter 5: well-being, equity, and decent living standards (DLS) and their relation to equity, social trust, and governance. Sections SM2-4 then provide background information on the five drivers of change introduced in Section 5.4 of Chapter 5, divided into the three categories shown in: Individual concepts and processes provide background on the behavioural drivers of change; social concepts and processes elaborate on the socio-cultural drivers of change; and structure elaborates on the business, technology, and institutional drivers of change (see (United Nations Environment Programme 2020)) (Figure SM5.3). Section SM5.5 provides additional background on transitions and Section SM5.6 provides several case studies as illustrative examples drawn from both developed and developing countries of social processes in various contexts of technology uptake, service provisioning and shifts in choices.

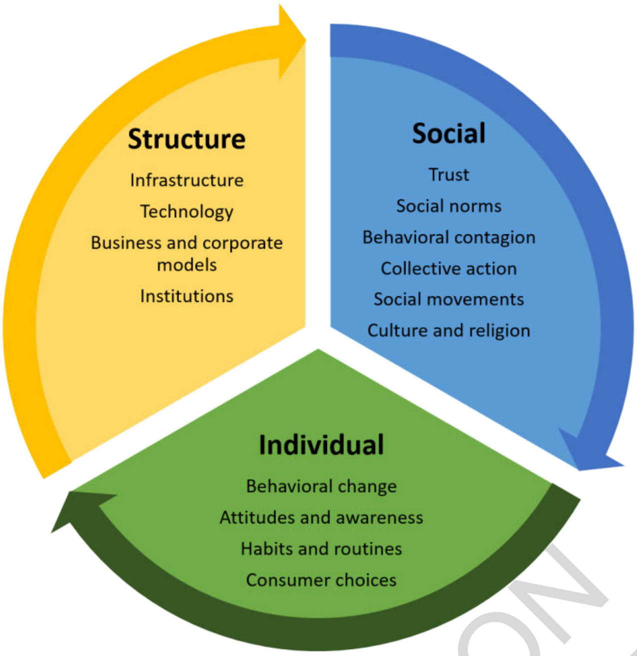

Figure SM5.3 Drivers of change: Perspectives and underlying concepts and processes

SM 5.1 Well-being, decent living standards, equity, and the SDGs

Well-being for all is a cornerstone of sustainable development (Dasgupta and Dasgupta 2017; Princen 2003) and directly underpins the Sustainable Development Goals (SDGs). A focus on human well-being improves upon GDP, which is an inadequate and incomplete goal for socio-economic activities (Faber et al. 2012; Zimmerer 2012; Arrow et al. 2013; Dasgupta 2013; Griggs et al. 2013; Hobson 2013; Dasgupta 2014; Gabriel and Bond 2019; Hayward and Roy 2019; McGregor and Pouw 2017; Sekulova et al. 2017; Fioramonti et al. 2019; Perkins 2019; Pollin 2019; Women’s Budget Group 2020). All of this literature shows that above a certain income threshold, further increases do not produce greater well-being; it is well-being that should be pursued, rather than economic growth. Human well-being is a description of the state of individuals’ life situations in multiple dimensions that captures their life circumstances (Mcgillivray and Clarke 2006). Constituents of well-being include health, happiness, meaningful work and social relationships, freedom and liberty, while determinants are the inputs that enable well being such as food, shelter, water, access to knowledge and information (Dasgupta 2001). A well being focus emphasises equity and universal needs satisfaction within planetary boundaries, compatible with SDG progress (Lamb and Steinberger 2017). GDP growth still dominates the current economic development literature, including the assumptions that ecosystem limits can always be overcome via production technologies and that welfare is predominantly associated with increased levels of consumption of products and services (Roy et al. 2012). However, GDP only measures economic activity with no reference to material limits, neglecting inequality and services delivered by current capital stocks (Haberl et al. 2019); it is therefore, a poor proxy for societal well-being (Ward et al. 2016). Instead, several new indices have emerged to measure well-being (i.e. Human Development Index, OECD better life initiative, QoL Index, Gallup Health, Well-Being Index, Gross National Happiness, Happy Planet Index). Applying a single measure represents a challenge due to the lack of data on many components of well-being (Sugiawan and Managi 2019). Measures such as inclusive wealth (the sum of capital assets that form the productive base of an economy) have been proposed as economic indicators to replace GDP for measuring well-being (Dasgupta et al. 2015; UNEP 2018;

Arrow et al. 2013; Sugiawan and Managi 2019). Another measure for considering aspects of social progress beyond economic activity is the social progress index (SPI), a composite index based on a dashboard of outcome-oriented indicators of fulfilment of basic human needs and foundations of well-being (Haberl et al. 2019), considering opportunities such as nutrition, shelter, water, safety, access to knowledge and information, health, education, freedom, rights and environmental quality.

All of these considerations have been fully or partially reflected in the United Nation's Sustainable Development Goals (SDGs) -- politically agreed-upon goals for human well-being and planetary stability for the year 2030.

Decent Living Standards (DLS) is a tool for assessing well-being for all in terms of needs satisfiers. It is defined as the minimum set of inputs required for a decent human livelihood, anywhere in the world (Doyal and Gough 1991; Neri 2002; Adema 2006; Antony and Visweswara Rao 2007; Saramet 2007; Acs and Turner 2008; Rao and Baer 2012; Frye 2013; Saramet et al. 2009; Rao and Min 2018b; Brand-Correa and Steinberger 2017) (see also SR6, Chapter 9.1). Services which make up DLS include adequate nutrition, shelter, hygiene, clothing, healthcare, mobility, education, communication, and information access. DLS goes beyond existing multidimensional poverty indicators which set a floor for human needs, by addressing living conditions and social participation – thus including social as well as individual components of well-being. It also offers a normative basis to assess environmental impacts and climate change (Rao and Min 2018b). DLS is based on human needs theory, which argues that material dimensions of well-being correlate with needs satisfaction, but only up to a threshold, after which additional use of needs satisfiers does not result in significant improvements in needs satisfaction (Frank 2010; Stiglitz 2012; Oishi et al. 2018; Xie et al. 2018; Wilkinson and Pickett 2009, 2019a; Doyal and Gough 1991). It is also closely related to eudaimonic well-being approaches focused on realising human potential, not just seeking pleasure and avoiding pain (Lamb and Steinberger 2017).

Equity. Equal, 'impartial' treatment does not always produce equitable outcomes, since different members of society face diverse barriers that influence their opportunities, choices, responsibilities, political agency and access to justice among other factors. These variances are particularly important for climate mitigation, especially demand side, social, and service-oriented mitigation approaches (Estrada-Oyuela 2000).

Mitigation, equity and well-being go hand in hand (see Box 5.2 and Figure 5.5) Both distributive justice and procedural justice are important in mitigation action (Roy et al. 2018a). As outlined in AR6 section 5.2, the social science literature includes strong consensus about a number of mutually-reinforcing relationships among well-being, social equity, social trust, and effective governance for managing energy transition and rapid emissions reductions.

Well-being is reinforced in equitable societies. Human well-being is socially-based and has a large relational component (Yellowfly 1992; Ball and Chernova 2008; D'Ambrosio and Frick 2012; Diener et al. 2013; McCubbin et al. 2013; Shields 2016; White 2017; Stone et al. 2018; Tu and Hsee 2018; Easterlin et al. 2010; Schneider 2016; Lamb and Steinberger 2017; Wang et al. 2019). Once subsistence needs are met, relative well-being is much more significant for human happiness than absolute consumption levels (Wilkinson and Pickett 2009; Frank 1999; Stiglitz 2012; Reyes-García et al. 2016; Oishi et al. 2018; Xie et al. 2018; Wilkinson and Pickett 2019), and the higher the income inequality, the more people compare themselves with their neighbours (Luttmer 2005; Cheung and Lucas 2016). Income inequality is associated with lower well-being, not only of the poor, but of everyone (Wilkinson 2005; Wilkinson et al. 2010; Cooper et al. 2014; Schröder 2018; Reyes-García et al. 2016). Some social components of well-being, such as community cohesion, social capital, and trust, are higher in more equitable societies (Delhey and Dragolov 2014; Roser et al. 2019; Schneider 2016). While differences in study indicators and methodologies complicate conclusions about the link between well-being and income, this shifts emphasis onto contextual social factors such as people's knowledge, values, norms and beliefs (Kragten and Rözer 2017; Schneider 2016; Ngamaba et al. 2018). More equitable societies are also more economically efficient societies (Singer 2018; Stiglitz 2012; Wilkinson and Pickett 2009).

More social trust leads to equity and vice versa. There is a well-documented correlation between social trust and income equality (Rothstein and Uslaner 2005; Jordahl 2011; Phan 2008; You 2012; Ivarsflaten and Strømsnes 2013; Bergh and Bjørnskov 2014). Trust is associated with greater human development (Özcan and Bjørnskov 2011) and with individual and country-level happiness (Tokuda et al. 2017) and life satisfaction (Mikucka et al. 2017). Social trust and trust in government institutions reduce well-being inequality and foster resilience, especially for those at lower levels of well-being (Nannestad et al. 2014; Helliwell et al. 2016).

Equity strengthens governance. Institutions work more fairly, with more public trust. Equitable income, wealth distribution, and tax policies make democracies stronger and more flexible (Sturm 2007; Steijn and Lancee 2011; Levin-Waldman 2012; Yamamura 2014; Lazarus and van Asselt 2018; Okereke 2018; Di Gregorio et al. 2019; Jordahl 2011; Stiglitz 2012; You 2012).

Effective governance fosters well-being for all. There is strong evidence across many countries that government quality indicated by quality of service delivery and quality of democracy is linked to national happiness, mainly because effective governance implies better service delivery (Helliwell and Huang 2008; Ott 2011; Helliwell et al. 2018). Democratic satisfaction and social trust embedded in impartial, fair, and efficient institutions are also linked directly with well-being (Rothstein and Stolle 2008; Orviska et al. 2014). Democratic governance alone, however, does not always lead to reduced wealth inequality or vice versa; voter preferences, social cleavages, and/or democratic capture by the rich can perpetuate inequalities even in democracies (Acemoglu et al. 2013; Scheve and Stasavage 2017).

SM 5.2 Individual perspectives

SM 5.2.1 Agency

Agency is defined as the capacity to act, both individually and collectively, as shaped by different physical, social, historical, cultural and other contexts. Using their agency, people engage in existing social practices, and also may step outside routines and engage in new behaviours. Agency is realised through different social roles for action, which include as citizen, role model, community member, worker, investor, professional, household member, consumer, etc. In the demand-side mitigation options space, agency is expressed by actors (individuals and households) who differ in motivations and goals, and in their capacities for change as shaped by different physical, social, historical, and cultural contexts.

SM 5.2.2 Behaviour change

Decisions or action that directly or indirectly reduce energy demand can be motivated by market- and non-market forces, and can be either legally vs. socially vs. ethically binding. It has long been thought useful to conceive of consumers as "rational actors," attentive to incentives, including all relevant costs and benefits (Becker 2013). If the price of certain goods increases, people will buy less of them. Under this framework, moral commitments, and social norms, may or may not matter (Becker and Murphy 2000). If they do, it is because violations of a social norm operate as a kind of "tax", leading a consumers to take steps to avoid such violations. The large point is that demand-side behaviour is above all reflection of what consumers perceive as costs and benefits. If, for example, consumers believe that it is in their interest to engage in consumption patterns that lead to a high-carbon economy, then a high-carbon economy is much more likely.

A transition to a low-carbon economy will require a significant shift in incentives. This understanding of consumer behaviour has clear implications for policy – suggesting, for example, that appropriate taxes or subsidies can lead to major reductions in greenhouse gas emissions. But focusing solely on material incentives misses important features of human judgment and decision making (Kahneman 2011; Thaler 2015), with relevant implications for environmental policy (Sunstein and Reisch 2014; Creutzig et al. 2016). For example, people may show "status quo bias," which means that they might continue to do what they have been doing, even if it would be in their interest to change (Samuelson and Zeckhauser 1988). Consumers may show "present bias," in the sense that they might focus on the short-term, even if it would be in their interest to consider the long-term (O'Donoghue and Rabin 2015). Whether consumers are responsive to material incentives depends on whether those incentives are made salient (Gabaix and Laibson 2018). Some characteristics of activities and products are "shrouded," even though they matter to consumer's well-being, and consumer may not pay a great deal of attention to them. In addition, norms matter, and can greatly affect behaviour (Lessig 1995).

To influence consumer demand, policymakers have an assortment of tools, including prohibitions, mandates, taxes, fees, subsidies, and "nudges" (Thaler and Sunstein 2009), defined to include such choice-preserving interventions as information, warnings, reminders, uses of social norms, and default rules such as automatic enrolment in "green energy" in the form of wind or solar (Ebeling and Lotz 2015). It would make little sense to say, in the abstra t, that one tool is better than another; the choice of tool depends on its effects on well-being in the relevant context. In principle, a carbon tax has many advantages over any other approach, because it forces consumers to bear the cost of their activities (Nordhaus 2013). But automatic enrolment in green energy might be a useful complement to a carbon tax, especially if that tax is too low. Responses and actions by relevant actors interact in complex ways that differ from the more linear integration in conventional (integrated assessment) models or macroeconomic computable general equilibrium models. Novel ways of capturing these influences and feedback processes (Stern 2016; Niamir et al. 2018, 2020b; Constantino et al. 2021) that include complex adaptive systems models (Levin et al. 2013) or agent-based models (Lamperti et al. 2018) allow for emergence of tipping points or other nonlinear change dynamics that may be necessary to bring about behaviour change on energy at the speed and scale required (Nyborg et al. 2016). Correctly understanding the roles, goals, and needs of these different actors, their perceptions and decision processes (Kunreuther et al 2014), and the feedback between their actions is imperative in designing effective policies and decision support systems (Roelich and Giesekam 2019).

SM 5.2.3 Consumer decisions

On a global scale, households influence, directly and indirectly, 72% of GHG emissions (Hertwich and Peters 2009; Roy et al. 2012). Energy use is disproportionally dominated by electricity in developed countries, and most cities in the developing countries, whereas non electric cooking fuels constitute the largest share of energy use in rural areas of developing countries; energy use for mobility is significant and rising most rapidly (Ahmad et al. 2015). Demand-side solutions require both the motivation to change and the capacity for change, in the form of availability and knowledge about change options and the resources to consider, initiate and maintain change. Existing willingness to change (to lower carbon sources of energy (Shift) or energy efficient devices (Improve) or to reduce energy use (Avoid)) is motivated by different factors in different demographics and geographies. For some, perceptions of climate risks and concerns about the environment and future generations trigger action. For others, prices drive energy decisions and subsidies of carbon energy can be problematic, as they set up cultural norms and individual habits, a path-dependence of sorts that requires additional interventions to be overcome. Individuals' perceptions of climate risks, first covered in AR5, continue to be studied as a perhaps necessary if not sufficient condition for behaviour change.

Core Human Values. Social change is a complex process that tries to integrate value and interest of people. Much of human behaviour is goal directed and core values reflect the general goals that people strive for. Four classes of values are most relevant to understand climate actions, and people differ in the extent to which they hold these values and goals: hedonic values (with the goal to seek pleasure, convenience and comfort), egoistic values (with the goal to safeguard personal resources), altruistic values (with the goal to protect the well-being of other people) and biospheric values (with the goal to protect nature and the environment (Steg et al. 2014).

Group differences in climate risk perception and motivation to act suggest the need for segmentation in information or climate action campaigns, with age, education, core values, political ideology, and personal experience being important segmentation variables. Such segmentation is not always easily accomplished; however, information relevant for different segments (e.g., metrics that allow individuals reduce their energy consumption for different reasons) can be provided in the same display. The fuel-economy sticker issued by the US Environmental Protection Agency in 2013 displays a car's energy requirements in monetary terms for buyers interested in financial savings, in technical terms for buyers interested in car performance, or in GHG ratings for buyers interested in climate impacts. These multiple ratings are almost perfectly correlated and their high-density display on a single label could be seen as confusing. However, consumers selectively attend to the information that conforms to their motivation (Ungemach et al. 2017). The full EPA fuel-economy label resulted in the highest willingness-to-pay for fuel economy, suggesting that duplication of information in slightly different formats is a communication asset rather than liability (Kormos and Sussman 2018).

Professional actors play important roles in climate mitigation. Working as building managers, landlords, energy efficiency advisers, technology installers and car dealers, they influence patterns of mobility and energy consumption (Shove 2003) by acting as 'middle actors' (Janda and Parag 2013; Parag and Janda 2014) or 'intermediaries' in the provision of building or mobility services (Grandclément et al. 2015; De Rubens et al. 2018). As influencers on the process of diffusion of innovations (Rogers 2003), professionals can enable or obstruct improvements in efficient service provision or shifts towards low-carbon technologies (LCTs) (e.g. air and ground source heat pumps, solar hot water, underfloor heating, programmable thermostats, and mechanical ventilation with heat recovery) and mobility (e.g. electric vehicles) technologies.

SM 5.3 Social perspectives

SM 5.3.1 Lifestyles

'Lifestyle' means a coherent pattern of behaviours and cognitions consistent with certain situational factors (Axsen et al. 2012; Hedlund-de Witt 2012). Behaviours include actions, activities, technology adoption, and consumption choices. Cognitions include values, worldviews, concerns and beliefs. Lifestyles typically apply to individuals, but can also be used to describe households. Lifestyles also depend on situational factors, which shape the accessibility of certain behaviours or the achievability of certain cognitive goals. Geography, infrastructure, and culture are all examples of situational factors relevant to lifestyles. Behaviours, cognitions and situational factors are common elements of lifestyle, but are emphasised differently depending on the perspective taken. Three common perspectives emphasise patterned behaviour, cognitive direction, or reflexive identity.

A patterned view sees lifestyle as manifest in routine, habitual patterns of behaviour (Darnton et al. 2011). These behavioural patterns are situational, in that they may vary between home, work, travel, leisure and other domains of everyday life (Barr et al. 2011). This patterned view lends itself to the identification of lifestyles through consumption activity and other observable behaviours (Schipper 1989). Put simply, lifestyle describes "*how people spend their money and their time*" (Mowen and Minor 1998).

A cognitive view similarly sees lifestyle as a regular pattern of behaviour, but rather than being primarily situational, it is led by intentions and so is directed towards an overarching goal (Jensen 2009). Intentions can be antecedent to specific choices such as where to live (Frenkel et al. 2013), or can be linked to broader cognitive constructs such as values or worldviews (Hedlund-de Witt 2012). This cognitive view is consistent with the idea of individuals pursuing a 'low-carbon lifestyle' to reduce their impact on climate change.

A reflexive view sees lifestyle as a way for individuals to organise and express their self-identity through their behaviour, while the behaviours then reflexively help constitute an individual s identity. This reflexive view is associated with the work of the sociologist, Anthony Giddens, who defined lifestyles as "*routines that include the presentation of self, consumption, interaction and setting*" (Giddens 1991).

Despite differences in emphasis, all three of these views recognise that lifestyle is shaped by context and so is both dynamic and plural. As examples, lifestyles change when people migrate from the countryside into cities (Chen et al. 2019), or when there is easier access to certain infrastructures like bike lanes or bus routes (Etminani-Ghasrodashti et al. 2018)

In the context of climate change, lifestyle is used both *descriptively* to identify clusters of low-carbon behaviours and quantify their emissions impact, and *normatively* to explore individuals' efforts to reduce their carbon footprint. As lifestyles are si uational as well as behavioural and cognitive, these efforts can be strongly shaped by public policy and infrastructure. In all these applications, lifestyle can sometimes be used interchangeably with behaviour. This is not appropriate as behaviours are discrete actions, whereas lifestyles comprise coh rent sets of actions linked in a consistent way to cognitions and identity (Lawson and Todd 2002).

Lifestyles can be id ntified and measured using both qualitative and quantitative methods. Qualitative methods explore self-identity situational influences, and the dynamics of how lifestyles are expressed. Common qualitative methods used to research lifestyles include interviews (Barr et al. 2011) and narra ives (Hagbert and Bradley 2017). Quantitative methods link lifestyles to outcomes and impacts, and identify segments and variation in a population. Common quantitative methods include cluster analysis, factor analysis (Kuan et al. 2019), hierarchical tree analysis (Baiocchi et al. 2015), and decision tree analysis (Le Gallic et al. 2018). These methods identify groups of individuals, who share similar sets of cognitions and behaviours in certain contexts. Quantitative methods are commonly applied to survey datasets, which combine information on behaviours with self-reported cognitions. Examples of datasets include national social surveys, household expenditure surveys, and time use surveys. These allow lifestyle groups or types to be identified in a population, and linked to sociodemographic, geographic or other widely-available indicators. For example, a recent study in France used census, housing, travel and household budget surveys to identify lifestyles grouped along eight dimensions: cohabitation, relationship with technology, mobility practices, attitude to work, dwelling location, living standard, leisure practices and demographics (Millot et al. 2018).

Measuring lifestyles is useful for different reasons. First, lifestyles can be tested as predictors or explanations of an outcome of interest such as risk of dementia (Lourida et al. 2019), food preferences (Nie and Zepeda 2011), or propensity to buy an electric vehicle (Axsen et al. 2012). The outcome of interest varies widely across research fields. Second, lifestyles can descriptively characterise common patterns of behaviour in specific domains or 'sites of practice' like shopping, food, domestic living, or energy and water consumption (Barr and Gilg 2006). This allows the relationship between lifestyles and situational factors to be explored in more depth. Third, lifestyles can explain variation between households in a population. This captures an important dimension of heterogeneity which can then be applied in modelling and scenario studies of how lifestyles may change into the future (Van den Berg et al. 2019; Le Gallic et al. 2018). Fourth, lifestyles can also explain variation between populations in different countries or cultures. Data from the periodic World Values Survey reveals systematic differences in lifestyles between regions with certain cultural characteristics such as pragmatism or respect for tradition. Variation can also be situational. For example, housing-related lifestyles were found to be similar across different European countries whereas food-related lifestyles were not (Thøgersen 2017a, 2018).

Pro-environmental, green, sustainable, or 'low-carbon' lifestyles have two different interpretations, one defined by intention and the other by impact (Van den Berg et al. 2019). Emphasising intentions, a green lifestyle has been defined as "*a collection of practices by which people t day try to address an interrelated set of environmental problems*" (Lorenzen 2012) Applied to climate change, 'low-carbon' lifestyles can be identified by the values, intentions or goals of individuals seeking to reduce their carbon footprint. In their second interpretation, low-carbon lifestyles can also refer to low levels of use of energy and other materials or other consumption-based reductions in greenhouse gas emissions (Le Gallic et al. 2018), which may not reflect choices but constraints.

These two interpretations of low-carbon lifestyles can be in tension as low-carbon intentions do not always translate into low-carbon impacts (e.g., a globetrotting IPCC scientist), and low-carbon impacts may not be the result of low-carbon intentions (e g., a low-income household living in fuel poverty). Such tensions between cognitions behaviours and impacts on emissions are almost always evident in population-level analyses of low-carbon lifestyles This reinforces that lifestyles are situational as well as cognitive and behavioural, and that lifestyles are multiple and reflexively constructed so can never offer a single unifying explanation for an individual's impact on emissions.

Research focused on very specific low-carbon lifestyle groups characterised by self-sufficiency, frugality or voluntary simplicity can avoid these tensions between intention and impact (Lorenzen 2012; Hagbert and Bradley 2017). Here the challenge is in scaling or replicating this type of intentional low-carbon l festyle more wide y. Conversely, research focused on resource-efficient consumption across the population as a whole is more widely applicable but is also more uncertain and contingent in terms of its emissions impact (Vita et al. 2019b). Low-carbon lifestyles can be defined broadly or situationally. Studies taking a broad view seek to generalise low-carbon lifestyles that are consistent across multiple domains of everyday life. Such studies inform social marketing and educational campaigns to encourage more sustainable lifestyles (DEFRA 2011; Darnton et al. 2011). Other studies test whether low-carbon lifestyles are generalisable explanations for technology adoption decisions in multiple domains, such as electric vehicles, solar panels and green electricity tariffs (Axsen et al. 2012). Recognising the importance of situational factors, many studies focus on low-carbon lifestyles in a specific domain of resource-intensive activity. This includes domestic energy use and waste generation (Tudor et al. 2016), dwelling location and type (Thøgersen 2017b; Frenkel et al. 2013), mobility and travel (Lanzendorf 2002; Thøgersen 2018), leisure and tourism (Barr et al. 2011), and food (Hur et al. 2010; Thøgersen 2017a). Some studies find that much of the variation in energy or resource consumption can be explained by domain-specific lifestyle factors (Sanquist et al. 2012). However, it is hard to generalise insights across domains as relationships between low-carbon lifestyles and emissions tend to be heterogeneous as well as situational or context-dependent.

In addition to heterogeneity and the tension between intention and impact, a third limitation of low-carbon lifestyles research is its concentration in technophile and/or environmentally-conscious population segments in the global North. Available studies in emerging economies tend to place less emphasis on intentions, and more emphasis on demographic, social or institutional factors which shape emissions-intensive lifestyles such as migration from countryside to cities (Chen et al. 2019) or literacy, theft and corruption (George-Ufot et al. 2017).

The 'consumer lifestyle approach' assigns upstream or indirect emissions to the final consumption of energy, materials, food or other resources by individuals and households (Ding et al. 2017; Chen et al. 2019). Similar to consumption-based accounting, this approach typically finds that over three quarters of emissions are attributable to the consumption activities which constitute lifestyles (Bin and Dowlatabadi 2005). Lifestyle change is therefore a potential means of delivering significant emission reductions.

Scenario and modelling studies confirm this potential by taking examples of low carbon behaviours and scaling them up to the population level to determine aggregate system outcomes (van Sluisveld et al. 2016; Van Vuuren et al. 2018). Common examples of low-carbon behaviours amenable to modelling analysis include reducing meat in diets, substituting driving for active travel modes or public transport, and turning thermostats down. Scenario narratives that describe why uch behaviours become more common tend to emphasise the spread of green values, environmental consciousness, or awareness of climate risks. This implies an intentional understanding of l festyle change, and deemphasises the influence of situational factors.

Differences underlying lifestyle choices influence efforts to meet targets for emissions reduction. A combined assessment of costs, lifestyles and technologies in France up to the year 2072 showed that an individualistic lifestyle with high take-up of digital technologies led to increased GDP but not carbon neutrality, in contrast to a society characterised by more collective lifestyles that resulted in less growth but greater emissions reductions (Millot et al. 2018). Voluntary lifestyle change typically focuses on relatively low impact beh viours (e.g. switching off lights at home, recycling) in a piecemeal manner instead of high impact behaviours (e.g. adopting a low meat diet or long-haul flights (Nash et al. 2019; Dubois et al. 2019) Changes in ocial, technological or demographic factors can also be enshrined in scenario narratives of future lifestyle change. Examples include a shift in consumption culture from owning goods to using services including through sharing economies (Vita et al. 2019b), and a demographic shift from rural to urban, from physical to virtual work, and from analogue to digital (Millot et al. 2018; Le Gallic et al. 2018). Such studies in the controlled environment of a simulation model show significant emission reduction potentials from low-carbon lifestyle change. This is not just limited to the direct impact of lifestyle change on emissions, but also to the indirect impact of reducing the speed of required transformation upstream in energy and land-use systems (Grubler et al. 2018).

Turning scenarios into reality is inevitably more complex and contingent. There is good evidence that interventions targeting specific behaviours can be effective, particularly if they combine different mechanisms such as price, norms, information, competences, and infrastructure (Stern et al. 2016). Robust principles for designing effective interventions for low-carbon behaviour change also benefit from a large body of evidence from public health (Michie et al. 2011). However interventions targeting low-carbon lifestyles in general rather than specific low-carbon behaviours are harder to define beyond general informational, educational, and marketing strategies (Haq et al. 2008). The signal of low-carbon lifestyle change is also difficult to detect amidst the noise of a continually changing technological, social and demographic landscape. This is particularly the case in emerging economies with rapidly changing income distributions, urban settlements, and living standards (Hubacek et al. 2007; Chen et al. 2019).

SM 5.3.2 Education

Modifying climate change awareness and perception help the dynamics of this radical shift (Halady and Rao 2010; Dombrowski et al. 2016; Odjugo and Ovuyovwiroye 2013; Niamir et al. 2020a). This requires a complete remodelling of educational methods, where the barriers to be tackled include not only a lack of funding, but the conservative environment of the educational system itself (Ferrer-Balas et al. 2009; Fisher and McAdams 2015; Velazquez et al. 2006; Leal Filho et al. 2018).

Traditional education is still structured on mercantilist and neoliberal ideologies and delivered in politicised educational institutions where environmental issues are invisible most of the time (Mendoza and Roa 2014). This situation calls for a move away from this commercial, individualised and entrepreneurial training model towards the commitment to education for solidarity and care that was highlighted by (Anderson et al. 2019) in the specific context of food, but that can be applied to the climate crisis. Even if the role of universities in climate change education has been acknowledged as extremely important there is few investment to embed climate change education in a higher education context. When achieved, there is a variety of appro ches and it is difficult to identify a clear pattern at the country or even university level (Molthan-Hill et al. 2019). This is why there is a need to achieve or/and reinforce a culture of climate wareness through new educational forms based on a convergence between education and communication (ducommunication) (Rodrigo-Cano et al. 2019) could be used as a base for ac ion and social and environmental intervention unlike communication and disinformation campaigns that use the environment to convey a commercial message (Delmas and Burbano 2011; Megias-Delagado et al. 2018).

SM 5.3.3 Religion

As a central component of many cultures, religion interacts with climate change in numerous and diverse ways (Jenkins et a . 2018). Some religious identities are associated with the denial of climate change, notably White US Evangelical Christians (Smith and Leiserowitz 2013), even though the situation may differ in other countries, for example in Sweden, where Evangelic Christians rather support progressive climate policies (Björnberg et al. 2017) . Different religions interpret climate change in different ways, but nearly all contain elements related to the protection of divine creation, including the environment. Faith groups are both social institutions and sites of collection action on climate change (Haluza-DeLay 2014). They can draw on shared symbols, identities and narratives to promote collective action on climate change (Bomberg and Hague 2018; Roy et al. 2012). Pope Francis' encyclical (2015) reframes climate action from being an economic and technological issue to one of moral stewardship of public goods. Understanding religion helps in understanding attitude towards climate change across communities and traditions (Jenkins et al. 2018). However, further research is required to capture the heterogeneous practices of diverse faith groups globally in relation to climate mitigation (Haluza-DeLay 2014).

Religious groups can communicate with social groups not necessarily involved in climate change action. However, most educational programs that train clergy remain silent on climate change or ecological issues; in North America only 24% of program included instructions (Heistein et al. 2017). Joint programs between academia and clergy has potential to bring climate action to communities that otherwise lack resources to interact with non-subsistence issues and to connect climate change mitigation with local contexts.

SM 5.3.4 Civil society, NGOs, and social movements

People, governed by values and social norms, make individual decisions on how to live, eat, travel, etc.: what they need in life, why and how they need it, and (within their means) what forms of consumption they choose. Collectively, the same values and social norms affect voting, politics, private sector and informal sector decision-making and policy, with the potential to induce even faster change (Adger 2003). Since people are both consumers and producers in economic terms, their collective decisions depend on many factors which also affect various individuals and groups differently (Johnson et al. 2020; Siciliano et al. 2021). For example, "just transition" movements advance climate-related politics and policies by linking people's interests as workers (e.g. for jobs and workplace safety) to their concerns as consumers (e.g. for healthy products, well-being, and reduced climate risk). "Just transition" is an interdisciplinary frame for inclusive climate and energy policy that is synergistic with changing social norms (Healy and Barry 2017; McCauley and Heffron 2018; Harrahill and Douglas 2019; Cha 2020; Clarke and Lipsig-Mummé 2020; Pianta and Lucchese 2020).

Collective action by individuals as part of formal social movements or informal 'lifestyle movements' (Haenfler et al. 2012) can significantly impact climate mitigation. Both AR5 and SR15 reports recognised the role of collective action as part of cultural shif s in consumption patterns and dietary change. Collective action has the potential to both enable and constrain societal shifts in emissions reduction. Movements that shift social norms can produce tipping points' towards lifestyles with reduced emissions, for example veganism (Cherry 2006). On the other hand, landscape conservation groups have opposed the deployment of onshore wind turbines in several European countries (McLaren Loring 2007; Toke et al. 2008).

SM 5.3.5 Meaning

A people-centred view of mitigation recognises that individuals and groups make sense of climate change through meanings, not just information processing (Jerome 1990). Meanings associated with climate mitigation are not neutral, but part of an active process of constructing possible futures in which some actors have more influence over shared narratives than others. Meanings are associated with climate mitigation at d fferent levels – from an individual person's values or identity (e.g. choosing to describe oneself to others as a vegan), to the symbolism associated with low-carbon technologies (e.g. how cook stoves or solar panels confer status on their owners), to the level of collective imaginary futures at community, city, national or global levels (e.g. stories about smart urban futures or environmental catastrophes).

SR15 recognised that narratives and storytelling can enable the imagining of novel visions of place-based 1 5°C futures, creating space for agency, deliberation and the co-construction of meaning around desirable pathways of transition (Veland et al. 2018). Stories about climate change are ways of collectively making sense of uncertain futures, involving processes of interpretation and understanding through communication and social interaction (Smith et al. 2017). Culture – including religious beliefs - is central to climate mitigation, influencing how individuals perceive demand for services in relation to emissions and their expectations about what is both possible and desirable (Moezzi et al. 2017; Batel 2018).

Collective narratives about climate change refer to imaginary futures that can be either utopian or dystopian (e.g. Amitav Ghosh 2016), often presenting apocalyptic stories and imagery in an effort to capture attention and evoke emotional and behavioural response (O'Neill and Smith 2014). The idea of the Anthropocene has gained traction as a way of imagining a new era of human-environment relations characterised by unprecedented human influence over natural ecosystems, and to mobilise a sense of grief at the potential for mass extinction of species, including humanity (Lovelock 2007; Head 2016; Heise 2017). In turn, epistemic evolution, the increasing dependency of global society in further developments in knowledge and technology to continue surviving in the Anthropocene, mirrors a narrative of opportunity (Renn 2018).

While climate stories themselves do not have agency in driving societal transformations, they can open up new ways of involving people in conversations about systemic changes that can provide motivation and confidence for people to participate in more inclusive ways (Smith et al. 2017). Science fiction has afforded indigenous communities a creative means to imagine climate futures divergent from conventional top-down narratives (Streeby 2018), signalling the role of power in shaping which climate stories are told and how prevalent they are (O'Neill and Smith 2014). Further research is required to study the impact of social media platforms on emerging narratives of climate change within societies and local communities (Pearce et al. 2019).

SM 5.3.6 Discourse and narratives

Meanings play a number of roles, both enabling and constraining action on mitigation (Buschmann and Oels 2019). At the societal level, imaginaries about the cities or homes of the future play important roles in enabling innovation by attracting attention, legitimating certain technology choices, rejecting or undermining others and attracting investment e.g. (Tozer and Klenk 2019). These imaginaries have been shown to be important in the innovation of wind and solar energy, biopower, nuclear energy and smart meters (Sovacool et al. 2018). Analysis of shifts in discourse over time has revealed 'turning points' that facilitate change in systems of energy provision, providing the basis for new narratives to emerge and to become legitimate (Buschmann and Oels 2019)

One aspect of current unsustainable societies is the prevalence of common sense assumptions about systems of provision that effectively lock in (Unruh 2002) social actors to certain patterns of thinking or behaviour, limiting awareness and take up of alternatives (e.g. assuming that domestic heating must come from household boilers instead of district heating systems) (Owens and Driffill 2008). Political beliefs play an important role in influencing the uptake of narratives. 'Climate justice' narratives polarise individuals along ideological lines, while narratives that centre on saving energy, avoiding waste and embedding the uptake of low carbon energy in patriotic values were more widely supported (Whitmarsh and Corner 2017).

Climate policies need to go beyond an emphasis upon the rational provision of information and the functional attributes of new services, to place greater emphasis on symbolic meanings and emotions as a means to encourage social change. Presenting narrative meanings instead of factual information can lead to greater public engagement and pro-environmental action on climate change through arousing emotional responses (Morris et al. 2019).

SM 5.3.7 Meanings of technology

At the design stage, expectations of potential users of energy technologies and services (e.g. cookstoves, meters, thermostats) are often scripted into the appearance and functionalities of those devices. Experts and designers may hold common assumptions that public users are characterised by deficits of knowledge, competence and interest in energy systems (Burningham et al. 2015; Skjølsvold and Lindkvist 2015; Owens and Driffill 2008). These assumptions shape pathways of technology development and deployment (Marvin et al. 1999) leading to smart technologies with passive roles for users rather than smart users playing more active roles in systems of provision, distribution, storage and consumption (Goulden et al. 2014).

Contrasting meanings signal more active roles, including ‘prosumers’ who act as producers as well as consumers in decentralised energy systems (Espe et al. 2018), ‘energy citizens’ who are motivated by altruistic and environmental concerns, not only self-interest (Devine-Wright 2007; Ryghaug et al. 2018) and collectives such as ‘clean energy communities’(Gui and MacGill 2018) engaged in peer-to-peer trading of energy services (Fell et al. 2019). Policy has an important role to play in communicating which of these expectations are preferred pathways of low carbon transition.

Meanings shape the willingness of individuals to use existing technologies or adopt new ones. Individuals develop attachments to material possessions (Belk 1988), which symbolise consumer-related identities (Dittmar 2008). Use of private cars for commuting is influenced by emotional and symbolic assumptions about driving (e.g. ideas of status, freedom and independence) as much as instrumental motives (Steg 2005). When new technologies are installed (e.g. feedback displays, smart meters), they become ‘domesticated’ into pre-existing daily routines (Monreal et al. 2016; Shove and Southerton 2000) that can involve negotiation and sometimes conflict within households (Hargreaves et al. 2013). Smart meters raise concerns about reduced autonomy and independence (Wilson et al. 2017). Failure of policy to recognise these emotional and symbolic processes can lead to overestimates of technology potentials, including emissions reduction.

When energy technologies are resisted by the public, meanings about objectors influence the responses of policy makers and energy companies. Adopting alternative meanings of communities, e.g. viewing them as repositories of expertise and local knowledge, and enabling genuine participation and benefit sharing can reduce conflict and increase acceptance (Bell et al. 2013; Walker and Baxter 2017). ‘NIMBY’ (Not In My Back Yard) is both a label used to describe objectors and an explanation for why protests over the siting of low carbon energy technologies take place (Burningham 2000). The concept suggests that objectors are characterised by ignorance, irrationality and selfishness (Devine-Wright 2005; Wolsink 2007; Burningham et al. 2015). When developers hold these views, it leads to strategies of community engagement that prioritise the provision of factual information and financial incentives as well as the avoidance of ‘angry’ crowds (Barnett et al. 2012; Walker et al. 2010). Engagement that overlooks technology meanings can produce unintended consequences, prolonging social conflict and reducing trust (Devine-Wright 2011; Wolsink 2007).

SM 5.3.8 Meanings of place and landscape

Renewable energy resources are widely dispersed across geographical areas, leading to consequences for patterns of development in rural areas (Pasqualetti 2000). ‘Energy landscapes’ refer to ways that meanings associated with rural areas evolve as land use changes from conventional agriculture to technological systems of heat and power generation and new ‘energy crops’ (Pasqualetti and Stremke 2018). Since landscapes are important symbols of cultural and social identity (Woods 2003; Short 2002), changes to their meaning influence the acceptability of technology siting (Devine-Wright 2009). Locations perceived as pristine and natural are considered less suitable for the siting of large scale energy infrastructures such as wind turbines and power lines (Wolsink 2010). Objections are often based on fears that technologies will ‘industrialise’ or ‘urbanise’ rural areas and are opposed by individuals with strong emotional attachments to those places (Devine-Wright and Howes 2010). Novel wave and tidal energy technologies have been positively associated with place attachments and public support, in part due to the ways they enhance a sense of local distinctiveness (Devine-Wright 2011).

SM 5.3.9 Social norms

Human behaviour is affected by the social environment, and in particular by what people commonly do or what other people think and expect (Cialdini 2006), even though people often do not acknowledge this (Nolan et al. 2008; Noppers et al. 2014); social influence seems more influential in some countries than others (Pettifor et al. 2017). Specifically, injunctive norms reflect perceptions of which behaviour is commonly approved or disapproved, and guide behaviour, as people are motivated to gain social approval and avoid social disapproval. Injunctive norms are related to a wide range of mitigation behaviours, including limited meat consumption, limited car use, the use of energy-saving light bulbs (Harland et al. 1999), energy use (Farrow et al. 2017) and recycling (Geiger et al. 2019), although the effects are not always strong (Gardner and Abraham 2008; Farrow et al. 2017).

Descriptive norms refer to behaviour commonly shown by others, and affect behaviour because it provides information about which behaviour is most sensible in a given situation. Descriptive norms (or peer effects) are related to different mitigation behaviours, including household energy savings (Nolan et al. 2008), car use (Gardner and Abraham 2008), energy use (Farrow et al., 2019), the adoption of electric vehicles and participation in smart energy systems (Noppers et al. 2019), and recycling (Geiger et al. 2019). Similarly, descriptive norm information or socially comparative feedback (in which case one's own performance is compared to the performance of others) can encourage mitigation actions, although the overall effect size is not strong (Abrahamse and Steg 2013). A study in Uganda suggests that peer effects mostly affect attitudes towards cookstoves, but not the actual purchase of cookstoves (Beltramo et al. 2015). Socially comparative feedback seems more effective when people more strongly identify with the reference group (De Dominicis et al. 2019). Descriptive norms are more strongly related to mitigation actions when injunctive norms are strong too, when people are not strongly personally involved with mitigation topics (Göckeritz et al. 2010), when people are currently acting inconsistent with their preferences, when norm-based interventions are supported by other interventions and when the context support norm-congruent actions (Miller and Prentice 2016). Weak descriptive norms, in which case people think others do not act on climate change, may inhibit mitigation actions (Schultz et al. 2007). Yet, trending norms that communicate that the number of people engaging in a behaviour is increasing, even if this concerns only a minority of people, can encourage the targeted behaviour, although the effect size is relatively small (Mortensen et al. 2019).

Human behaviour and choices are a function of personal and social norms and the content of norms depends on the context (Sunstein 1996; Niamir 2019; Thaler and Sunstein 2009). Climate change challenges pose major collective action problems, where a group benefits from a certain action, but no individual has sufficient incentive to act alone (Nyborg et al. 2016; Niamir 2019). Here, formal institutions (e.g., laws and regulations) are not always able to impose collectively desirable outcomes. Instead, informal institutions, such as social norms, can play a crucial role. If conditions are right, policy can support social norm changes, helping address global problems (Nyborg et al. 2016; Niamir 2019). Sunstein (Sunstein 1996) appraise people's choices and preferences in terms of *intrinsic value*, *reputational effects*, and *effects on self-conception*. Law and regulations potentially play an important role, by which the function of law in expressing social values with the goal of shifting social norms. There can be a serious obstacle to freedom in the fact that individual choices are a function of social norms, social meanings, and social roles, which individuals may deplore, and over which individuals have little or no control (Sunstein 1996). Here collective action and movements may be necessary to enable people to change norms that they do not like (Bamberg et al. 2015; Sunstein and Reisch 2014; Niamir et al. 2020a). Some norms are obstacles to human well-being and autonomy. It is appropriate for law to alter norms if they diminish well-being and autonomy (Thaler and Sunstein 2009; Sunstein 1996).

Being part of a group or organisation that values the environment and advocates mitigation actions promotes mitigation actions (Ruepert et al. 2017; Sloot et al. 2018), particularly when individuals strongly identify with the peer group (Biddau et al. 2016; Fielding and Hornsey 2016; Jans et al. 2018) or have strong ties with this group (Weenig and Midden 1991). When people feel strongly connected to a group, they may come to adopt the goals of the group as their own goals (Jans et al. 2018). Similarly, block leader approaches in which change is initiated from the bottom-up are effective in promoting mitigation behaviours (Abrahamse and Steg 2013); local ambassadors are more successful at convincing others when they already adopted the promoted behaviour or programmes themselves as this increases their credibility (Kraft-Todd et al. 2018).

SM 5.4 Structural perspectives

Sociological and historical analyses of energy demand (Royston et al. 2018) deduce that patterns and dynamics of consumption are shaped by shifting configurations of infrastructures, technologies and collective conventions (Frantzeskaki and Loorbach 2008). When the aim is to reverse the current growing trend in demand, it is imperative to effectively activate and combine the three leverage points underlying structures (rules, organisations and infrastructures) to trigger social consistent with mitigation targets. If these leverage points are activated separately there is a high probability that path dependencies and behavioural lock-ins cannot be overcome; if they are activated together but independently, they can cause unwanted bounce effects or induce unexpected trends. There is a high probability that the ex-ante design of a relevant combination of infrastructures, organisations and rules, together with collective change of behaviours and adapted governance, will enable a real change in demand-side mitigation. Past lessons are helpful to fine-tune the required combination.

SM 5.4.1 Infrastructures and technologies

Infrastructures, defined in relation to organised practices (Star and Ruhleder 1996), should not be treated as independent systems, levers and drivers of change as it is often the case, but rather as systemic interconnections between infrastructures and practices (Cass et al. 2018). Indeed, the ways in which infrastructures intersect explain their potential influence (Thacker et al. 2019). For instance, the introduction of cycling lanes is embedded within multiple systems in flux, including the staged societal transformations with specific forms of governance and intervention associated with each phase of cycling lane hi tory a study (Oldenziel et al. 2016). Similar results can be derived from an analysis of district heating systems (Hawkey 2012) or at urban level (Bulkeley et al. 2014). In the power sector, huge investments in electricity generation are foreseen, due to both the strong growth in emerging countries and a shift in usage towards "decarbonable" sources. Therefore, there is a need for the transformation of networks because of urban concentration and more dispersed electricity generation resulting from the rise of renewables. It implies that a compromise has to be found between two transition options: the design of a new electricity system to maintain its qualities of supply and sustain its current levels of reliability; a change in consumption habits and the adaption of lifestyles compliant with more power supply interruption (Maïzi and Mazauric 2019; Maïzi et al. 2017). This illustrates the multiple-level relationships between infrastructures, technology choices, economic development and individual choices.

Disciplines identify different drivers of technology adoption. Using rational choice models, mainstream economists propose relative costs and performance of new technologies compared to existing ones as the main driver of adoption (Nelson et al. 2004). Adding to this, evolutionary economists and innovation scholars suggest that technological development experiences positive feedbacks and increasing returns to adoption (like scale economies, learning-by-using, network externalities, informational increasing returns, and technological interrelatedness) that improve a technology's price/performance characteristics as more people adopt (Arthur 1989; Creutzig et al. 2017). Psychologists argue that adoption decisions are shaped by people's attitudes and beliefs with regard to instrumental considerations (perceived usefulness and ease of use) and wider norms and values (Davis 1989; Ajzen 1991). These disciplines conceptualise adoption as one-off purchase decisions, which is particularly useful with regard to 'improve' options that do not require wider changes in lifestyles and user routines. Offering a broader and more longitudinal view, sociologists of innovation and social practice theorists focus on the co-evolution of technologies with lifestyles, social practices and user routines (Hand et al. 2005; Gram-Hanssen 2008; Hyysalo et al. 2013; Shove et al. 2014; McMeekin and Southerton 2012), which is particularly relevant for 'shift' and 'avoid/reduce/ options. On the one hand, new technologies are not just purchased, but also integrated into daily life routines and user practices, which involves several activities (Shove and Southerton 2000; Monreal et al. 2016): a) cognitive activities involve the learning of new skills and competencies, b) interpretive and sense-making activities imbue new technologies with meanings, c) practical activities involve adjustments in everyday routines and material contexts. On the other hand, users do not just adopt new technologies, but can also actively contribute to development and innovation processes by: a) providing feedback to engineers about how technologies function in real-world user contexts (Heiskanen and Lovio 2010; Schot et al 2016; Sopjani et al. 2019), b) tinkering themselves with the technology (Nielsen et l. 2016; Hyysalo et al. 2013), c) developing new organisational templates and business models (Truffer 2003; Ornetzeder and Rohracher 2013; De Vries et al. 2016).

Moving beyond adoption, sociologists of innovation have shown that new technologies need to be embedded in multiple contexts (Ó Tuama 2015; Kanger et al. 2019; Mylan et al. 2019), which involve not just user environments but also: a) business environments, including the development of business models, supply chains, repair facilities and infrastructures (Markard 2011; van Waes et al. 2018), b) civil society, including discourses, narratives, and public debates that shape cultural legitimacy and societal acceptance of new technologies (Geels and Verhees 2011; Rosenbloom et al. 2016), and c) institutional environments, including safety regulations, reliability standards and performance requirements (Reddy et al. 1991; Bohnsack et al. 2016; Andrews-Speed 2016).

SM 5.4.2 Institutions

Policymaking is a political process in that policies are conceived and implemented by governments and their policy coalitions with particu ar political priorities and values, and within a wider socio-economic context (Eyre and Killip 2019). Government policy contributes to shaping demand for energy services, travel and mobility and given range of energy-using activities, the policy agenda involves reaching out to a wide rang of actors that includes practitioners and the general public. Doing this effectively will require a systematic deployment of effective regulatory and enforcement framework, consisting of regulations, market-based instruments, and information based instruments to voluntary agreements at various governance levels to address a wide range of stakeholders and their concerns (Park 2015; Mundaca and Markandya 2016).

The function of institutions in shaping policies and the interaction of various policy instruments is critical for the transition to a low carbon economy (O'riordan and Jordan 1999). One important characteristic of institutions, understood as 'rules of the game in society', consists of formal rules such as laws and regulations and informal norms or conventions that set the incentive structure for decision making (Vatn 2015). For example, Feed-in Tariffs and similar regulations set rules that enable citizens to participate in energy transitions as energy prosumers (Inderberg et al. 2018) (see also 5.4.4.3). The literature around policy processes and implementation with respect to demand and services relates that timing and policy choice is dynamic. At certain times there may be 'policy windows' for ambitious climate change policies, but such windows may also close unpredictably (Carter and Jacobs 2014).

Another way to understand institutions is that they shape the political context for decision making, empowering some interests and reducing the influence of others (Steinmo et al. 1992; Hall 1993; Moser 2009). An example of this is the fossil fuel subsidy that advantages incumbent actors in this sector over those from the renewable, leaving individuals or businesses who wish to invest in green energy, receiving much less support (Lockwood 2015; Healy and Barry 2017; Rentschler and Bazilian 2017). In some countries, establishing carbon reduction as a policy priority is shared across the political spectrum (UK, Germany, India, South Africa), but even then much of the consensus has remained in single issue areas of intervention such as expansion of renewable energy; and rarely around structural change in areas such as sustainable prosperity in a circular economy (Jackson 2017) or sufficiency (Darby and Fawcett 2018; Thomas et al. 2019). These are both politically contentious and suffer from institutional inertia where the tendency is that institutions move slowly and resist change in challenges that call for structural and system-wide change (Munck af Rosenschöld et al. 2014).

SM 5.4.3 Sharing economy

The term sharing economy is used interchangeably with *shareconomy*, collaborative consumption, collaborative economy, the gig economy, and the mesh (Botsman and Rogers 2011; Martin 2016). The sharing economy has grown in a variety of sectors and platforms over the past years (Belk 2014a; Böcker and Meelen 2017). It defines a system that connects users/renters and owner/providers through consumer-to-consumer (C2C)/peer-to-peer (P2P) (e.g. Uber, Airbnb, couch surfing) or business-to-consumer (B2C) or business-to-business (B2B) platforms, and allowing rentals in more flexible, social interactive terms (e.g. Zipcar, WeWork) (Schor 2014; Frenken and Schor 2017; Parente et al. 2018; Möhlmann 2015; Botsman and Rogers 2011; Belk 2014a). However, there are criticisms regarding business relationship masquerading as communal sharing, so-called pseudo-sharing because these practices may not be beneficial to all parties as well as friendly to the environment and to reducing inequalities in access of products and services (Belk 2014b).

The motivation to participate in the sharing economy differs among socio-demographic groups, between users and providers and among different types of shared goods (e.g. cars, rides, accommodation, and tools). For example, empirical data analysis shows that sharing expensive goods (e.g. accommodation) is economically motivated since most of room sharing hosts pay their rent and utility bills by sharing their living spaces. Environmental motivations are important particularly for mobility, ride sharing, in which a passenger travels in a private vehicle driven by its owner, for free or for a fee, and ride hailing, which uses a third party that connects riders with taxi services in the area (Böcker and Meelen 2017). Food sharing, which is a practice where individuals or groups of people make a commitment to ensure that food is shared instead of wasted, involves highly personal interactions, especially for meal sharing, often motivated by social desires (Böcker and Meelen 2017). However, not all food sharing initiatives are based on social motivations. In fact, there are companies enjoying remarkably rapid growth and initiatives driven by economic benefits such as businesses seeking to match farmers and/or distributors to consumers for fresh produce that are still edible but contain defects in size, colour, shape and size; the so-called market for "ugly food" (Richards and Hamilton 2018). Other popular meal sharing initiatives are EatWith, Meal Sharing, Traveling Spoon, in which hosts offer affordable food and a closer look into local life to tourists. Although younger and low-income groups are more economically motivated to use and provide shared assets; younger, higher-income and higher-educated groups are less socially motivated; and women are more environmentally motivated (Böcker and Meelen 2017).

SM 5.5 Transition

SM 5.5.1 Transition perspectives

The literature offers several theoretical approaches that attempt to explain how transitions take place: social practices, energy cultures, and socio-technical transitions. Social practice theory emphasises interactions between artefacts, competences, and cultural meanings (Shove and Walker 2014; Røpke 2009). The energy cultures framework highlights feedbacks between materials, norms, and behavioural practices (Stephenson et al. 2015; Jürisoo et al. 2019) highlights. And socio-technical transitions theory, which spans both provisioning systems and use contexts, addresses interactions between technologies, user practices, cultural meanings, business, infrastructures, and public policies (Geels et al. 2017b; McMeekin and Southerton 2012).

Cultural meanings and discourses shape the beliefs, preferences and motivations of various actors and what they consider to be desirable, legitimate or acceptable (Stryker 1994; Phillips et al. 2004). Structural elements such as regulations, institutions, technologies and infrastructures provide the more tangible contexts within which actors act (Currie and Spyridonidis 2016; Solér et al 2020). Actors like households, firms, civil society organisations, and policymakers reproduce or transform cultural and structural contexts through storytelling, political lobbying, innovation activities and infrastructure building (Lounsbury and Glynn 2001; Dolata 2009; Battilana et al. 2009).

The energy cultures framework and socio-technical transitions theory both understand demand-side transitions as involving interactions between: 1) radical social or technical innovations, which deviate in one more dimensions from dominant configurations, 2) relatively stable dominant energy cultures or socio-technical systems, 3) external influences such as shocks or gradually increasing pressures.
Radical demand-side innovations like new technologies, new business models or alternative behavioural practices initially emerge in small, peripheral niches (Kemp et al. 1998; Schot and Geels 2008). These projects and initiatives offer protection from mainstream selection pressures and nurture the development of radical innovations (Smith and Raven 2012). Dominant energy cultures, social practices or socio-technical systems resist radical change, because they are stabilised by multiple lock-in mechanisms (Klitkou et al. 2015; Clausen et al. 2017; Ivanova et al. 2018; Seto et al. 2016).

SM 5.5.2 Lock in mechanisms of existing systems and practices

Although there are many demand-side mitigation options, low-carbon transitions do not happen easily because multiple lock-in mechanisms stabilise existing systems of service provision and social practices and thus hinder major change (Clausen et al. 2017; Ivanova et al. 2018; Seto et al. 2016; Klitkou et al. 2015). Existing activities and demand patterns are often stabilised by behavioural lock-in mechanisms identified by psychological and economic literature: a) routines and habits tend to be repeated over time as 'normal' dietary, heating or travel patterns (Barnes et al. 2004; Maréchal 2010; Kurz et al. 2015; Hoolohan et al. 2018); b) preferences and attitudes can orient people positively towards existing practices over alternatives, e.g. private car travel over public transport (Sheller 2004); and c) cost-benefit calculations make people purchase technologies that are more practical or cheaper than alternatives (e.g. cars over public transport in rural areas; petrol cars over electric cars).

Structural elements of existing systems and practices are also stabilised by lock-in mechanisms as sociological, political science and innovation literature have demonstrated. Institutional lock-in mechanisms can stabilise existing policies that support existing technologies and demand patterns: a) policy networks facilitate interactions between policymakers, specialists, and established business interests and tend to shape policymaking towards status quo protection or incremental reform rather than more radical policy change (Walker 2000; Knox-Hayes 2012; Geels 2014; Normann 2017; Roberts and Geels 2019); b) existing policy paradigms shape how policymakers frame problems and think about solutions (Kern et al. 2014; Rosenbloom 2018; Schmidt et al. 2019; Buschmann and Oels 2019), often leading to a focus on upstream technologies, market-based instruments, and hands-off policy styles (Whittle et al. 2019), c) incumbent firms use corporate political strategies and resistance tactics to delay or water down strong climate policies (Kolk and Pinkse 2007; Smink et al. 2015; Ferguson et al. 2016; Supran and Oreskes 2017; Geels 2014). Technological lock-in mechanisms such as core competencies and sunk investments in factories and employees generate vested interests and technological regimes that incumbent firms will try to protect through incremental innovation (Berkhout 2002; Raven and Verbong 2004; Vanloqueren and Baret 2009). Infrastructural lock-in mechanisms such as capital-intensity, asset durability, obduracy, and systemic interrelatedness (van der Vleuten 2004; Markard 2011) means that infrastructure-related technologies and practices are difficult to change. Existing roads, petrol stations and land-use patterns stabilise car-based mobility patterns (Seto et al. 2016) while gas infrastructures stabilise home-based boiler heating practices (Gross and Hanna 2019).

Existing meanings may also lock-in existing systems and practices. Discourse and cultural studies literature have found that established meanings, values and discourses help legitimise and normalise the status quo (Bosman et al. 2014; Buschmann and Oels 2019). For example, discourses that frame cars as status symbols that embody success, power, freedom, and autonomy help entrench auto-mobility and hinder shifts to public transport (Stephenson et al. 2015). Discourses that portray dairy milk as healthy and natural stabilise particular diets and hinder transitions to plant-based milk (Mylan et al. 2019). Most people and communities hold a plurality of cultural values; environmental protection and climate mitigation is only one value cluster amongst others such as efficiency, security and stability, social justice and fairness, autonomy and freedom, and improved quality of life (Plumecocq et al. 2018; Demski et al. 2015).

SM 5.5.3 Rates of change, acceleration

Rates of change are usually slow in the first and second transition phase, because experimentation, social and technological learning, the creation of standards, and the reduction of uncertainty take a long time, often decades (Bento et al. 2018; Bento 2013; Wilson 2012). Rates of change increase in the third phase, as radical innovations diffuse from initial niches into mainstream markets, propelled by the self-reinforcing mechanisms, discussed above. The rate of adoption (diffusion) of new practices, processes, artefacts, and behaviours is determined by a wide range of factors at the macro- and micro-scales, which have been identified by several decades of diffusion research in multiple disciplines (for comprehensive reviews see, e.g., Tornatzky and Klein, 1982; Feder & Umali, 1993;). (Ausubel 1991; Bayus 1994; Van den Bulte and Stremersch 2004; Comin and Hobijn 2003, 2010; Davis 1979; Meade and Islam 2006; Mahajan et al. 1990; Mansfield 1968; Martino et al. 1978; Peres et al. 2010; Grubler 1991; Rogers 2003).

Diffusion rates are determined by two broad categories of variables, those intrinsic to the technology/product/practice under consideration (typically performance, costs, benefits), and those intrinsic to the adoption environment (e.g., socio-economic and market characteristics).
The literature on systems or macro-determinants of diffusion (technology growth and behavioural change) rates comprises three streams: historical energy transition research (e.g., Fouquet 2008; Geels 2002), systems theories of technological change (Grübler et al. 1999), as well as the recent literature on scaling(-up) dynamics of technologies (Wilson 2009) which has also been applied for validation of climate mitigation scenarios (Wilson et al. 2013). Common to them all is the recognition of the importance of scale, or market size, as well as time and place as determinants of rates of change. Three main conclusions emerge from this literature. Ceteris paribus, a) larger systems take more time to

evolve, grow, and change compared to smaller ones; b) the creation of entirely new systems (diffusion) takes longer time than replacements of existing technologies/practices (substitution); and c) late adopters tend to adopt faster than early pioneers.

The micro-level literature on technology- (or product-) specific rates of adoption is vast (for reviews see, (Tornatzky and Klein 1982; Grübler et al. 1999; Peres et al. 2010; Rogers 2003)) and has identified three clusters of variables: a) relative advantage; b) adoption effort required and complexity; and c) compatibility, observability, and trialability. All variables, except adoption effort, are positively correlated with (rapid) rates of change.
The acceleration of transitions is a complex issue, because of the multitude and combination of both macro- (societal, economic, markets) and micro- (e.g., firm- or consumer-) level determinants. A recent debate (Sovacool 2016) vs. (Grubler et al. 2016) led to a special journal issue on the duration and acceleration of energy transitions from a variety of (opposing) perspectives, which ranged from political urgency and malleability (Bromley, 2016) to inertia in large-techno-economic systems (Smil 2016) for a summary of the debate cf. (Sovacool and Geels 2016).

SM 5.5.4 Feasibility and barriers of demand-side transitions

While demand-side solutions have very high mitigation potential, the widespread diffusion and transitioning of many options is challenging. Table SM5 1 provides a high level assessment of feasibility barriers for avoid, shift and improve options on behavioural, technological, business, institutional and socio-cultural dimensions. This assessment shows that improve options, which are mostly about technical component substitutions that do not require wider changes, face low to medium feasibility barriers. related to higher costs (specially if new technologies also require new infrastructures), limited consumer interest, and some industry reluctance. Shift options, which involve different ways of fulfilling desired services, face medium to large feasibility barriers, due to substantial required changes in behavioural routines, technologies, institutions, and investments. Avoid options, which involve deep changes in lifestyles and socia practices, face large feasibility barriers in behavioural routines, institutions and cultural meanings, small to medium technical barriers and variable economic barriers.

There is variability within this high-level assessment of feasibility and speed of transition. Some improve options may diffuse rapidly (e.g LED lightbulbs), but other improve options, such as improved cooking stoves remain at low levels due to mismatch with cultural practices or cost barriers. Avoid and shift options often require longer time scales, especially if new infrastructures, such as tram lines or building retrofits, are involved Sometimes they unfold rapidly, however. For example, digital service provision models rangi g from communication to entertainment, retail, or banking via integrated digital platforms (typically via smartphone apps) diffused quickly, replacing conventional analogue and/or physical service provisioning systems (home entertainment systems, bank offices, or shops (TWI2050 2019).

Demand-side transitions thus face the dilemma that improve options are in some cases more feasible, but only exploit part of the solution space, because they are less deep. Shift and avoid options have higher mitigation potential, but face larger feasibility barriers, for instance for living car-free and restricting long-haul flights (Dubois et al. 2019). While the diffusion of most demand-side options is likely to be slow without stronger policies, this dilemma means that the diffusion of shift and avoid options would particularly benefit from stronger policy support that also address social norms. Importantly, feasibility barriers are not fixed or static, but malleable and evolving over time. Obstacles and feasibility barriers are high in early transition phases. But over time, the various barriers decrease as a result of technical and social learning processes, network building, scale economies, cultural debates and institutional adjustments.

Table SM5.1 Assessment of feasibility/barriers for the diffusion of demand-side mitigation options

	Behavioural	**Technology, infrastructure**	**Business**	**Institutional**	**Socio-cultural**
Improve options: Electric vehicles, light-weight vehicles, wood as building material, solar thermal devices, insulation, energy-efficient appliances and light bulbs, low carbon fabrics, improved clean cookstoves	**Small-medium** -Small change in behavioural routines -Costs or lack of interest may hold back purchase	**Small-medium** -Most component substitutions are technically feasible. -Some options require infrastructure change (e.g. recharging)	**Medium** -More expensive than existing technologies (although learning curves reduce costs) -Infrastructure change would increase costs - Incumbent firms may delay reorientation to new technical capabilities	**Small** -No major institutional change needed (as existing systems mostly remain intact) -Diffusion slow without policy support and financing models	**Small** - No major cultural change needed
Shift options: **Shift from cars to public transport or cycling, less material-intensive construction, district heating, passive house, smaller devices, circular economy, shift towards from meat to other protein sources**	**Medium-large** -Medium change in behavioural routines -Not widespread consumer interest	**Small-Medium** -Increased use of existing or new technologies -New provisioning systems and sometimes new infrastructures	**Medium-large** - Investments in technologies, supply chains, business models, infrastructure - Resistance from incumbent industries	**Medium-large** -Medium institutional change (new agencies, responsibilities) -Large policy change (new goals, programs, instruments) - Substantial political resistance and struggle	**Medium-large** - Large scale cultural change for some shif options (e.g. less meat)
Avoid options: Integrated transport and land-use planning, tele-working, compact cities, smaller apartments, shared common spaces, multi-generational housing, change	**Large** -Large change in behavioural routines -Small to limited consumer interest	**Small-medium** -Limited technical change (except for some options) -Mostly using existing or	**Variable** High costs for some options (e.g. compact cities), low costs for others (e.g. change dress codes)	**Large** -Large institutional change (e.g. overcoming silo-problem, new agencies) -Large policy change for some options	**Large** -Large cultural change in many options (e.g. smaller apartments, consume less in some contexts)

dress codes, change work times, change temperature settings, consume less goods, keep calories in line with health guidelines, daylighting	proven technologies	(e.g. compact cities, tele-working)

SM 5.6 Case studies

SM 5.6.1 Consumer-led innovation in solar photovoltaics (CS1)

Although solar PV has attained massive scale as an energy supply technology, its success in becoming a low-cost mitigation option is attributable in large part to the collective agency of energy consumers who embraced the unique services that PV’s modularity provides These bottom-up socio-cultural forces catalysed a supportive policy environment, which enabled improvements in the technology by innovative firms. PV’s technological evolution can be summarised as the result of distinct contributions by the US, Japan, Germany, Australia, and China—in that sequence over seven decades (Nemet 2019) (Figure SM5.4).

Since its first commercial application in 1958, PV ha provided distinct energy services to a sequence of increasingly large consumer niche markets w th high but decreasing willingness to pay (Dracker and De Laquil III 1996; Jacobsson and Lauber 2006). Modul rity is among PV’s most consequential attributes; the smallest electronics application o utility-scale spans nine orders of magnitude (Shum and Watanabe 2009). Nearly every scale in between has been applied to provide needed services—often serving not a policy-driven market but one arising from idiosyncratic consumer needs, for which PV was well suited. In the 1950s the US Navy bought cells for early satellites from an electronics entrepreneur who had been selling solar-power radios (NRC 1972; Perlin 1999). In India in early days activist entrepreneurs marketed solar-powered lanterns in rural areas with unreliable electricity (Roy 1997; Roy and Jana 1998). Off-grid housing, water pumps in Mali, and electronics provided important consumer niche markets (Perlin 2013). It has played a substantial role in reducing poverty in China (Zhang et al. 2020).

Institutionally, the most important policy for the improvements observed in PV was Germany’s Erneuerbare Energie Gesetz (EEG) passed in 2000, guaranteeing prices paid to prosumers (i.e. citizens acting as both producers and consumers) of renewable electricity for 20 years (RESA 2001). The EEG quadrupled the size of he German solar market in one year and stimulated corporate actors to invest in designing PV-specific production equipment that was crucial for subsequent improvements and cost reductions accomplished by Chinese producers (Palz 2010). In India in 1982 the Department of Non-conventional Energy Sources was set up which eventually got transformed into Ministry of Non-conventional Energy Sources (MNES) in 1992 and in 2006 to MNRE in 2006. Indian Renewable Energy Development Agency (IREDA) was established in 1987 to finance renewable energy projects (Bhattacharya and Jana 2009).

The EEG adopted the policy innovation of guaranteed long term contracts that California regulators had designed to provide grid access to small energy producers in the 1980s (CPUC 1983; Hirsch 1999). It also adopted the Japanese innovations of a declining subsidy and the first national rooftop top solar program in 1995 (Kimura and Suzuki 2006). The adoption behaviour of the 200,000 Japanese households who installed PV in the next ten years showed the world that consumer demand for PV energy services was strong (Shimamoto 2014). The Japanese subsidy was far less generous than the subsequent German program and surveys of adopters indicate that environmental values were a stronger driver than economics (Kimura and Suzuki 2006). Corporate actors, in the form of Japanese electronic conglomerates, became the world's largest PV producers using experience incorporating PV's unique attributes, scale and mobility, into consumer products, like watches, calculators, and electronic toys (Honda 2008).

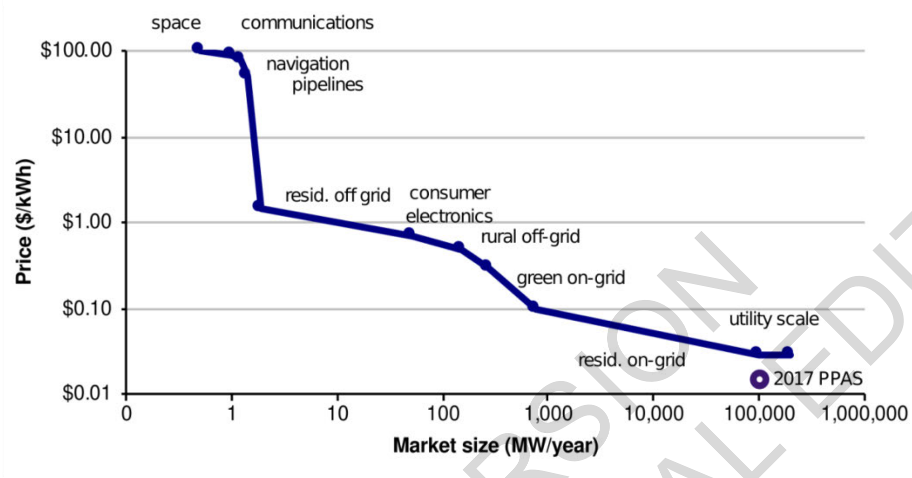

Figure SM5.4 Technological learning curve of photovoltaic solar energy. Prices decline with production and associated innovation and economics of scale. As granular technology that can be matched to diverse settings, technological learning is faster than in most other technologies.

Source:(Nemet 2019)

The EEG only became politically feasible in Germany because of an environmental activist social movement, originating in the 1968 student protests, advocating a shift to consumer-led green energy production (Morris and Jungjohann 2016). PV had the potential to avoid: environmental damage, oil dependence, hegemony of electric utilities nuclear power, and later climate change. PV thus attained meaning beyond its technical elegance; its main advocate in the German Parliament, Hermann Scheer emphasised the importance of its "emancipatory motivation" (Palz 2010). In 1998, when a policy window opened, broad social acceptability existed, cities had de-risked the technology, and policy implementation details had been worked leading to a cascade of technology adoption, performance improvement, and cost reductions that set the stage for broader systemic change (Lauber and Jacobsson 2016)

Today's massive utility-scale PV projects are now a factor of 10,000 cheaper than the first PV cells in satellites. They are also inextricably linked to a seven-decade evolution in which the agency of consumers has consistently played a key role in multiple countries, such that deriving half of global electricity supply from solar is now a realistic possibility (Creutzig et al. 2017).

SM 5.6.2 Energy services for cooking: Improve cookstoves and shift to new forms of energy (CS2)

The majority of households in developing countries use traditional solid biomass fuel through inefficient and incomplete combustion for cooking and heating (Bhattacharya and Cropper 2010; Nepal et al. 2010; Bonjour et al. 2013; IEA 2017; Wester et al. 2019; Jeuland et al. 2021), . This has been a major concern for deforestation (Kissinger et al. 2012) and for health, gender relations, and economic

livelihood (Batchelor et al. 2019). For example, about 85% of the fine particulate matter (PM2.5) emission in Africa in 2018 came from the burning of biomass indoors (IEA 2019).
Cleaner and safer cooking solutions in South Asia and Africa can obtain a range of benefits: reduce firewood collection from the forest (Pattanayak et al. 2004; Sharma et al. 2020), ; reduce the burden on women (Hazra et al. 2014); deliver better health (Pant 2008; Thakuri 2009); higher labour productivity (Kalyanaratne 2014) for the users and reduce emissions of greenhouse gases (Zhang et al. 2013; Somanathan and Bluffstone 2015; Lafave et al. 2019; Bluffstone et al. 2021), . Studies have shown that net reduction in emission for the switch from biomass as a cooking fuel to LPG has clear climate and non-climate benefits (Anenberg et al. 2017; Singh et al. 2017; Ghilardi et al. 2018; Goldemberg et al. 2018). In India during 2001 and 2011 increase in LPG use has led to a net emissions (Kyoto and non-Kyoto Gases) reduction of 6.73 $MtCO_2$-eq (0.94 $MtCO_2$-eq in rural area and 5.79 $MtCO_2$-eq in urban area) with fuel wood displaced 7.2 million tons (0.99 million tons in rural area and 6.19 million tons in urban area)(Singh et al. 2017).

To improve the affordability of the cleaner fuel and cook stove choice, actors at the households level need motivation through pricing policy like subsidies and installation cost waiver (Troncoso and Soares da Silva 2017; Dickinson et al. 2018; Sankhyayan and Dasgupta 2019) Well intended subsidy programs often do not help world's poorest to adopt cleaner fuel, suggesting a need for targeted programs (Bhattarai et al. 2018). The decision towards actual transition to a cleaner cooking fuel and technology is often governed by other demand-side drivers/barrier like lifestyle and socio-cultural norms and practices.

The useful energy demand for cooking is a crucial component of the choice between various cooking technology options and has been the subject of numerous studies (Balmer 2007; Nerini et al. 2016; Van de Ven et al. 2019; Forouli et al. 2020; Silaen et al. 2020; Taylor et al. 2020), . Daioglo et al. (Daioglou et al. 2012) conclude that a mean of 3 MJ cap^{-1} day^{-1} (range 0.77 to 7.22) of useful energy is required for cooking (equivalent to 125 kWh $month^{-1}$ for a household of 5. Accommodating cooking energy services in off-grid electrification technologies Zubi et al. (Zubi et al. 2017) estimate that a three litre multi-cooker needs just 0.6 kWh day^{-1} to cook lunch and dinner for a household of six, which is equivalent to 0.36 MJ cap^{-1} day^{-1} . Similarly, according to Batchelor et al. (Batchelor et al. 2018) 0.2 kWh could be enough to cook rice for a household of four in a rice cooker.

Shifts towards electr c and LPG stoves in Bhutan (Dendup and Arimura 2019), India (Pattanayak et al. 2019), Ecuador (Gould et al. 2018; Martínez et al. 2017) and Ethiopia (Tesfamichael et al. 2021); are taking over now compared to past trend towards *improved* biomass stoves in China (Smith et al. 1993). Significant subsidy (Litzow et al. 2019), information (Dendup and Arimura 2019), social marketing and availability of technology in the local markets are some of the key instruments helping to adopt ICS (Pattanayak et al 2019), through supply chain creation availability was scaled up enormously in India (Sankhyayan and Dasgupta 2019). Shift in use of energy efficient cooking appliances like pressure cookers and rice cookers is now almost universal in South Asia and beginning to penetrate the African market as consumer attitudes are changing towards household cooking appliances with higher energy efficiencies (Batchelor et al. 2019).

There is substantial evidence that more awareness programs are needed to break the behavioural barriers towards usage of modern cooking fuel (Giri and Aadil 2018). While designing ICS, along with technical aspects like energy efficiency, emission mitigation, and improving health outcomes researchers are also needed to factor in functionality, asthetics and consumers' need and preference. A tailoring in the technology is also needed based on the region, climate and culture (Bielecki and Wingenbach 2014). Many of the families who are first time users of LPG often find safety issues as a barrier to use it. Studies from Senegal and Mexico shows that even though households are complaining of smoke and itchy and watery eyes during cooking with solid fuels, and are aware of the health benefits of using LPG or other efficient technology, they still find traditional cooking practices using solid fuels to be more desirable (Pine et al. 2011; Hooper et al. 2018). Many country-specific studies have also shown that the types of diet, modes of cooking and types of utensils, vessels used have an impact on the choice of cooking fuel and technology (Ravindranath and Ramakrishna 1997; Atanassov 2010; Mukhopadhyay et al. 2012; Troncoso et al. 2019; Bielecki and Wingenbach 2014) the perception of food tastes (Wiedinmyer et al. 2017; Mukhopadhyay et al. 2012; Hooper et al. 2018), differences in the housing-style and location of the cooking area-indoor or outdoor (Chattopadhyay et al. 2017) delays transition to a cleaner fuel or new technology . In Mozambique the dissemination of solar cookstove has seen limited success as its design failed to capture end-user need of cooking process like boiling, steaming or frying and how the food is prepared like standing versus sitting (Otte 2014).

Universal access to clean and modern cooking energy could cut premature death from HAP by two-third relative to baseline in 2030 while reducing forest degradation and deforestation and contribute to the reduction of up to 50% of CO_2 emissions from cooking relative to baseline by 2030 (Hof et al. 2019; IEA 2017). However, in the absence of policy reform and substantial energy investments, 2.3 billion people will have no access to clean cooking fuels such as biogas, LPG, natural gas or electricity in 2030 (IEA 2017). The increasing efficiency *improvements* in electric ooking technologies, together with the ongoing decrease in prices of renewable energy technologies could enable households to shift to electrical cooking at mass scale (Figure SM5.5a).

SM 5.6.3 Shift in mobility service provision through public transport in Kolkata (CS3)

In densely populated cities in India, mobility is still predominantly dependent on public transport, walking and cycling modes (Tiwari et al. 2016). There is an increasing shift of narratives towards comfortable, affordable public transport systems in public policy, which is translated into infrastructure investments, procurement of equipment road safety legislation, and even public consultations on mobility in smart cities (Roy et al 2018b; Ghosh and Arora 2019). This transition in mobility systems in historically public transport dominated cities like Kolkata and Mumbai is happening through 'fit and conform' strategies, but also by 'stretch and transform strategy' in new cities like Ahmedabad, Bangalore, Pune (Ghosh et al. 2018; Ghosh and Schot 2019; Roy et al. 2018b).

In the megacity Kolkata, as many as twelve different modes of public transportation 'regimes' - each with its own system, structure, network of actors and meanings - co-exist and offer means of mobility to its 14 million citizens Most public transport modes are shared mobility options ranging from sharing between two people in a rickshaw or between a few hundred in metro or sub-urban trains. Sharing also happen as daily commuters avail shared taxis organised by organically formed local taxi associations and neighbours borrow each other's car or bicycle for urgent or day trips. However, there are also formal efforts by several actors and initiatives to transform the existing systems in sustainable directions. Many factors have contributed to transformative changes in Kolkata's public transport regimes, including socio-cultural awareness generated through mass-media like television and newspaper reports, research and communication by NGOs on the detrimental effects of existing standards of fuel and equipment, environmental campaigns by civil society organisations involving school children, students and the elderly. There were efforts to improve efficiency in managing fleets and service provision through smart, real time and integrated display and fare collection system etc. A crucial driver of this policy has been to discourage users to shift their demand from public to private mobility and new meaning to buses, autorickshaws were getting added continuously. Many of these changes were driven by new policy at national and urban levels, for instance the National Urban Renewal Mission (2005) (Ministry of Housing and Urban Affairs 2005), National Urban Transport Policy (2006) (Ministry Of Urban Transport 2006) and Kolkata's comprehensive urban mobility plan (2008) (IDFC 2008).

A key role is played by the state government to improve the system as whole and formalise certain semi-formal modes of transport. An important policy consideration has been to make Kolkata's mobility system more efficient (in terms of speed, reliability and avoidance of congestion) and sustainable through strengthening coordination between different mode-based regimes as each of these regimes are transformed individually and collectively over the past 10 years (Ghosh 2019). Such transformations within the regimes arose from a broad range of drivers such as need for new infrastructure, increased fuel efficiency, digitalisation of operation, and pollution mitigation. Many of these interventions were to address wider sustainability challenges such as increasing demand for individual mobility, high concentration of pollutants in the air, lack of affordability etc. Each of Kolkata's diverse public transport regimes have changed along different pathways in the past decade owing partly to new standards and regulations, but also to new values, beliefs and expectations-(cognitive and normative meanings. Four distinctive regime level change processes are: improvements and new meaning to public buses, greening and formalisation of auto-rickshaws, the institutional and socio-cultural support to the emergence of 'app-cab' niche, a cycling ban policy in major arterial roads of Kolkata.
Each of Kolkata's diverse public transport regimes have changed along different pathways in the past decade owing partly to new standards and regulations, but also to new values, beliefs and expectations (cognitive and normative meanings). Four distinctive regime level change processes are elaborated here: 1) improvements and new meaning to public buses; 2) greening and formalisation of auto-rickshaws; 3) the institutional and socio-cultural support to the emergence of 'app-cab' niche; 4) a cycling ban policy in major arterial roads of Kolkata.

Public Buses attracting the middle class: Supported by the National Urban Renewal Mission in 2010, the West Bengal government rolled out 1200 new fuel efficient, low floor buses with an aim to provide 'modern and efficient bus service to the u ban middle class citizens of Kolkata, who will be willing to pay a premium fare for a comfortable and reliable bus service'(Ghosh and Schot 2019). Several changes in the state bus regime followed this effort to improve public bus infrastructure to match the demands for a new urban lifestyle There were efforts to improve efficiency in managing fleets and service provision through smart, real time and int grated display and fare collection system etc. A crucial driver of this policy has been to discourage users to shift their demand from public to private mobility. The primary focus on these strategies have been to cater to their preferences for safety, reliability and comfort. A way to incentivise the middle class, urban population of Kolkata to keep using public buses was through transforming the socio-cultural meaning of the public bus regime by rebranding and advancing a new image of the bus as a comfortable and efficient mode of transport.

Auto-rickshaws and new meanings: While the transformation of the public bus was triggered by social pressures like affordability, safety and reliability, transformation in the auto-rickshaw regime started off in response to the environmental challenges from the unsustainable fuel used in these vehicles. Emissions from auto-rickshaws operated with a cheap toxic mixture of petrol, kerosene and naphtha accounted for 60% of the city's air pollution. Since 2009, new legislation has mandated the use of single mode liquified petroleum gas (LPG). This improvement in fuel infrastructure coupled with consequent initiatives by the state government to formally recognise and integrate auto-rickshaws as part of the public transport portfolio of the city, resulted in a transformation of the socio-cultural meaning of auto-rickshaws from one considered to be noisy, polluting, unregulated and informal paratransit mode into an environment-friendly, fast and efficient mode of shared mobility.

Emergence of 'app-cab' niche: Public buses started attracting middle classes, Autorickshaws got new meaning and with digitalisation Taxi services got transformed. The existing social norm of sharing public transport modes coupled with a rapid uptake of smartphones facilitated the emergence of 'app-cabs' in Kolkata (Ghosh 2019). Since 2014, the global mobility platform, Uber and the Indian app-cab company, Ola started operating services in Kolkata, gaining quick momentum in shifting the demand of users from yellow taxis to app-based taxi services. Both Uber and Ola have 'pool' (ride-sharing) options which are considerably cheaper than booking the entire car. Commuters could even buy a monthly pass for cheaper daily access. Owing to these facilities, transparency of payment and safety promises, shifts have taken place in the expectations and routines of commuters from "car is the only comfortable way of travelling" to "sharing a cab is much faster and efficient" (Ghosh and Schot 2019). Such deeper shifts in the beliefs of the more affluent urban population are crucial for transitioning towards sustainable mobility in coherence with emerging lifestyle preferences in megacities like Kolkata. However, there is also a change in behaviour of the urban middle-class, who are willing to replace their bus, metro or auto-rickshaw rides with app-cabs because of additional benefits like door to door service.

Cycling ban policy: While the effect on social justice, equity and inclusion is clear in the cases of the bus, auto-rickshaw or app-cabs, some recent policy actions in Kolkata are directly related to socio-economic exclusion. Since 2014, Kolkata police have banned cycling in many major arterial roads as a traffic management strategy under the pressure of congestion and to avoid road accidents in over crowded narrow streets. Civil society activists and NGOs have protested against the ban on grounds of environmental impacts and injustice against the poor. The ban was partially retracted in 2016 (Ghosh 2019). Scholars have argued that such policy measures exacerbate inequalities by disadvantaging the urban poor, and hence are undesirable, even though it might seem to be a congestion mitigation strategy in the short term (Raven et al. 2017; Sur 2017) The agency of political actors in implementing regulatory policies in individual bus, auto or taxi regimes is important, but not enough to maintain the existing sustainable practices of shared mobility. The transformation processes in state bus and auto-rickshaw regimes highlight that policies need to align with specific user demands (for safety, reliability, comfort) and focus on changing deeper beliefs and practices across multiple mobility regimes in the city. The emergence of the app-cab service suggests the role of digitalisation beyond policies and markets to renew the taxi regime following the existing ride sharing culture that already exists in Kolkata. The cycling ban case highlights the exclusionary effects of policy, which the agency of civil society actors in social movements can hold into account in a democratic context.

To conclude, more thoughtful action at a policy level is required to sustain and coordinate the diversity of public transport modes through infrastructure design and reflecting on the overall directionality of change (Schot and Steinmueller 2018; Roy et al. 2018b). The case of urban mobility transitions in Kolkata shows interconnected policy, institutional, socio-cultural and behavioural drivers for socio-technical change. Change has unfolded in complex interactions between multiple actors, sustainability values and megatrends where direct causalities are hard to identify. However, the prominence of policy actors as change-agents is clear as they are changing multiple regimes from within. The state government initiated infrastructural change in public bus systems, coordinated with private and non-governmental actors such as auto-rickshaw operators and app-cab owners who hold crucial agency in offering public transport services in the city. The latter can directly be attributed to the global momentum of mobility-as-a-service platforms, at the intersection of digitalisation and sharing economy trends. However, sensitivity of the policy actors in the developing countries to local needs and capabilities are important, instead of chasing global trends, especially if such trends increase inequality at the cost of improved standard of living for a selected section of people. It is a fact that many of these above mentioned policy changes cater to middle class aspirations and preferences, at the cost of lower income and less privileged communities. Complexity of governance and risk of increasing inequalities are also discussed in the literature (Sheller 2018; Nikolaeva et al. 2019) along with new approaches for collective governance and accessibility in the mobility transition. (Figure SM5.5b).

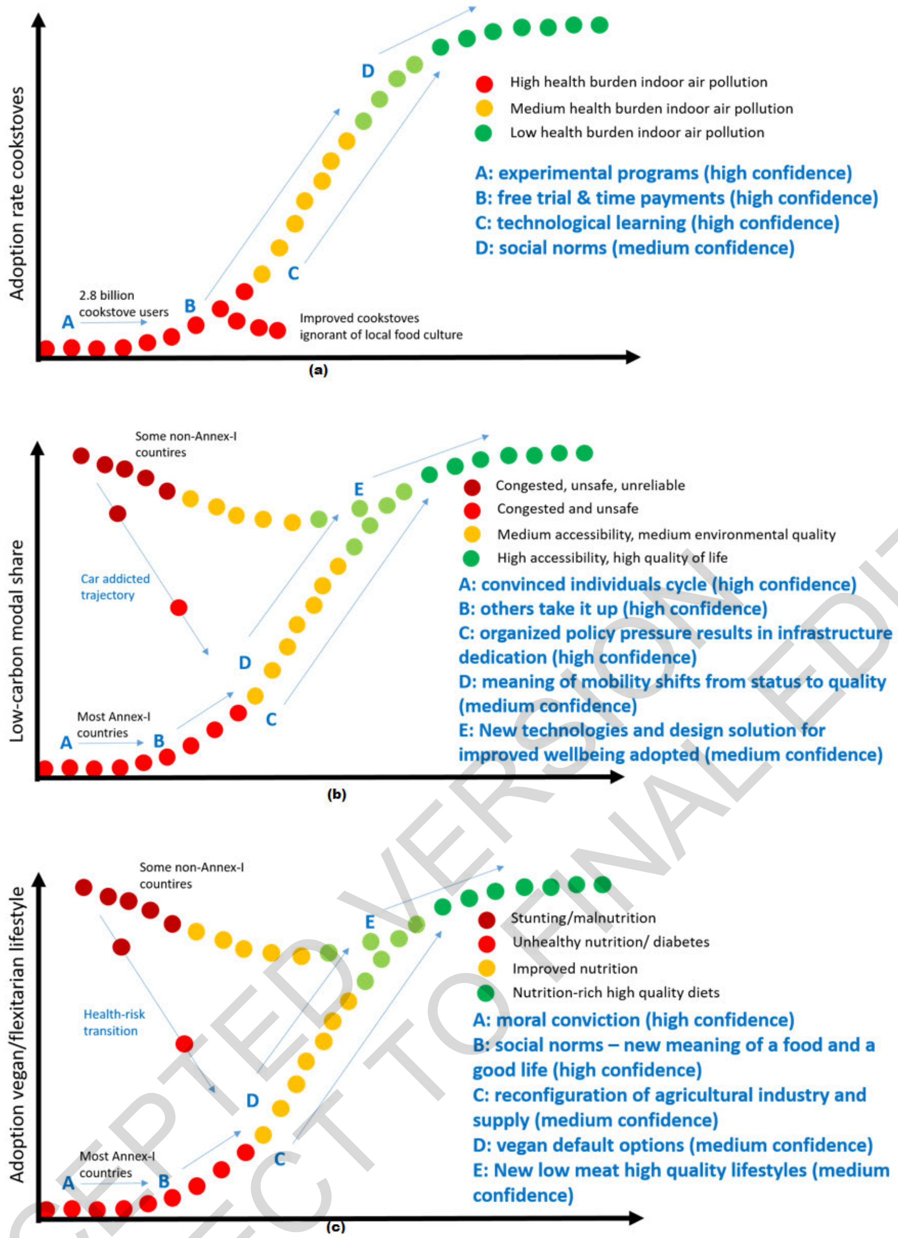

Figure SM5.5 Exemplary transition dynamics for the cases of improved cookstoves, modal shifts, and diet shift

SM 5 6.4 Dietary change and reduced meat consumption (CS4)

UK per capita meat consumption increased from 69.2 kg yr^{-1} in 1961 to 85.7 kg yr^{-1} in 2006, and then declined to 78.6 kg yr^{-1} in 2015 (= 8.3%), followed by a small increase in 2016 and decline in 2017 (see Figure SM5.6). Despite ups and downs, the trend since 2006 is downward. Another long-term trend is a relative shift from carbon-intensive red meat towards poultry. Research indicates that this shift away from meat consumption is likely to have resulted from interactions between several actors and multiple dimensions (Vinnari and Vinnari 2014).

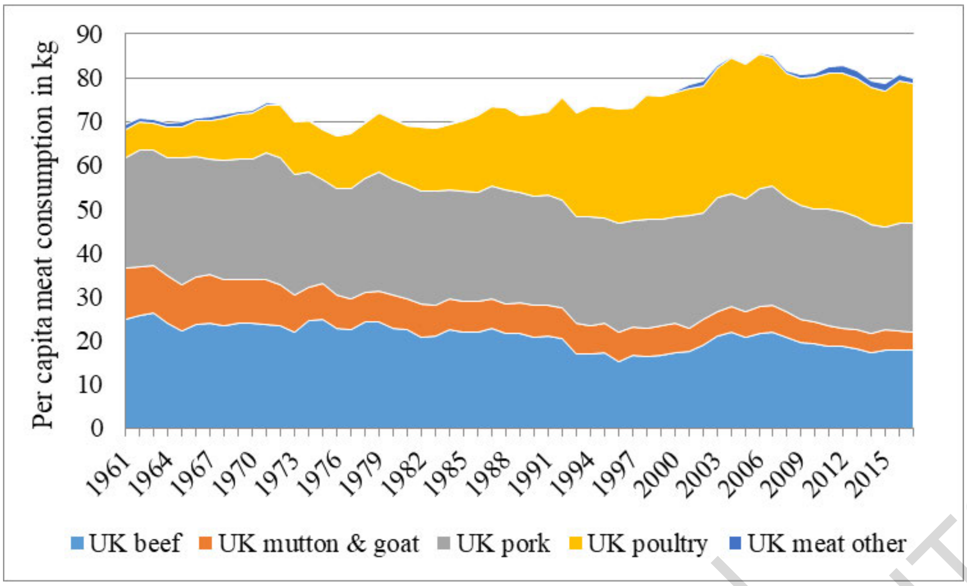

Figure SM5.6 UK per capita meat consumption (kgs; constructed from FAO Food Balances database)

A substantial body of literature indicates that self-reported consumer motivations for shifting away from meat are primarily linked to concerns for personal health. Food safety, cost, and animal welfare, are also important, with concerns about climate change less so (Latvala et al. 2012; Dibb and Fitzpatrick 2014; Hartmann and Siegrist 2017; Graça et al. 2019) However, there is little evidence to link these motivations to actual behaviour change (Bianchi et al. 2018; Graça et al. 2019). This can be attributed to lock-in mechanisms, such as established habits of food provision; skills deficits in preparing non-meat meals (Pohjolainen et al. 2015); positive socio-cultural meanings attached to meat eating, including vitality and sociality (Mylan 2018) and limitations in the availability of non-meat options when eating out of the home (Graça et al. 2019).

NGO campaigns that aim to change public discourses and attitudes toward meat production and consumption (Laestadius et al 2016), have gained prominence in UK over the past decade, drawing attention to issues including health, climate change and animal welfare. There has also been a proliferation of behaviour change initiatives led by social movements including ‘meat-free-Mondays’ and ‘Veganuary’ which, in addition to information provision, aim to encourage behaviour change by providing practical guidance and creating normative pressures (Morris et al. 2014). The effectiveness of these civic led interventions, and accompanying attempts to ‘nudge’ consumers toward meat reduction by altering the visual appeal, position, or size of meat offerings at the point of purchase, is being debated in the literature (Garnett et al. 2015; Godfray et al. 2018; Taufik et al. 2019; Harguess et al. 2020; Sahakian et al. 2020).

Companies have started to respond to the growing demand for ‘meat free’ products, with 16% of new UK food products launched in 2018 presenting ‘non animal’ claims – a doubling since 2015 (MINTEL 2019). These ‘meat alternatives’ vary in material form, with more ‘radical’ products such as cultured meat, or algae and insect-based proteins, facing substantial structural barriers (technological, organisational, institutional), which presently hinder their widespread diffusion (van der Weele et al. 2019). Nevertheless, it is clear that both corporate food actors and new entrants offering more innovative ‘meat alternatives’ view consumer preferences as an economic opportunity, and are responding by increasing the availability of meat replacement products. Farmers and meat industry actors have opposed these developments through political lobbying, which in 2019 led the European Parliament’s agriculture committee to prohibit these new companies from using the terms “burger” or “sausage” to describe products that do not contain meat.

Policy support for meat alternatives or behavioural change has remained limited in the UK, where reduced meat consumption is low on the political agenda (Wellesley and Froggatt 2015). The extent to which policymakers are willing to actively stimulate reduced meat consumption thus remains an open question(Godfray et al. 2018). Agricultural policies in the UK serve to support meat production with large subsidies that lower production cost and effectively increase the meat intensity of diets at a population level (Simon 2003; Godfray et al. 2018). Deeper, population wide reductions in meat consumption are hampered by these lock-in mechanisms which continue to stabilise the existing meat production-consumption system.

To conclude, analysis of the dynamics across the UK food provisioning system which have accompanied the observed decline in UK meat consumption, indicates that this has resulted from interaction between multiple behavioural, socio-cultural, and corporate drivers (Figure SM5.5c).

References

Abrahamse, W., and L. Steg, 2013: Social influence approaches to encourage resource conservation: A meta-analysis. *Glob. Environ. Chang.*, **23**(6), 1773–1785, doi:10.1016/j.gloenvcha.2013.07.029.

Acemoglu, D., S. Naidu, P. Restrepo, and J. A. Robinson, 2013: *Democracy, Redistribution and Inequality*. , Cambridge, MA,.

Acs, G., and M. A. Turner, 2008: *Making Work Pay Enough A Decent Standard of Living for Working Families*. 21 pp. http://www.urban.org/url.cfm?ID=411711 (Accessed November 4, 2019).

Adema, W., 2006: *Social Assistance Policy Development and the Provision of a Decent Level of Income in Selected OECD Countries*.

Adger, W. N., 2003: Social capital, collective action, and adaptation to climate change. *Econ. Geogr.*, **79**(4), 387–404, doi:10.1111/j.1944-8287.2003.tb00220.x.

Ahmad, S., G. Baiocchi, and F. Creutzig, 2015: CO2 Emissions from Direct Energy Use of Urban Households in India. *Environ. Sci. Technol.*, **49**(19), 11312–11320, doi:10.1021/es505814g.

Ajzen, I., 1991: The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.*, **50**(2), 179–211, doi:10.1016/0749-5978(91)90020-T.

Akenji, L., 2014: Consumer scapegoatism and limits to green consumerism. *J. Clean. Prod.*, **63**, 13–23, doi:10.1016/j.jclepro.2013.05.022.

Ameli, N., and N. Brandt, 2015: Determinants of households' investment in energy efficiency and renewables: evidence from the OECD survey on household environmental behaviour and attitudes. *Environ. Res. Lett.*, **10**(4), doi:10.1088/1748-9326/10/4/044015.

Anderson, C. R., R. Binimelis, M. P. Pimbert, and M. G. Rivera-Ferre, 2019: Introduction to the symposium on critical adult education in food movements: learning for transformation in and beyond food movements—the why, where, how and the what next? *Agriculture and Human Values*.

Andrews-Speed, P., 2016: Applying institutional theory to the low-carbon energy transition. *Energy Res. Soc. Sci.*, **13**, 216–225, doi:10.1016/j.erss.2015.12.011.

Anenberg, S. C. et al., 2017: Air pollution-related health and climate benefits of clean cookstove programs in Mozambique. *Environ. Res. Lett.*, **12**(2), doi:10.1088/1748-9326/aa5557.

Antony, G. M., and K. Visweswara Rao, 2007: A composite index to explain variations in poverty, health, nutritional status and standard of living: Use of multivariate statistical methods. *Public Health*, **121**(8), 578–587, doi:10.1016/j.puhe.2006.10.018.

Arent, D. J. et al., 2015: Key economic sectors and services. In: *Climate Change 2014 Impacts, Adaptation and Vulnerability: Part A: Global and Sectoral Aspects*, Cambridge University Press, pp. 659–708.

Arrow, K. J., P. Dasgupta, L. H. Goulder, K. J. Mumford, and K. Oleson, 2013: Sustainability and the measurement of wealth: further reflections. *Environ. Dev. Econ.*, **18**(4), 504–516, doi:10.1017/s1355770x13000193.

Arthur, B., 1989: Competing technologies, increasing returns, and lock-in by historical events. *Econ. J.*, **99**(394), 116–131, doi:10.2307/2234208.

Atanassov, B., 2010: Socio-cultural dimensions in household cooking energy choice: Implications for energy transition in Catembe, Mozambique. Department of Human Geography, Stockholm University, 95 pp. www.humangeo.su.se.

Ausubel, J. H., 1991: Rat-race dynamics and crazy companies. The diffusion of technologies and social behavior. *Technol. Forecast. Soc. Change*, **39**(1–2), 11–22, doi:10.1016/0040-1625(91)90025-B.

Axsen, J., J. TyreeHageman, and A. Lentz, 2012: Lifestyle practices and pro-environmental technology.

Ecol. Econ., **82**, 64–74, doi:10.1016/j.ecolecon.2012.07.013.

Baiocchi, G., F. Creutzig, J. Minx, and P.-P. Pichler, 2015: A spatial typology of human settlements and their CO 2 emissions in England. *Glob. Environ. Chang.*, **34**, 13–21.

Ball, R., and K. Chernova, 2008: Absolute Income, Relative Income, and Happiness. *Soc. Indic. Res.*, **88**(3), 497–529, doi:10.1007/s11205-007-9217-0.

Balmer, M., 2007: Energy poverty and cooking energy requirements: The forgotten issue in South African energy policy? *J. Energy South. Africa*, **18**(3), 4–9, doi:10.17159/2413-3051/2007/v18i3a3380.

Bamberg, S., M. Hunecke, and A. Blöbaum, 2007a: Social context, personal norms and the use of public transportation: Two field studies. *J. Environ. Psychol.*, **27**(3), 190–203, doi:10.1016/J.JENVP.2007.04.001.

Bamberg, S., G. Möser, and G. M. Mo¨ser, 2007b: Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *J. Environ. Psychol.*, **27**(1), 14–25, doi:10.1016/j.jenvp.2006.12.002.

Bamberg, S., J. Rees, and S. Seebauer, 2015: Collective climate action: Determinants of participation intention in community-based pro-environmental initiatives. *J. Environ. Psychol.*, **43**, 155–165, doi:10.1016/j.jenvp.2015.06.006.

Barnes, W., M. Gartland, and M. Stack, 2004: Old habits die hard: Path dependency and behavioral lock-in. *J. Econ. Issues*, **38**(2), 371–377, doi:10.1080/00213624.2004.11506696.

Barnett, J., K. Burningham, G. Walker, and N. Cass, 2012: Imagined publics and engagement around renewable energy technologies in the UK. *Public Underst. Sci.*, **21**(1), 36–50, doi:10.1177/0963662510365663.

Barr, S., and A. Gilg, 2006: Sustainable lifestyles: Framing environmental action in and around the home. *Geoforum*, **37**(6), 906–920, doi:10.1016/j.geoforum.2006.05.002.

Barr, S., G. Shaw, and T. Coles, 2011: Sustainable lifestyles: Sites, practices, and policy. *Environ. Plan. A*, **43**(12), 3011–3029, doi:10.1068/a43529.

Batchelor, S. et al., 2018: Solar electric cooking in Africa: Where will the transition happen first? *Energy Res. Soc. Sci.*, **40**, 257–272, doi:10.1016/j.erss.2018.01.019.

Batchelor, S., E. Brown, N. Scott, and J. Leary, 2019: Two birds, one stone-reframing cooking energy policies in Africa and Asia. *Energies*, **12**(9), 1591, doi:10.3390/en12091591.

Batel, S., 2018: A critical discussion of research on the social acceptance of renewable energy generation and associated infrastructures and an agenda for the future. *J. Environ. Policy Plan.*, **20**(3), 356–369, doi:10.1080/1523908X.2017.1417120.

Battilana, J., B. Leca, and E. Boxenbaum, 2009: 2 How Actors Change Institutions: Towards a Theory of Institutional Entrepreneurship. *Acad. Manag. Ann.*, **3**(1), 65–107, doi:10.1080/19416520903053598.

Bayus, B. L., 1994: Are product life cycles really getting shorter? *J. Prod. Innov. Manag.*, **11**(4), 300–308, doi:10.1016/0737-6782(94)90085-X.

Beattie, G., and L. Sale, 2009: Explicit and Implicit Attitudes to Low and High Carbon Footprint Products. *Int. J. Environ. Cult. Econ. Soc. Sustain. Annu. Rev.*, **5**(4), 191–206, doi:10.18848/1832-2077/cgp/v05i04/54652.

Beckage, B. et al., 2018: Linking models of human behaviour and climate alters projected climate change. *Nat. Clim. Chang.*, **8**, 79–84, doi:10.1038/s41558-017-0031-7.

Becker, G. S., 2013: *The Economic Approach to Human Behavior*. University of Chicago Press, Chicago, 314 pp.

Becker, G. S., and K. M. Murphy, 2000: Fad, fashion and norm. In: *Social economics : Market behavior* *in a social environment* [Becker, G.S. and K.M. Murphy, (eds.)], Belknap Press of Harvard University Press, p. pp. 170.

Belk, R., 2014a: You are what you can access: Sharing and collaborative consumption online. *J. Bus. Res.*, **67**(8), 1595–1600, doi:https://doi.org/10.1016/j.jbusres.2013.10.001.

Belk, R., 2014b: Sharing versus pseudo-sharing in web 2.0. *Anthropologist*, **18**(1), 7–23, doi:10.1080/09720073.2014.11891518.

Belk, R. W., 1988: Possessions and the Extended Self. *J. Consum. Res.*, **15**(2), 139–168, doi:10.1086/209154.

Bell, D., T. Gray, C. Haggett, and J. Swaffield, 2013: Re-visiting the "social gap": Public opinion and relations of power in the local politics of wind energy. *Env. Polit.*, **22**(1), 115–135, doi:10.1080/09644016.2013.755793.

Bello, M. O., S. A. Solarin, and Y. Y. Yen, 2018: The impact of electricity consumption on CO2 emission, carbon footprint, water footprint and ecological footprint: The role of hydropower in an emerging economy. *J. Environ. Manage.*, **219**, 218–230, doi:10.1016/j.jenvman.2018.04.101.

Beltramo, T., G. Blalock, D. I. Levine, and A. M. Simons, 2015: Does peer use influence adoption of efficient cookstoves? Evidence from a randomized controlled trial in uganda *J. Health Commun.*, **20**, 55–66, doi:10.1080/10810730.2014.994244.

Bento, N., 2013: *New Evidence in Technology Scaling Dynamics and the Role of the Formative Phase*. , Laxenburg, Austria, 45 pp. http://pure.iiasa.ac.at/id/eprint/10752/

Bento, N., C. Wilson, and L. D. Anadon, 2018: Time to get ready: Conceptualizing the temporal and spatial dynamics of formative phases for energy technologies. *Energy Policy*, **119**(May), 282–293, doi:10.1016/j.enpol.2018.04.015.

Bergh, A., and C. Bjørnskov, 2014: Trust, welfare states and income equality: Sorting out the causality. *Eur. J. Polit. Econ.*, **35**, 183–199 doi:10.1016/j.ejpoleco.2014.06.002.

Berkhout, F., 2002: Technological regimes, path dependency and the environment. *Glob. Environ. Chang.*, **12**, 1–4, doi:10.1016/s0959-3780(0)00025-5.

Bhattacharya, S., and M. L Cropper, 2010: *Options for Energy Efficiency in India and Barriers to Their Adoption A Scoping Study Options for Energy Efficiency in India and Barriers to Their Adoption*. Resources for the Future (RfF) Press, Washington DC, 38 pp. https://media.rff org/documents/RFF-DP-10-20.pdf.

Bhattacharya, S. C., and C. Jana, 2009: Renewable energy in India: Historical developments and prospects *Energy*, **34**(8), 981–991, doi:10.1016/j.energy.2008.10.017.

Bhattarai D., E. Somanathan, and M. Nepal, 2018: Are renewable energy subsidies in Nepal reaching the poor? *Energy Sustain. Dev.*, **43**, 114–122, doi:10.1016/J.ESD.2018.01.001.

Bianchi, F., E. Garnett, C. Dorsel, P. Aveyard, and S. A. Jebb, 2018: Restructuring physical micro-environments to reduce the demand for meat: a systematic review and qualitative comparative analysis *Lancet Planet. Heal.*, **2**(9), e384–e397, doi:10.1016/S2542-5196(18)30188-8.

Biddau, F., A. Armenti, and P. Cottone, 2016: Socio-psychological aspects of grassroots participation in the transition movement: An Italian case study. *J. Soc. Polit. Psychol.*, **4**(1), 142–165, doi:10.5964/jspp.v4i1.518.

Bielecki, C., and G. Wingenbach, 2014: Rethinking improved cookstove diffusion programs: A case study of social perceptions and cooking choices in rural Guatemala. *Energy Policy*, **66**, 350–358, doi:10.1016/j.enpol.2013.10.082.

Bierwirth, A., and S. Thomas, 2019: *Estimating the sufficiency potential in buildings: the space between under-dimensioned and oversized*. https://ec.europa.eu/eurostat/.

Bin, S., and H. Dowlatabadi, 2005: Consumer lifestyle approach to US energy use and the related CO2 emissions. *Energy Policy*, **33**(2), 197–208, doi:10.1016/S0301-4215(03)00210-6.

Björnberg, K. E., M. Karlsson, M. Gilek, and S. O. Hansson, 2017: Climate and environmental science denial: A review of the scientific literature published in 1990–2015. *J. Clean. Prod.*, **167**, 229–241, doi:10.1016/J.JCLEPRO.2017.08.066.

Bluffstone, R. A. et al., 2021: Does Providing Improved Biomass Cooking Stoves Free-of-Charge Reduce Regular Usage? Do Use Incentives Promote Habits? *Land Econ.*, **97**(1), 180–195, doi:10.3368/WPLE.97.1.060818-0077R1.

Böcker, L., and T. Meelen, 2017: Sharing for people, planet or profit? Analysing motivations for intended sharing economy participation. *Environ. Innov. Soc. Transitions*, **23**, 28–39, doi:10.1016/J.EIST.2016.09.004.

Bohnsack, R., J. Pinkse, and A. Waelpoel, 2016: The institutional evolution process of the global solar industry: The role of public and private actors in creating institutional shifts. *Environ. Innov. Soc. Transitions*, **20**, 16–32, doi:10.1016/j.eist.2015.10.006.

Bomberg, E., and A. Hague, 2018: Faith-based climate action in Christian congregations: mobilisation and spiritual resources. *Local Environ.*, **23**(5), 582–596, doi:10.1080/13549839.2018.1449822.

Bonjour, S. et al., 2013: Solid fuel use for household cooking: Country and regional estimates for 1980-2010. *Environ. Health Perspect.*, **121**(7), 784–790, doi:10 1289/ehp.1205987.

Bosman, R., D. Loorbach, N. Frantzeskaki, and T. Pistorius, 2014: Discursive egime dynamics in the Dutch energy transition. *Environ. Innov Soc. Transitions*, **13**, 45–59, doi:10.1016/j.eist.2014.07.003.

Botsman, R., and R. Rogers, 2011: *What's mine is yours: how collaborative consumption is changing the way we live*. Collins, 280 pp.

Brand-Correa, L. I., and J. K. Steinberger, 2017: A Framework for Decoupling Human Need Satisfaction From Energy Use. *Ecol. Econ.*, **141**, 43–52, doi:10.1016/j.ecolecon.2017.05.019.

Brockway, P. et al., 2017: Energy Rebound as a Potential Threat to a Low-Carbon Future: Findings from a New Exergy-Based National-Level Rebound Approach. *Energies*, **10**(1), 51, doi:10.3390/en10010051.

Buchanan, M., P. Godfrey, and E. Kaufman, 2020: Gender and Environmental Studies. *Companion to Women's Gend Stud.*, , 365–383, doi:10.1002/9781119315063.CH19.

Bulkeley, H., V. Castán Broto, and A. Maassen, 2014: Low-carbon Transitions and the Reconfiguration of Urban Infrastructure. *Urban Stud.*, **51**(7), 1471–1486, doi:10.1177/0042098013500089.

Bullock, C., D Joyce, and M. Collier, 2018: An exploration of the relationships between cultural eco ystem services, socio-cultural values and well-being. *Ecosyst. Serv.*, **31**, 142–152, doi:10.1016/j.ecoser.2018.02.020.

Burningham, K 2000: Using the language of NIMBY: A topic for research, not an activity for researchers. *Local Environ.*, **5**(1), 55–67, doi:10.1080/135498300113264.

Burningham, K., J. Barnett, and G. Walker, 2015: An Array of Deficits: Unpacking NIMBY Discourses in Wind Energy Developers' Conceptualizations of Their Local Opponents. *Soc. Nat. Resour.*, **28**(3), 246–260, doi:10.1080/08941920.2014.933923.

Buschmann, P., and A. Oels, 2019: The overlooked role of discourse in breaking carbon lock-in: The case of the German energy transition. *Wiley Interdiscip. Rev. Clim. Chang.*, **10**(e574), 1–14, doi:10.1002/wcc.574.

Carter, N., and M. Jacobs, 2014: Explaining radical policy change: The case of climate change and energy policy under the British labour government 2006-10. *Public Adm.*, **92**(1), 125–141, doi:10.1111/padm.12046.

Cass, N., T. Schwanen, and E. Shove, 2018: Infrastructures, intersections and societal transformations.

Technol. Forecast. Soc. Change, **137**, 160–167, doi:10.1016/J.TECHFORE.2018.07.039.

Cha, J. M., 2020: A just transition for whom? Politics, contestation, and social identity in the disruption of coal in the Powder River Basin. *Energy Res. Soc. Sci.*, **69**, 101657, doi:10.1016/J.ERSS.2020.101657.

Chakravarty, D., S. Dasgupta, and J. Roy, 2013: Rebound effect: How much to worry? *Curr. Opin. Environ. Sustain.*, **5**(2), 216–228, doi:http://dx.doi.org/10.1016/j.cosust.2013.03.001.

Chattopadhyay, M., T. H. Arimura, H. Katayama, S. Mari, and H. Yokoo, 2017: Cooking Fuel Choices—Analysis of Socio-economic and Demographic Factors in Rural India. *Environ. Sci.*, **30**(2), 131–140, doi:10.11353/sesj.30.131.

Chen, C. et al., 2019: Energy consumption and carbon footprint accounting of urban and rural residents in Beijing through Consumer Lifestyle Approach. *Ecol. Indic.*, **98**(April 2018), 575–586, doi:10.1016/j.ecolind.2018.11.049.

Chen, G., T. Wiedmann, M. Hadjikakou, and H. Rowley, 2016: City Carbon Footprint Networks. *Energies*, **9**(8), 602, doi:10.3390/en9080602.

Cherry, E., 2006: Veganism as a Cultural Movement: A Relational Approach. *Soc. Mov. Stud.*, **5**(2), 155–170, doi:10.1080/14742830600807543.

Cheung, F., and R. E. Lucas, 2016: Income inequality is associated with stronger social comparisons: the effect of relative income on life satisfaction. , 332–341

Choy, Y. K., 2018: Cost-benefit Analysis, Values, Wellbeing and Ethics: An Indigenous Worldview Analysis. *Ecol. Econ.*, **145**, 1–9, doi:10.1016/j.ecolecon.2017.08.005.

Cialdini, R. B., 2006: *Influence: The psychology of persuasion*. Herper Collins New York, 173–174 pp.

Clarke, L., and C. Lipsig-Mummé, 2020: Future conditional: From just transition to radical transformation?: *Eur. J. Ind. Relations*, **26**(4), 351–366, doi:10.1177/0959680120951684.

Clausen, J., E. Göll, and V. Tappeser, 2017: Sticky Transformation – How path dependencies in socio-technical regimes are impeding the transformation to a Green Economy. *J. Innov. Manag.*, **5**(2), 111–138, doi:10.1007/BF00727536.

Comin, D., and B. Hobijn, 2003: *Cross-country technology adoption: Making the theories face the facts*. , New York, USA, USA, 49 pp. http://hdl.handle.net/10419/60558.

Comin, D., and B. Hobijn, 2010: An exploration of technology diffusion. *Am. Econ. Rev.*, **100**(5), 2031–2059, doi:10.1257/aer.100.5.2031.

Constantino, S. M., M. Schlüter, E. U. Weber, and N. Wijermans, 2021: Behavior in context: Towards a comprehensive selection and taxonomy of behavioral theories for socio-ecological systems research. *Sustain. Sci.*, **In Press**.

Cooper, C. L., Y. Liu, and S. Y. Tarba, 2014: Resilience, HRM practices and impact on organizational performance and employee well-being. *Int. J. Hum. Resour. Manag.*, **25**(17), 2466–2471, doi:10.1080/09585192.2014.926688.

Court, V., and S. Sorrell, 2020: Digitalisation of goods: A systematic review of the determinants and magnitude of the impacts on energy consumption. *Environ. Res. Lett.*, **15**(4), doi:10.1088/1748-9326/ab6788.

CPUC, 1983: Approval of Interim Standard Offer No.4 for PG&E, SCE, and SDG&E based on the results of a Negotiating Conference. *Decision*, **83-09–054**.

Creutzig, F. et al., 2016: Beyond technology: demand-side solutions for climate change mitigation. *Annu. Rev. Environ. Resour.*, **41**(1), 173–198, doi:10.1146/annurev-environ-110615-085428.

Creutzig, F. et al., 2017: The underestimated potential of solar energy to mitigate climate change. *Nat. Energy*, **2**(9), doi:10.1038/nenergy.2017.140.

Creutzig, F. et al., 2018: Towards demand-side solutions for mitigating climate change. *Nat. Clim. Chang.*, **8**(4), 260–263, doi:10.1038/s41558-018-0121-1.

Creutzig, F. et al., 2021a: A typology of 100,000 publications on demand, services and social aspects of climate change mitigation. *Environ. Res. Lett.*, **16**(3), 033001, doi:10.1088/1748-9326/abd78b.

Creutzig, F. et al., 2021b: Demand-side solutions to climate change mitigation consistent with high levels of wellbeing. *Nat. Clim. Chang.*, **Accepted**.

Currie, G., and D. Spyridonidis, 2016: Interpretation of Multiple Institutional Logics on the Ground: Actors' Position, their Agency and Situational Constraints in Professionalized Contexts. *Organ. Stud.*, **37**(1), 77–97, doi:10.1177/0170840615604503.

D'Ambrosio, C., and J. R. Frick, 2012: Individual Wellbeing in a Dynamic Perspective. *Economica*, **79**(314), 284–302, doi:10.1111/j.1468-0335.2011.00896.x.

Daioglou, V., B. J. van Ruijven, and D. P. van Vuuren, 2012: Model projections for household energy use in developing countries. *Energy*, **37**(1), 601–615, doi:10.1016/j.energy.2011.10.044

Darby, S., 2007: *Enough is as good as a feast sufficiency as policy*. 111–119 pp. https://ora-ox-ac-uk.ezproxy.library.yorku.ca/objects/uuid:3bc3d450-2c5a-45d4-92cf 8a4afb47249d/download_file?file_format=pdf&safe_filename=1 255_Darby.pdf&type_of_work =Conference+item (Accessed August 28, 2020).

Darby, S., and T. Fawcett, 2018: *Energy sufficiency an introduc ion Concept paper*. https://www.energysufficiency.org/static/media/uploads/site-8/library/papers/sufficiency-introduction-final-oct2018.pdf (Accessed Decemb r 16, 2019)

Darnton, A., B. Verplanken, P. White, and L. Whitmarsh, 2011: *Habits , Routines and Sustainable Lifestyles Summary Report A research report completed for the Department for Environment , Food*. 71 pp. file:///C:/U ers/gyma/OneDrive - Loughborough University/Lifestyle_Lowcarbon/Lifestyle_references/Darnton etal (2011) Habits, Routines and Sustainable Lifestyles A summary report to DEFRA pdf.

Dasgupta, A., and P. Dasgupta 2017 Socially Embedded Preferences, Environmental Externalities, and Reproductive Rights. *Popul Dev. R v.*, **43**(3), 405–441, doi:10.1111/padr.12090.

Dasgupta, P., 2001: *Human Well-Being and the Natural Environment*. Oxford University Press, Oxford, 328 pp.

Dasgupta, P., 2013: The Nature of Economic Development and the Economic Development of Nature. *Econ. Polit Wkly* **48**(51)

Dasgupta, P 2014: Pricing climate change. *Polit. Philos. Econ.*, **13**(4), 394–416, doi 10.1177/1470594X14541521.

Dasgupta, P. et al., 2015: How to measure sustainable progress. *Science* , **350**(6262), 748–748, doi:10.1126/scienc 350.6262.748.

Davis, F. D., 1989: Perceived Usefulness, Perceived Ease Of Use, And User Acceptance of Information Technology. *MIS Q.*, **13**(3), 319–340, doi:10.2307/249008.

Davis, S., 1979: *The Diffusion of Process Innovations*. Cambridge University Press, Cambridge, UK, UK, 193 pp.

De Dominicis, S., R. Sokoloski, C. M. Jaeger, and P. W. Schultz, 2019: Making the smart meter social promotes long-term energy conservation. *Palgrave Commun.*, **5**(1), 1–8, doi:10.1057/s41599-019-0254-5.

De Rubens, Z. G., L. Noel, and B. K. Sovacool, 2018: Dismissive and deceptive car dealerships create barriers to electric vehicle adoption at the point of sale. *Nat. Energy*, **3**, 501–507, doi:10.1038/s41560-018-0152-x.

De Vries, G. W., W. P. C. Boon, and A. Peine, 2016: User-led innovation in civic energy communities.

Environ. Innov. Soc. Transitions, **19**, 51–65, doi:10.1016/j.eist.2015.09.001.

DEFRA, 2011: *Sustainable Lifestyles Framework*. 33 pp. file:///C:/Users/gyma/OneDrive - Loughborough University/Lifestyle_Lowcarbon/Lifestyle_references/DEFRA (2011)Sustainable_lifestyles_framework.pdf.

Delhey, J., and G. Dragolov, 2014: Why Inequality Makes Europeans Less Happy: The Role of Distrust, Status Anxiety, and Perceived Conflict. *Eur. Sociol. Rev.*, **30**(2), 151–165, doi:10.1093/esr/jct033.

Delmas, M. A., and V. C. Burbano, 2011: The Drivers of Greenwashing. *Calif. Manage. Rev.*, **54**(1), 64–87, doi:10.1525/cmr.2011.54.1.64.

Demski, C., C. Butler, K. A. Parkhill, A. Spence, and N. F. Pidgeon, 2015: Public values for energy system change. *Glob. Environ. Chang.*, **34**, 59–69, doi:10.1016/j.gloenvcha.2015.06.014.

Dendup, N., and T. H. Arimura, 2019: Information leverage: The adoption of clean cooking fuel in Bhutan. *Energy Policy*, **125**, 181–195, doi:10.1016/j.enpol.2018.10.054.

Devine-Wright, P., 2005: Beyond NIMBYism: Towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy*, **8**(2), 125–139, doi:10.1002/we.124

Devine-Wright, P., 2007: Energy citizenship: psychological aspects of evolution in sustainable energy technologies. In: *Governing Technology for Sustainability* [Joseph, M., (ed)], Earthscan, London, p. pp. 24.

Devine-Wright, P., 2009: Rethinking NIMBYism: The role of place attachment and place identity in explaining place-protective action. *J. Community Appl. Soc Psychol.*, **19**(6), 426–441, doi:10.1002/casp.1004.

Devine-Wright, P., 2011: Public engagement with large scale renewable energy technologies: Breaking the cycle of NIMBYism. *Wiley Interdiscip. Rev. Clim. Chang.*, **2**(1), 19–26, doi:10.1002/wcc.89.

Devine-Wright, P., and Y. Howes, 2010: Disruption to place attachment and the protection of restorative environments: A wind energy case study. *J. Environ. Psychol.*, **30**(3), 271–280, doi:10.1016/j.jenvp.2010.01.008.

Di Gregorio, M. et al., 2019: Multi-level governance and power in climate change policy networks. *Glob. Environ. Chang.*, **54**, 64–77, doi:10.1016/j.gloenvcha.2018.10.003.

Dibb, S., and I. Fitzpatrick, 2014: *Let's talk about meat: changing dietary behaviour for the 21st century*. 32 pp. https://www.eating-better.org/uploads/Documents/LetsTalkAboutMeat.pdf (Accessed December 10, 2019).

Dickinson, K. L. et al., 2018: Prices, peers, and perceptions (P3): Study protocol for improved biomass cookstove project in northern Ghana. *BMC Public Health*, **18**(1), 1209, doi:10.1186/s12889-018-6116-z.

Diener, E., L. Tay, and S. Oishi, 2013: Rising income and the subjective well-being of nations. *J. Pers. Soc. Psychol.*, **104**(2), 267–276, doi:10.1037/a0030487.

Ding, Q., W. Cai, C. Wang, and M. Sanwal, 2017: The relationships between household consumption activities and energy consumption in china— An input-output analysis from the lifestyle perspective. *Appl. Energy*, **207**, 520–532, doi:10.1016/j.apenergy.2017.06.003.

Dittmar, H., 2008: *Consumer culture, identity and well-being : the search for the "good life" and the "body perfect."* Psychology Press, Hove, 271 pp.

Dolata, U., 2009: Technological innovations and sectoral change. Transformative capacity, adaptability, patterns of change: An analytical framework. *Res. Policy*, **38**(6), 1066–1076, doi:10.1016/j.respol.2009.03.006.

Dombrowski, U., S. Ernst, and A. Reimer, 2016: A New Training for Factory Planning Engineers to Create Awareness of Climate Change. *Procedia CIRP*, **48**, 443–448, doi:10.1016/j.procir.2016.04.083.

Doyal, L., and I. Gough, 1991: Introduction. In: *A Theory of Human Need*, Palgrave, London, pp. 1–2.

Dracker, R., and P. De Laquil III, 1996: Progress Commercializing Solar-Electric Power Systems. *Annu. Rev. Energy Environ.*, **21**(1), 371–402, doi:10.1146/annurev.energy.21.1.371.

Dubois, G. et al., 2019: It starts at home? Climate policies targeting household consumption and behavioral decisions are key to low-carbon futures. *Energy Res. Soc. Sci.*, **52**, 144–158, doi:10.1016/j.erss.2019.02.001.

Easterlin, R. A., L. A. McVey, M. Switek, O. Sawangfa, and J. S. Zweig, 2010: The happiness-income paradox revisited. *Proc. Natl. Acad. Sci. U. S. A.*, **107**(52), doi:10.1073/pnas.1015962107.

Ebeling, F., and S. Lotz, 2015: Domestic uptake of green energy promoted by opt-out tariffs. *Nat. Clim. Chang.*, **5**(9), 868–871, doi:10.1038/nclimate2681.

Espe, E., V. Potdar, and E. Chang, 2018: Prosumer communities and relationships in smart grids: A literature review, evolution and future directions. *Energies*, **11**(10), doi:10.3390/en11102528.

Estrada-Oyuela, R. A., 2000: *Climate Change Mitigation and Equity*. [Pichs, R., R. Swart, N. Leary, and F. Ormond, (eds.)]. , Havana, Cuba,.

Etminani-Ghasrodashti, R., M. Paydar, and A. Ardeshiri, 2018: Recreational cycling in a coastal city: Investigating lifestyle, attitudes and built environment in cycling behavior. *Sustain. Cities Soc.*, **39**(February), 241–251, doi:10.1016/j.scs.2018.02.037.

Eyre, N., and G. Killip, 2019: *Shifting the focus: energy demand in a net-zero carbon UK*. https://www.creds.ac.uk/publications/shifting-the-focus-energy-demand-in-a-net-zero-carbon-uk/ (Accessed December 16, 2019).

Faber, J. et al., 2012: *Behavioural Climate Change Mitigation Options and Their Appropriate Inclusion in Quantitative Longer Term Policy Scenarios*. CE Delft, Delft, Netherlands, 87 pp. http://publications.europa.eu/resource/cellar/d9f5683a-b330-47c4-beac-d4d4f5dec681.0001.07/DOC_1.

Farrow, K., G. Grolleau, and L. Ibanez, 2017: Social Norms and Pro-environmental Behavior: A Review of the Evidence. *Ecol. Econ.*, **140**, 1–13, doi:10.1016/j.ecolecon.2017.04.017.

Fawcett, T., and S. Darby, 2019: *Energy sufficiency in policy and practice: the question of needs and wants*. , Oxford, 2–226 pp. http://www.oxfordlearnersdictionaries.com/definition/english/sufficiency (Accessed December 21, 2020).

Fell, M. J., A. Schneiders, and D. Shipworth, 2019: Consumer Demand for Blockchain-Enabled Peer-to-Peer Electricity Trading in the United Kingdom: An Online Survey Experiment. *Energies*, **12**(20), 3913, doi:10.3390/en12203913.

Fenner, A. E. et al., 2018: The carbon footprint of buildings: A review of methodologies and applications. *Renew. Sustain. Energy Rev.*, **94**, 1142–1152, doi:10.1016/j.rser.2018.07.012.

Ferguson, J., T. R. Sales de Aguiar, and A. Fearfull, 2016: Corporate response to climate change: language, power and symbolic construction,. *Accounting, Audit. Account. J.*, **29**(2), 278–304, doi:http://dx.doi.org/10.1108/MRR-09-2015-0216.

Ferrer-Balas, D., H. Buckland, and M. de Mingo, 2009: Explorations on the University's role in society for sustainable development through a systems transition approach. Case-study of the Technical University of Catalonia (UPC). *J. Clean. Prod.*, **17**(12), 1075–1085, doi:10.1016/J.JCLEPRO.2008.11.006.

Fielding, K. S., and M. J. Hornsey, 2016: A social identity analysis of climate change and environmental attitudes and behaviors: Insights and opportunities. *Front. Psychol.*, **7**(February), 1–12, doi:10.3389/fpsyg.2016.00121.

Fioramonti, L., L. Coscieme, and L. F. Mortensen, 2019: From gross domestic product to wellbeing: How alternative indicators can help connect the new economy with the Sustainable Development

Goals. *Anthr. Rev.*, **6**(3), 207–222, doi:10.1177/2053019619869947.

Fisher, P. B., and E. McAdams, 2015: Gaps in sustainability education. *Int. J. Sustain. High. Educ.*, **16**(4), 407–423, doi:10.1108/IJSHE-08-2013-0106.

Forouli, A., A. Nikas, D. J. Van de Ven, J. Sampedro, and H. Doukas, 2020: A multiple-uncertainty analysis framework for integrated assessment modelling of several sustainable development goals. *Environ. Model. Softw.*, **131**, 104795, doi:10.1016/J.ENVSOFT.2020.104795.

Fouquet, R., 2008: *Heat, power and light: revolutions in energy services*. Edward Elgar Publishing, Cheltenham, UK, UK, 470 pp.

Frank, R. H., 1999: *Luxury Fever : Weighing the Cost of Excess*. Princeton University Press,.

Frantzeskaki, N., and D. Loorbach, 2008: Infrastructures in transition role and response of infrastructures in societal transitions. *2008 1st International Conference on Infrastructure Systems and Services: Building Networks for a Brighter Future, INFRA 2008*.

Freire-González, J., 2021: Governing Jevons' Paradox: Policies and systemic alternatives to avoid the rebound effect. *Energy Res. Soc. Sci.*, **72**, 101893, doi:10.1016/J.ERSS.2020.101893.

Frenkel, A., E. Bendit, and S. Kaplan, 2013: The linkage between the life style of knowledge-workers and their intra-metropolitan residential choice: A clustering approach based on self-organizing maps. *Comput. Environ. Urban Syst.*, **39**, 151–161, doi:10.1016/j.compenvurbsys.2012.09.001.

Frenken, K., and J. Schor, 2017: Putting the sharing economy into perspective. *Environ. Innov. Soc. Transitions*, **23**, 3–10, doi:10.1016/j.eist.2017.01.003.

Frye, I., 2013: *Towards a Decent Living Level*. 18 pp. https://dslnow.net/wp-content/uploads/2019/06/Policy-Brief-2.pdf (Accessed November 4, 2019).

Gabaix, X., and D. Laibson, 2018: Shrouded attributes, consumer myopia and information suppression in competitive markets. In: *Handbook of Behavioral Industrial Organization*, Edward Elgar Publishing.

Gabriel, C. A., and C. Bond, 2019: Need, Entitlement and Desert: A Distributive Justice Framework for Consumption Degrowth. *Ecol. Econ.*, **156**, 327–336, doi:10.1016/j.ecolecon.2018.10.006.

Gardner, B., and C. Abraham, 2008: Psychological correlates of car use: A meta-analysis. *Transp. Res. Part F Traffic Psychol. Behav.*, **11**(4), 300–311, doi:10.1016/j.trf.2008.01.004.

Garnett, T., S. Mathewson, P. Angelides, F. Borthwick, and C. House, 2015: *Policies and actions to shift eating patterns: What works?* 85 pp. https://www.fcrn.org.uk/sites/default/files/fcrn_chatham_house_0.pdf.

Geels, F. W., 2002: Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Res. Policy*, **31**(8–9), 1257–1274, doi:10.1016/S0048-7333(02)00062-8.

Geels, F. W., and B. Verhees, 2011: Cultural legitimacy and framing struggles in innovation journeys: A cultural performative perspective and a case study of Dutch nuclear energy (1945-1986). *Technol. Forecast. Soc. Change*, **78**(6), 910–930, doi:10.1016/j.techfore.2010.12.004.

Geels, F. W., B. K. Sovacool, T. Schwanen, and S. Sorrell, 2017a: Sociotechnical transitions for deep decarbonization. *Science* , **357**(6357), 1242–1244, doi:10.1126/science.aao3760.

Geels, F. W., B. K. Sovacool, T. Schwanen, and S. Sorrell, 2017b: Sociotechnical transitions for deep decarbonization. *Science* , **357**(6357), 1242–1244, doi:10.1126/science.aao3760.

Geels, F. W. F. W., 2014: Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. *Theory, Cult. Soc.*, **31**(5), 21–40, doi:10.1177/0263276414531627.

Geiger, J. L., L. Steg, E. van der Werff, and A. B. Ünal, 2019: A meta-analysis of factors related to recycling. *J. Environ. Psychol.*, **64**(March), 78–97, doi:10.1016/j.jenvp.2019.05.004.

George-Ufot, G., Y. Qu, and I. J. Orji, 2017: Sustainable lifestyle factors influencing industries' electric consumption patterns using Fuzzy logic and DEMATEL: The Nigerian perspective. *J. Clean. Prod.*, **162**, 624–634, doi:10.1016/j.jclepro.2017.05.188.

Ghilardi, A., A. Tarter, and R. Bailis, 2018: Potential environmental benefits from woodfuel transitions in Haiti: Geospatial scenarios to 2027. *Environ. Res. Lett.*, **13**(3), doi:10.1088/1748-9326/aaa846.

Ghosh, A., 2016: *The great derangement*. University of Chicago Press, 182 pp.

Ghosh, B., 2019: Transformation beyond experimentation Sustainability transitions in megacities. University of Sussex, 246 pp. http://sro.sussex.ac.uk/id/eprint/82511/ (Accessed December 10, 2019).

Ghosh, B., and S. Arora, 2019: *Smart as Democratically Transformative? An Analysis of "Smart City" Sociotechnical Imaginary in India*. ESRC Steps Centre, https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/14670 (Accessed December 3, 2020).

Ghosh, B., and J. Schot, 2019: Towards a novel regime change framework: Studying mobility transitions in public transport regimes in an Indian megacity. *Energy Res. Soc. Sci* **51**, 82–95, doi:10.1016/J.ERSS.2018.12.001.

Ghosh, D. et al., 2018: Urban mobility experiments in India and Thailand. In: *The Experimental City* [Evans, J., A. Karvonen, and R. Raven, (eds.)], Routledge pp. 122–136.

Giddens, A., 1991: *Modernity and self-identity: Self and society in the late modern age*. Stanford University Press, Stanford, 70–108 pp.

Giri, A., and A. Aadil, 2018: *Pradhan Mantri Ujjwala Yojana: A demand-side diagnostic study of LPG refills Policy brief www.microsave.net*. www.microsave.net (Accessed December 3, 2020).

Göckeritz, S. et al., 2010: Descriptive mormative belief and conservative behaviour: The moderating roles of personal involvement and injunctive normative belief. *Eur. J. Soc. Psychol.*, **40**, 514–523, doi:10.1002/ejsp.643.

Godfray, H. et al., 2018: Meat consumption, health, and the environment. *Science* , **361**(6399), doi:10.1126/science.aam5324.

Goldemberg, J., J. Martinez-Gomez, A. Sagar, and K. R. Smith, 2018: Household air pollution, health, and climate change: Cleaning the air. *Environ. Res. Lett.*, **13**(3), doi:10.1088/1748-9326/aaa49d.

González-García, S., X. Esteve-Llorens, M. T. Moreira, and G. Feijoo, 2018: Carbon footprint and nutritional quality of different human dietary choices. *Sci. Total Environ.*, **644**, 77–94, doi:10.1016/j.scitotenv.2018.06 339.

Gorge, H., M. Herbert, N. Özçağlar-Toulouse, and I. Robert, 2014: What Do We Really Need? Question ng Consumption Through Sufficiency. *J. Macromarketing*, **35**(1), 11–22, doi:10.1177/0276146714553935.

Gould, C. F. et al., 2018: Government policy, clean fuel access, and persistent fuel stacking in Ecuador. *Energy Sustain Dev.*, **46**, 111–122, doi:10.1016/j.esd.2018.05.009.

Goulden, M., B. Bedwell, S. Rennick-Egglestone, T. Rodden, and A. Spence, 2014: Smart grids, smart users? the role of the user in demand side management. *Energy Res. Soc. Sci.*, **2**, 21–29, doi:10.1016/j.erss.2014.04.008.

Graça, J., C. A. Godinho, and M. Truninger, 2019: Reducing meat consumption and following plant-based diets: Current evidence and future directions to inform integrated transitions. *Trends Food Sci. Technol.*, **91**, 380–390, doi:10.1016/j.tifs.2019.07.046.

Gram-Hanssen, K., 2008: Consuming technologies - developing routines. *J. Clean. Prod.*, **16**(11), 1181–1189, doi:10.1016/j.jclepro.2007.08.006.

Grandclément, C., A. Karvonen, and S. Guy, 2015: Negotiating comfort in low energy housing: The politics of intermediation. *Energy Policy*, **84**, 213–222, doi:10.1016/j.enpol.2014.11.034.

Griggs, D. et al., 2013: Sustainable development goals for people and planet. *Nature*, **495**(7441), 305–307, doi:https://doi.org/10.1038/495305a.

Gross, R., and R. Hanna, 2019: Path dependency in provision of domestic heating. *Nat. Energy*, **4**(May), 358–364, doi:10.1038/s41560-019-0383-5.

Grubb, M., 2014: *Energy, Climate Change and the Three Domains of Sustainable Development*. Routledge,.

Grubler, A., 1991: Energy in the 21st century: From resource to environmental and lifestyle constraints. *Entropie Rev. Sci. Tech. Thermodyn.*, **164**, 29–33.

Grubler, A. et al., 2012: Energy Primer. In: *Global Energy Assessment - Toward a Sustainable Future*, , Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria, pp. 99–150.

Grubler, A., C. Wilson, and G. Nemet, 2016: Apples, oranges, and consistent comparisons of the temporal dynamics of energy transitions. *Energy Res. Soc. Sci.*, **22**, 18–25, doi:10.1016/j.erss.2016.08.015.

Grubler, A. et al., 2018: A low energy demand scenario for meeting the 1.5° C target and sustainable development goals without negative emission technologies. *Nat. Energy*, **3**(6), 515–527, doi:10.1038/s41560-018-0172-6.

Grübler, A., N. Nakićenović, and D. G. Victor, 1999: Dynamics of energy technologies and global change. *Energy Policy*, **27**(5), 247–280, doi:10.1016/S0301-4215(98)00067-6.

Gui, E. M., and I. MacGill, 2018: Typology of future clean ene gy communities: An exploratory structure, opportunities, and challenges. *Energy Res Soc. Sci.*, **35**, 94–107, doi:10.1016/j.erss.2017.10.019.

Haberl, H. et al., 2019: Contributions of sociometabolic research to sustainability science. *Nat. Sustain.*, **2**(3), 173–184, doi:10.1038/s41893-019-0225-2.

Haenfler, R., B. Johnson, and E Jones, 2012: Lifestyle Movements: Exploring the Intersection of Lifestyle and Social Movements. *Soc. Mov. Stud.*, **11**(1), 1–20, doi:10.1080/14742837 2012 640535.

Hagbert, P., and K. Bradley, 2017: Transitions on the home front: A story of sustainable living beyond eco-efficiency. *Energy Res. Soc. Sci.*, **31**(August 2016), 240–248, doi:10.1016/j.erss.2017.05.002.

Halady, I. R., and P H. Rao, 2010: Does awareness to climate change lead to behavioral change? *Int. J. Clim. Chang. Strateg. Manag* , **2**(1), 6–22, doi:10.1108/17568691011020229.

Hall, P. A., 1993: Policy Paradigms, Social Learning, and the State: The Case of Economic Pol cymaking in Britain. *Comp. Polit.*, **25**(3), 275, doi:10.2307/422246.

Haluza-DeLay, R., 2014: Religion and climate change: varieties in viewpoints and practices. *Wiley Interdiscip Rev. Clim. Chang.*, **5**(2), 261–279, doi:10.1002/wcc.268.

Hand, M., E. Shove, and D. Southerton, 2005: Explaining showering: A discussion of the material, conventional, and temporal dimensions of practice. *Sociol. Res. Online*, **10**(2), doi:10.5153/sro.1100.

Haq, G., J. Whitelegg, S. Cinderby, and A. Owen, 2008: The use of personalised social marketing to foster voluntary behavioural change for sustainable travel and lifestyles. *Local Environ.*, **13**(7), 549–569, doi:10.1080/13549830802260092.

Hargreaves, T., M. Nye, and J. Burgess, 2013: Keeping energy visible? Exploring how householders interact with feedback from smart energy monitors in the longer term. *Energy Policy*, **52**, 126–134, doi:10.1016/J.ENPOL.2012.03.027.

Harguess, J. M., N. C. Crespo, and M. Y. Hong, 2020: Strategies to reduce meat consumption: A systematic literature review of experimental studies. *Appetite*, **144**, 104478, doi:10.1016/j.appet.2019.104478.

Harland, P., H. Staats, and H. A. M. Wilke, 1999: Explaining proenvironmental intention and behavior by personal norms and the theory of planned behavior. *J. Appl. Soc. Psychol.*, **29**(12), 2505–2528, doi:10.1111/j.1559-1816.1999.tb00123.x.

Harrahill, K., and O. Douglas, 2019: Framework development for 'just transition' in coal producing jurisdictions. *Energy Policy*, **134**, 110990, doi:10.1016/J.ENPOL.2019.110990.

Hartmann, C., and M. Siegrist, 2017: Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends Food Sci. Technol.*, **61**, 11–25, doi:10.1016/j.tifs.2016.12.006.

Hawkey, D. J. C., 2012: District heating in the UK: A Technological Innovation Systems analysis. *Environ. Innov. Soc. Transitions*, **5**, 19–32, doi:10.1016/j.eist.2012.10.005.

Hayward, B., and J. Roy, 2019: Sustainable Living: Bridging the North-South Divide in Lifestyles and Consumption Debates. *Annu. Rev. Environ. Resour.*, **44**(6), 1–9, doi:10.1146/annurev-environ-101718-033119.

Hazra, S., Lewis Jessica, Das Ipsita, and Kumar Singha Ashok, 2014: *Adoption and use of improved stoves and biogas plants in rural India*. South Asian Network for Development and Environmental Economics., 22 pp.

Head, L., 2016: *Hope and grief in the anthropocene: Re-conceptualising human-nature relations*. Routledge,.

Healy, N., and J. Barry, 2017: Politicizing energy just ce and energy system transitions: Fossil fuel divestment and a "just transition" *Energy Policy*, **108**, 451–459, doi:10.1016/j.enpol.2017.06.014.

Hedlund-de Witt, A., 2012: Exploring worldviews and their relationships to sustainable lifestyles: Towards a new conceptual and methodological approach. *Ecol. Econ.*, **84**, 74–83, doi:10.1016/j.ecolecon.2012.09.009

Heise, U. K., 2017: *Imagining Extinction: The cu tural meanings of endangered species*. University of Chicago Press,.

Heiskanen, E., and R. Lovio, 2010: User−Producer Interaction in Housing Energy Innovations. *J. Ind. Ecol.*, **14**(1), 91–102, doi:10.1111/j.1530-9290.2009.00196.x.

Heistein, A. et al., 2017: *Report on Ecologically Informed Theological Education*. www.interfaithsustain.com (Accessed December 26, 2019).

Helliwell J., H Huang, and S. Wang, 2016: New Evidence on Trust and Well-being. *Natl. Bur. Econ. Res* , , do :10.3386/w22450.

Helliwell, J. F., and H. Huang, 2008: How's Your Government? International Evidence Linking Good Government and Well-Being. *Br. J. Polit. Sci.*, **38**(4), 595–619, doi:10.1017/S0007123408000306.

Helliwell, J. F. H Huang, S. Grover, and S. Wang, 2018: Empirical linkages between good governance and national well-being. *J. Comp. Econ.*, **46**(4), 1332–1346, doi:10.1016/j.jce.2018.01.004.

Hertwich, E. G., and G. P. Peters, 2009: Carbon footprint of nations: A global, trade-linked analysis. *Environ. Sci. Technol.*, **43**(16), 6414–6420, doi:10.1021/es803496a.

Hess, D. J., and B. K. Sovacool, 2020: Sociotechnical matters: Reviewing and integrating science and technology studies with energy social science. *Energy Res. Soc. Sci.*, **65**, 101462, doi:10.1016/j.erss.2020.101462.

Hirsch, R. F., 1999: *Power loss: the origins of deregulation and restructuring in the American electric utility system*. MIT Press, Cambridge, MA, 406 pp.

Hobson, K., 2013: "Weak" or "strong" sustainable consumption? Efficiency, degrowth, and the 10 Year

Framework of Programmes. *Environ. Plan. C Gov. Policy*, **20**(3), 1082–1098, doi:10.1068/cl2279.

Hof, A. F., A. G. Dagnachew, P. L. Lucas, and D. P. van Vuuren, 2019: *Towards Universal Access to Clean Cooking Solutions in Sub-Saharan Africa: An integrated assessment of the cost, health and environmental implications of policies and targets*. , The Hague, 60 pp. https://www.pbl.nl/sites/default/files/downloads/pbl-2019-clean-cooking-solutions-sub-saharan-africa_3421_0.pdf.

Honda, J., 2008: History of Photovoltaic Industry Development in Japan. *Proceedings of ISES World Congress 2007*, Springer, 118–123.

Hoolohan, C., C. McLachlan, and S. Mander, 2018: Food related routines and energy policy: A focus group study examining potential for change in the United Kingdom. *Energy Res. Soc. Sci.*, **39**, 93–102, doi:10.1016/j.erss.2017.10.050.

Hooper, L. G. et al., 2018: Traditional cooking practices and preferences for stove features among women in rural Senegal: Informing improved cookstove design and interventions. *PLoS One*, **13**(11), e0206822, doi:10.1371/journal.pone.0206822.

Hubacek, K., D. Guan, and A. Barua, 2007: Changing lifestyles and consumption patterns in developing countries: A scenario analysis for China and India. *Futures*, **39**(9), 1084–1096, doi:10.1016/j.futures.2007.03.010.

Hur, W. M., H. K. Kim, and J. K. Park, 2010: Food- and situation specific lifestyle segmentation of kitchen appliance market. *Br. Food J.*, **112**(3), 294–305, doi:10.1108/00070701011029165.

Hyysalo, S., J. K. Juntunen, and S. Freeman, 2013: User innovation in sustainable home energy technologies. *Energy Policy*, **55**, 490–500, doi:10.1016/j.enpol.2012.12.038.

IDFC, 2008: *Comprehensive Mobility Plan for Kolkata Metropolitan Area*. , Kolkata, https://pdfslide.net/documents/comprehensive-mobility-plan-for-kolkata-metropolitan-area.html (Accessed December 21, 2020).

IEA, 2017: *Energy Access Outlook 2017: From Poverty to Prosperity*. , Paris,.

IEA, 2019: *World Energy Outlook 2019*. OECD, Paris,

Ikuenobe, P. A., 2016: The Communal Basis for Moral Dignity: An African Perspective. *Philos. Pap.*, **45**(3), 437–469, doi:10.1080/05568641.2016.1245833.

Inderberg, T. H. J., K. Tews, and B. Turner, 2018: *Is there a Prosumer Pathway? Exploring household solar energy development in Germany, Norway, and the United Kingdom*. http://dro.dur.ac.uk/25205/1/25205.pdf (Accessed December 16, 2019).

Ivanova, D. et al., 2018: Carbon mitigation in domains of high consumer lock-in. *Glob. Environ. Chang.*, **52**, 117–130, doi:10.1016/j.gloenvcha.2018.06.006.

Ivarsflaten, E., and K. Strømsnes, 2013: Inequality, Diversity and Social Trust in Norwegian Communities. *J. Elections, Public Opin. Parties*, **23**(3), 322–342, doi:10.1080/17457289.2013.808643.

Jackson, T., 2005: Live better by consuming less? Is there a “double dividend” in sustainable consumption? *Journal of Industrial Ecology*, Vol. 9 of, 19–36.

Jackson, T., 2017: *Prosperity without growth : foundations for the economy of tomorrow*. Second. Routledge, London, 310 pp.

Jacobsson, S., and V. Lauber, 2006: The politics and policy of energy system transformation--explaining the {German} diffusion of renewable energy technology. *Energy Policy*, **34**(3), 256–276.

Janda, K. B., and Y. Parag, 2013: A middle-out approach for improving energy performance in buildings. *Build. Res. Inf.*, **41**(1), 39–50, doi:10.1080/09613218.2013.743396.

Jans, L., T. Bouman, and K. Fielding, 2018: A part of the energy “in crowd”: Changing people’s energy behavior via group-based approaches. *IEEE Power Energy Mag.*, **16**(1), 35–41, doi:10.1109/MPE.2017.2759883.

Jenkins, W., E. Berry, and L. B. Kreider, 2018: Religion and Climate Change. *Annu. Rev. Environ. Resour.*, **43**, 85–108, doi:https://doi.org/10.1146/annurev-environ-102017-025855.

Jensen, M., 2009: Lifestyle: Suggesting mechanisms and a definition from a cognitive science perspective. *Environ. Dev. Sustain.*, **11**(1), 215–228, doi:10.1007/s10668-007-9105-4.

Jerome, B., 1990: *Acts of Meaning*. Harvard University Press, Cambridge,.

Jeuland, M. et al., 2021: Is energy the golden thread? A systematic review of the impacts of modern and traditional energy use in low- and middle-income countries. *Renew. Sustain. Energy Rev.*, **135**, 110406, doi:10.1016/J.RSER.2020.110406.

Johansson, T., A. Patwardhan, N. Nakićenović, and GEA, 2012: *Global Energy Assessment - Toward a Sustainable Future*. , Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria,.

Johnson, O. W. et al., 2020: Intersectionality and energy transitions: A review of gender, social equity and low-carbon energy. *Energy Res. Soc. Sci.*, **70**, 101774, doi:10.1016/j.erss.2020 101774.

Jordahl, H., 2011: Inequality and Trust. *SSRN Electron. J.*, , doi 10.2139/ssrn.1012786.

Jorgenson, A. K. et al., 2018: Social science perspectives on drivers of and responses to global climate change. *WIREs Clim. Chang.*, **10**(February 2018), 1–17 doi:10.1002/wcc.554.

Jürisoo, M., N. Serenje, F. Mwila, F. Lambe, and M. Osborne, 2019: Old habits die hard: Using the energy cultures framework to understand drivers of household-level energy transitions in urban Zambia. *Energy Res. Soc. Sci.*, **53**, 59–67 doi:10.1016/j.erss 2019.03.001.

Kahneman, D., 2011: *Thinking, Fast and Slow* Macmillan and Co.,.

Kalyanaratne, A., 2014: *Housing and Labor Productivity of Female Tea Pluckers in Sri Lanka*. 38 pp.

Kanemoto, K., D. Moran, and E. G. Hertwich, 2016: Mapping the Carbon Footprint of Nations. *Environ. Sci. Technol.*, **50** 19), 10512–10517, doi 10.1021/acs.est.6b03227.

Kanger, L., F. W. Geels, B. Sovacool, and J. Schot, 2019: Technological diffusion as a process of societal embedding: Lessons from historical automobile transitions for future electric mobility. *Transp. Res. Part D Transp. Environ* , **71**, 47–66, doi:10.1016/j.trd.2018.11.012.

Kemp, R., J. Schot and R. Hoogma, 1998: Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technol. Anal. Strateg. Manag.*, **10**(2), 175–195, doi: 0.1080/09537329808524310.

Kern, F., C. Kuzemco and C. Mitchell, 2014: Measuring and Explaining Policy Paradigm Change. *Policy Polit.*, **42** 4), 513–530.

Kimura, O., and T. Suzuki, 2006: *30 years of solar energy development in Japan: co-evolution process of technology policies, and the market*. 25 pp.

Kissinger, G., M Herold, and V. De Sy, 2012: *Drivers of Deforestation and Forest Degradation: A Synthesis Report for REDD+ Policymakers*. , Vancouver, 48 pp. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/65505/6316-drivers-deforestation-report.pdf.

Klitkou, A., S. Bolwig, T. Hansen, and N. Wessberg, 2015: The role of lock-in mechanisms in transition processes: The case of energy for road transport. *Environ. Innov. Soc. Transitions*, **16**, 22–37, doi:10.1016/j.eist.2015.07.005.

Knox-Hayes, J., 2012: Negotiating climate legislation: Policy path dependence and coalition stabilization. *Regul. Gov.*, **6**(4), 545–567, doi:10.1111/j.1748-5991.2012.01138.x.

Kolk, A., and J. Pinkse, 2007: Multinationals' Political Activities on Climate Change. *Bus. Soc.*, **46**(2), 201–228, doi:10.1177/0007650307301383.

Komiyama, H., 2014: *Beyond the limits to growth: New ideas for sustainability from Japan*. [Komiyama, H., (ed.)]. Springer Japan, Tokyo, 1–103 pp.

Kopp, T., and F. Dorn, 2018: Social Equity and Ecological Sustainability - Can the Two Be Achieved Together? *SSRN Electron. J.*, , doi:10.2139/ssrn.3294285.

Kraft-Todd, G. T., B. Bollinger, K. Gillingham, S. Lamp, and D. G. Rand, 2018: Credibility-enhancing displays promote the provision of non-normative public goods. *Nature*, **563**(7730), 245–248, doi:10.1038/s41586-018-0647-4.

Kragten, N., and J. Rözer, 2017: The Income Inequality Hypothesis Revisited: Assessing the Hypothesis Using Four Methodological Approaches. *Soc. Indic. Res.*, **131**(3), 1015–1033, doi:10.1007/s11205-016-1283-8.

Kuan, G., Y. C. Kueh, N. Abdullah, and E. L. M. Tai, 2019: Psychometric properties of the health-promoting lifestyle profile II: Cross-cultural validation of the Malay language version. *BMC Public Health*, **19**(1), 1–10, doi:10.1186/s12889-019-7109-2.

Kunreuther, H. et al., 2014: Integrated Risk and Uncertainty Assessment of Climate Change Response Policies. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O. et al., (eds.)], Cambridge University Press Cambridge, UK, and New York, Cambridge, United Kingdom and New York, NY, USA, pp. 151–206.

Kurz, T., B. Gardner, B. Verplanken, and C. Abraham, 2015: Habitual behaviors or patterns of practice? Explaining and changing repetitive climate-relevant actions. *Wiley Interdiscip. Rev. Clim. Chang.*, **6**(1), 113–128, doi:10.1002/wcc.327.

Laestadius, L. I., R. A. Neff, C. L. Barry, and S. Frattaroli, 2016: No Meat, Less Meat, or Better Meat: Understanding NGO Messaging Choices Intended to Alter Meat Consumption in Light of Climate Change. *Environ. Commun.*, **10**(1), 84–103, doi:10.1080/17524032.2014.981561.

Lafave, D. et al., 2019: *Impacts of Improved Biomass Cookstoves on Child and Adult Health Experimental Evidence from Rural Ethiopia*. https://openknowledge.worldbank.org/bitstream/handle/10986/32001/WPS8929.pdf?sequence=4 (Accessed October 10, 2021).

Lamb, W. F., and J. K. Steinberger, 2017: Human well-being and climate change mitigation. *Wiley Interdiscip. Rev. Clim. Chang.*, **8**(6), doi:10.1002/wcc.485.

Lamperti, F., G. Dosi, M. Napoletano, A. Roventini, and A. Sapio, 2018: *A Service of zbw Leibniz-Informationszentrum Wirtschaft Leibniz Information Centre for Economics*. http://hdl.handle.net/10419/174562 (Accessed December 6, 2019).

Lanzendorf, M., 2002: Mobility styles and travel behavior: Application of a lifestyle approach to leisure travel. *Transp. Res. Rec.*, (1807), 163–173, doi:10.3141/1807-20.

Latvala, T. et al., 2012: Diversifying meat consumption patterns: Consumers' self-reported past behaviour and intentions for change. *Meat Sci.*, **92**(1), 71–77, doi:10.1016/j.meatsci.2012.04.014.

Lauber, V., and S. Jacobsson, 2016: The politics and economics of constructing, contesting and restricting socio-political space for renewables – The German Renewable Energy Act. *Environ. Innov. Soc. Transitions*, **18**, 147–163.

Lawson, R., and S. Todd, 2002: Consumer lifestyles: A social stratification perspective. *Mark. Theory*, **2**(3), 295–307, doi:10.1177/1470593102002003278.

Lazarus, M., and H. van Asselt, 2018: Fossil fuel supply and climate policy: exploring the road less taken. *Clim. Change*, **150**(1–2), doi:10.1007/s10584-018-2266-3.

Le Gallic, T., E. Assoumou, and N. Maïzi, 2018: Investigating long-term lifestyle changes: A methodological proposal based on a statistical model. *Sustain. Dev.*, **26**(2), 159–171, doi:10.1002/sd.1727.

Leal Filho, W. et al., 2018: The role of transformation in learning and education for sustainability. *J. Clean. Prod.*, **199**, 286–295, doi:10.1016/J.JCLEPRO.2018.07.017.

Lenzen, M. et al., 2018: The carbon footprint of global tourism. *Nat. Clim. Chang.*, **8**(6), 522–528, doi:10.1038/s41558-018-0141-x.

Lessig, L., 1995: The regulation of social meaning. *Univ. Chicago Law Rev.*, **62**(3), 943–1045.

Levin-Waldman, O. M., 2012: *Income inequality and disparities in civic participation in the New York City Metro Area*. 22–29 pp.

Levin, S. et al., 2013: Social-ecological systems as complex adaptive systems: modeling and policy implications. *Environ. Dev. Econ.*, **18**(2), 111–132, doi:10.1017/S1355770X12000460.

Lin, D. et al., 2018: Ecological Footprint Accounting for Countries: Updates and Results of the National Footprint Accounts, 2012–2018. *Resources*, **7**(3), 58, doi:10.3390/resources7030058.

Litzow, E. L., S. K. Pattanayak, and T. Thinley, 2019: Returns to rural electrification: Evidence from Bhutan. *World Dev.*, **121**, 75–96, doi:10.1016/j.worlddev.2019.04.002.

Lockwood, M., 2015: Fossil Fuel Subsidy Reform, Rent Management and Political Fragmentation in Developing Countries. *New Polit. Econ.*, **20**(4), 475–494, doi:10.1080/13563467.2014.923826.

Lorenzen, J. A., 2012: Going Green: The Process of Lifestyle Change. *Sociol. Forum*, **27**(1), 94–116, doi:10.1111/j.1573-7861.2011.01303.x.

Lounsbury, M., and M. A. Glynn, 2001: Cultural entrepreneurship: Stories, legitimacy, and the acquisition of resources. *Strateg. Manag. J*, **22**(6–7), 545–564, doi:10.1002/smj.188.

Lourida, I. et al., 2019: Association of Lifestyle and Genetic Risk with Incidence of Dementia. *JAMA - J. Am. Med. Assoc.*, **322**(5), 430–437, doi:10.1001/jama.2019.9879.

Lovelock, J., 2007: *The Revenge of Gaia: Why the Earth is Fighting Back and How We Can Still Save Humanity*. Penguin, 256 pp.

Luttmer, E. F. P., 2005: Neighbors as Negatives: Relative Earnings and Well-Being. *Q. J. Econ.*, **120**(3), 963–1002, doi:10.1093/qje/120.3.963.

Mahajan, V., E. Muller, and F. M. Bass, 1990: New product diffusion models in marketing: A review and directions for research. *J. Mark.*, **54**(1), 1–26, doi:10.2307/1252170.

Maïzi, N., and V. Mazauric, 2019: From centralized to decentralized power systems: The shift on finitude constraints. *Energy Procedia*, **158**(2019), 4262–4267, doi:10.1016/j.egypro.2019.01.800.

Maïzi, N. et al., 2017: Maximizing intermittency in 100% renewable and reliable power systems: A holistic approach applied to Reunion Island in 2030. *Appl. Energy*, **227**, 332–341, doi:10.1016/j.apenergy.2017.08.058.

Mansfield, E., 1968: *The Economics of Technological Change*. W.W. Norton & Co., New York, USA, USA, 150 pp.

Maréchal, K., 2010: Not irrational but habitual: The importance of "behavioural lock-in" in energy consumption. *Ecol. Econ.*, **69**(5), 1104–1114, doi:10.1016/j.ecolecon.2009.12.004.

Markard, J., 2011: Transformation of Infrastructures: Sector Characteristics and Implications for Fundamental Change. *J. Infrastruct. Syst.*, **17**(3), 107–117, doi:10.1061/(asce)is.1943-555x.0000056.

Martin, C. J., 2016: The sharing economy: A pathway to sustainability or a nightmarish form of neoliberal capitalism? *Ecol. Econ.*, **121**, 149–159, doi:https://doi.org/10.1016/j.ecolecon.2015.11.027.

Martínez, J., J. Martí-Herrero, S. Villacís, A. J. J. Riofrio, and D. Vaca, 2017: Analysis of energy, CO2 emissions and economy of the technological migration for clean cooking in Ecuador. *Energy*

Policy, **107**, 182–187, doi:10.1016/j.enpol.2017.04.033.

Martino, J. P., K.-L. Chen, and R. C. Lenz, 1978: *Predicting the Diffusion Rate of Industrial Innovations*. , Springfield, VA, USA, VA, USA,.

Marvin, S., H. Chappells, and S. Guy, 1999: *Pathways of smart metering development: shaping environmental innovation*. 109–126 pp. www.elsevier.com/locate/compenvurbsys.

Mastrucci, A., and N. D. Rao, 2017: Decent housing in the developing world: Reducing life-cycle energy requirements. *Energy Build.*, **152**, 629–642, doi:10.1016/j.enbuild.2017.07.072.

Mastrucci, A., and N. D. Rao, 2019: Bridging India's housing gap: lowering costs and CO2 emissions. *Build. Res. Inf.*, **47**(1), 8–23, doi:10.1080/09613218.2018.1483634.

Matthews, H. S., C. L. Weber, and C. Hendrickson, 2008: Estimating Carbon Footprints with Input-Output Models. *Input-Output & Environment*, Seville, Spain www.eiolca.net.

McCauley, D., and R. Heffron, 2018: Just transition: Integrating climate, energy and environmental justice. *Energy Policy*, **119**, 1–7, doi:10.1016/J.ENPOL.2018.04.014.

McCubbin, L. D., H. I. McCubbin, W. Zhang, L. Kehl, and I. Strom, 2013: Relational Well being: An Indigenous Perspective and Measure. *Fam. Relat.*, **62**(2), 354–365, d i:10.1111/fare 12007.

Mcgillivray, M., and M. Clarke, 2006: *Understanding Human Well-being*. [McGillivray, M. and M. Clarke, (eds.)]. United Nations University Press, Tokio, 377 pp.

McGregor, J. A., and N. Pouw, 2017: Towards an economic of well-being. *Cambridge J. Econ.*, **41**(4), 1123–1142, doi:10.1093/cje/bew044.

McLaren Loring, J., 2007: Wind energy planning in England, Wales and Denmark: Factors influencing project success. *Energy Policy*, **35**(4), 2648–2660, doi:10 1016/j.enpol.2006.10.008.

McMeekin, A., and D. Southerton, 2012: Sustainability transitions and final consumption: Practices and socio-technical systems *Technol. Anal Strateg. Manag.*, **24**(4), 345–361, doi:10.1080/09537325.2012.663960

Meade, N., and T. Islam, 2006: Modelling and forecasting the diffusion of innovation - A 25-year review. *Int. J. Forecast* , **22**(3) 519–545, doi:10.1016/j.ijforecast.2006.01.005.

Megias-Delagado, M., C. Baldallo-González, and P. Maraver-López, 2018: Validity of advertising as a resource in Environmental Education. *Rev. Mediterránea Comun.*, **9**(2), 203–2015, doi:10.14198/MEDCOM2018.9.2.11.

Mendoza, M. E. B., nd O. G M. Roa, 2014: Educomunicación y medio ambiente: en la búsqueda y construcción de fisuras. *Rev. Investig. Agrar. y Ambient.*, **5**(1), doi:10.22490/21456453.960.

Michie, S., M M. van Stralen and R. West, 2011: The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implement. Sci.*, **6**(1), 42, doi:10.1186/1748-5908-6-42.

Mikucka, M , F. Sarracino, and J. K. Dubrow, 2017: When Does Economic Growth Improve Life Satisfaction? Multilevel Analysis of the Roles of Social Trust and Income Inequality in 46 Countries, 1981–2012. *World Dev.*, **93**, 447–459, doi:10.1016/j.worlddev.2017.01.002.

Miller, D. T., and D. A. Prentice, 2016: Changing Norms to Change Behavior. *Annu. Rev. Psychol.*, **67**(1), 339–361, doi:10.1146/annurev-psych-010814-015013.

Millonig, A., and S. Haustein, 2020: Human factors of digitalized mobility forms and services. *Eur. Transp. Res. Rev.*, **12**(46), doi:10.1186/s12544-020-00435-5.

Millot, A. et al., 2018: France 2072: Lifestyles at the core of carbon neutrality challenges. In: *Limiting Global Warming to Well Below 2 °C: Energy System Modelling and Policy Development. Lecture Notes in Energy 54* [Giannakidis, G., K.B. Karlsson, M. Labriet, and B. Gallachóir, (eds.)], Vol. 64 of, Springer Verlag, pp. 173–190.

Mills, B., and J. Schleich, 2012: Residential energy-efficient technology adoption, energy conservation, knowledge, and attitudes: An analysis of European countries. *Energy Policy*, **49**, 616–628, doi:10.1016/J.ENPOL.2012.07.008.

Millward-Hopkins, J., J. K. Steinberger, N. D. Rao, and Y. Oswald, 2020: Providing decent living with minimum energy: A global scenario. *Glob. Environ. Chang.*, **65**, 102168, doi:10.1016/j.gloenvcha.2020.102168.

Ministry of Housing and Urban Affairs, 2005: Jawaharlal Nehru National Urban Renewal Mission. https://www.prsindia.org/theprsblog/status-jawaharlal-nehru-national-urban-renewal-mission (Accessed December 21, 2020).

Ministry Of Urban Transport, 2006: *National Urban Transport Policy*. 22 pp. http://urbantransport.kar.gov.in/National Urban TransportPolicy.pdf (Accessed December 21, 2020).

MINTEL, 2019: MINTEL Global New Products Database. *Mintel Glob. New Prod. database*,. https://www.mintel.com/global-new-products-database/features (Accessed November 27, 2020).

Moezzi, M., K. B. Janda, and S. Rotmann, 2017: Using stories, narratives, and storytelling in energy and climate change research. *Energy Res. Soc. Sci.*, **31**, 1–10, doi:10 1016/j.erss.2017.06.034.

Möhlmann, M., 2015: Collaborative consumption: determinan s of satisfaction and the likelihood of using a sharing economy option again. *J. Consum. Behav* , **14**(3), 193–207, doi:10.1002/cb.1512.

Molthan-Hill, P., N. Worsfold, G. J. Nagy, W. Leal Filho, and M. Mifsud, 2019: Climate change education for universities: A conceptual framework from an international study. *J. Clean. Prod.*, **226**, 1092–1101, doi:10.1016/j.jclepro.2019 04 053.

Mongsawad, P., 2012: The philosophy of the sufficiency economy: a contribution to the theory of development. *Asia-Pacific Dev. J.*, **17**(1), 123–143, doi 10.18356/02bd5fb3-en.

Monreal, A. C., A. McMeekin, and D. Southerton, 2016: Beyond acquisition: Exploring energy consumption through the appreciation and appropriation of domestic lighting in the UK. *Sustain. Prod. Consum.*, **7**(February), 37–48, doi:10 1016/j.spc.2016.02.002.

Monyei, C. G. et al., 2019: Response to Todd De Groot, Mose, McCauley and Heffron's critique of "Examining energy sufficiency and energy mobility in the global south through the energy justice framework." *Ene gy Policy*, **133** 110917, doi:10.1016/j.enpol.2019.110917.

Morris, B. S. et al., 2019 Stories vs. facts: triggering emotion and action-taking on climate change. *Clim. Change*, **154**(1–2), 19–36, doi:10.1007/s10584-019-02425-6.

Morris, C. and A. Jungjohann 2016: *Energy democracy: Germany's Energiewende to renewables*. Springer,

Morris, C., J. Kirwan and R. Lally, 2014: Less Meat Initiatives : An Initial Exploration of a Diet-focused Social Innovation in Transitions to a More Sustainable Regime of Meat Provisioning. *Int. J. Sociol Agric. Food*, **21**(2), 189–208.

Mortensen, C R. t al., 2019: Trending Norms: A Lever for Encouraging Behaviors Performed by the Minority. *Soc. Psychol. Personal. Sci.*, **10**(2), 201–210, doi:10.1177/1948550617734615.

Moser, S. C., 2009: Communicating Climate Change and Motivating Civic Action: Renewing, Activating, and Building Democracies. In: *Changing Climates in North American Politics: Institutions, Policymaking, and Multilevel Governance* [Selin, H. and S.D. VanDeveer, (eds.)], The MIT Press, pp. 283–302.

Mowen, J. C., and M. Minor, 1998: *Consumer behavior*. Prentice-Hall, 696 pp.

Mukhopadhyay, R. et al., 2012: Cooking practices, air quality, and the acceptability of advanced cookstoves in Haryana, India: an exploratory study to inform large-scale interventions. *Glob. Health Action*, **5**(1), 19016, doi:10.3402/gha.v5i0.19016.

Munck af Rosenschöld, J., J. G. Rozema, and L. A. Frye-Levine, 2014: Institutional inertia and climate change: a review of the new institutionalist literature. *Wiley Interdiscip. Rev. Clim. Chang.*, **5**(5), 639–648, doi:10.1002/wcc.292.

Mundaca, L., and A. Markandya, 2016: Assessing regional progress towards a 'Green Energy Economy''.' *Appl. Energy*, **179**, 1372–1394, doi:10.1016/j.apenergy.2015.10.098.

Mundaca, L., D. Ürge-Vorsatz, and C. Wilson, 2019: Demand-side approaches for limiting global warming to 1.5 °C. *Energy Effic.*, **12**(2), 343–362, doi:10.1007/s12053-018-9722-9.

Mylan, J., 2018: Sustainable consumption in everyday life: A qualitative study of UK consumer experiences of meat reduction. *Sustainability*, **10**(7), 2307, doi:10.3390/su10072307.

Mylan, J., C. Morris, E. Beech, and F. W. Geels, 2019: Rage against the regime: Niche-regime interactions in the societal embedding of plant-based milk. *Environ. Innov. Soc. Transitions*, **31**, 233–247, doi:10.1016/j.eist.2018.11.001.

Nakićenović, N. et al., 1996: Energy Primer. In: *Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses. Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change* [Watson, R.T., M.C. Zinyowera, and R.H. Moss, (eds.)], Cambridge University Press, Camb idge, United Kingdom and New York, NY, USA, pp. 75–94.

Nannestad, P., G. T. Svendsen, P. T. Dinesen, and K. M. Sønderskov, 2014: Do Institutions or Culture Determine the Level of Social Trust? The Natural Experim nt of Migration from Non-western to Western Countries. *J. Ethn. Migr. Stud.*, **40**(4), 544–565 doi:10.1080/1369183X.2013.830499.

Nash, N. et al., 2019: Reflecting on behavioral spillover in context: How do behavioral motivations and awareness catalyze other environmentally responsible actions in Brazil, China, and Denmark? *Front. Psychol.*, **10**(JUN), doi:10.3389/fpsyg 2019.00788

Nelson, R. R., A. Peterhansl, and B. Sampat, 2004: Why and how innovations get adopted: A tale of four models. *Ind. Corp. Chang* , **13**(5), 679–699, doi 10.1093/icc/dth027.

Nemet, G. F., 2019: *How solar energy became cheap : A model for low-carbon innovation*. Routledge,.

Nepal, M., A. Nepal, and K Grimsrud, 2010 Unbelievable but improved cookstoves are not helpful in reducing firewood demand in Nepal. *Environ. Dev. Econ.*, **16**(1), 1–23, doi:10.1017/S1355770X10000409

Neri, M. C., 2002: *De ent Work and the Informal Sector in Brazil*. 115 pp.

Nerini, F. F. et al., 2016: A cost comparison of technology approaches for improving access to electricity services. *Energy*, **95**, 255–265, doi:10.1016/j.energy.2015.11.068.

Ngamaba K. H., M. Panagioti, and C. J. Armitage, 2018: Income inequality and subjective well-being: a systematic review and meta-analysis. *Qual. Life Res.*, **27**(3), 577–596, doi:10.1007/s11136-017-1719-x.

Niamir, L., 2019: Behavioural Climate Change Mitigation: from individual energy choices to demand-side potential. University of Twente, 267 pp.

Niamir, L., T. Filatova, A. Voinov, and H. Bressers, 2018: Transition to low-carbon economy: Assessing cumulative impacts of individual behavioral changes. *Energy Policy*, **118**, 325–345, doi:10.1016/j.enpol.2018.03.045.

Niamir, L., O. Ivanova, T. Filatova, A. Voinov, and H. Bressers, 2020a: Demand-side solutions for climate mitigation: Bottom-up drivers of household energy behavior change in the Netherlands and Spain. *Energy Res. Soc. Sci.*, **62**(101356), 101356, doi:10.1016/j.erss.2019.101356.

Niamir, L. et al., 2020b: Assessing the macroeconomic impacts of individual behavioral changes on carbon emissions. *Clim. Change*, **158**, 141–160, doi:10.1007/s10584-019-02566-8.

Nie, C., and L. Zepeda, 2011: Lifestyle segmentation of US food shoppers to examine organic and local food consumption. *Appetite*, **57**(1), 28–37, doi:10.1016/j.appet.2011.03.012.

Nielsen, K. R., L. A. Reisch, and J. Thøgersen, 2016: Sustainable user innovation from a policy perspective: a systematic literature review. *J. Clean. Prod.*, **133**, 65–77, doi:10.1016/j.jclepro.2016.05.092.

Nikolaeva, A. et al., 2019: Commoning mobility: Towards a new politics of mobility transitions. *Trans. Inst. Br. Geogr.*, **44**(2), 346–360, doi:10.1111/TRAN.12287.

Nolan, J. M., P. W. Schultz, R. B. Cialdini, N. J. Goldstein, and V. Griskevicius, 2008: Normative social influence is underdetected. *Personal. Soc. Psychol. Bull.*, **34**(7), 913–923, doi:10.1177/0146167208316691.

Noppers, E., K. Keizer, M. Milovanovic, and L. Steg, 2019: The role of adoption norms and perceived product attributes in the adoption of Dutch electric vehicles and smart energy systems. *Energy Res. Soc. Sci.*, **57**(October 2018), 101237, doi:10.1016/j.erss.2019.101237.

Noppers, E. H., K. Keizer, J. W. Bolderdijk, and L. Steg, 2014: The adoption of sustainable innovations: Driven by symbolic and environmental motives. *Glob. Environ. Chang.*, **25**(1), 52–62, doi:10.1016/j.gloenvcha.2014.01.012.

Nordhaus, W. D., 2013: *The Climate casino : Risk, uncertainty, and economics for a warming world*. Yale University Press, 378 pp.

Normann, H. E., 2017: Policy networks in energy transitions: The cases of carbon capture and storage and offshore wind in Norway. *Technol. Forecast. Soc. Change*, **118**, 80–93, doi:10.1016/j.techfore.2017.02.004.

NRC, 1972: *Solar Cells: Outlook for Improved Efficiency*. The National Academies Press, Washington, DC, DC,.

Nyborg, K. et al., 2016: Social norms as solutions. *Science* , **354**(6308), 42–43, doi:10.1126/science.aaf8317.

O'Donoghue, T., and M. Rabin, 2015: Present bias: Lessons learned and to be learned. *Am. Econ. Rev.*, **105**(5), 273–279, doi:10.1257/aer.p20151085.

O'Neill, D. W. et al., 2018: A good life for all within planetary boundaries. *Nat. Sustain.*, **1**(2), 88–95, doi:10.1038/s41893-018-0021-4.

O'Neill, S. J., and N. Smith, 2014: Climate change and visual imagery. *Wiley Interdiscip. Rev. Clim. Chang.*, **5**(1), 73–87, doi:10.1002/wcc.249.

O'riordan, T., and A. Jordan, 1999: *Institutions, climate change and cultural theory: towards a common analytical framework*. 81–93 pp.

Ó Tuama, D., 2015: Ripples through the city: Understanding the processes set in motion through embedding a public bike sharing scheme in a city. *Res. Transp. Bus. Manag.*, **15**, 15–27, doi:10.1016/j.rtbm.2015.03.002.

Odjugo, and P. A. Ovuyovwiroye, 2013: Analysis of climate change awareness in Nigeria. *Sci. Res. Essays*, **8**(26), 1203–1211, doi:10.5897/SRE11.2018.

Oishi, S., K. Kushlev, and U. Schimmack, 2018: Progressive taxation, income inequality, and happiness. *Am. Psychol.*, **73**(2), 157–168, doi:10.1037/amp0000166.

Okereke, C., 2018: Equity and Justice in Polycentric Climate Governance. In: *Governing Climate Change* [Jordan, A., D. Huitema, H. Van Asselt, and J. Forster, (eds.)], Cambridge University Press, pp. 320–337.

Oldenziel, R., M. Emanuel, A. de la Bruheze, and F. Veraart, 2016: *Cycling Cities: The European Experience: Hundred Years of Policy and Practice*. [Oldenziel, R., M. Emanuel, A. De La Bruheze, and F. Veraart, (eds.)]. Foundation for the History of Technology and Rachel Carson Center for Environment and Society, 256 pp.

Ornetzeder, M., and H. Rohracher, 2013: Of solar collectors, wind power, and car sharing: Comparing and understanding successful cases of grassroots innovations. *Glob. Environ. Chang.*, **23**(5), 856–867, doi:10.1016/j.gloenvcha.2012.12.007.

Orviska, M., A. Caplanova, and J. Hudson, 2014: The Impact of Democracy on Well-being. *Soc. Indic. Res.*, **115**(1), 493–508, doi:10.1007/s11205-012-9997-8.

Ott, J. C., 2011: Government and Happiness in 130 Nations: Good Governance Fosters Higher Level and More Equality of Happiness. *Soc. Indic. Res.*, **102**(1), 3–22, doi:10.1007/s11205-010-9719-z.

Otte, P. P., 2014: Solar cooking in Mozambique-an investigation of end-user's needs for the design of solar cookers. *Energy Policy*, **74**(C), 366–375, doi:10.1016/j.enpol.2014.06.032.

Otto, S., G. W. Evans, M. J. Moon, and F. G. Kaiser, 2019: The development of children's environmental attitude and behavior. *Glob. Environ. Chang.*, **58**, 101947, doi:10.1016/j.gloenvcha.2019.101947.

Owens, S., and L. Driffill, 2008: How to change attitudes and behaviours in the context of energy. *Energy Policy*, **36**(12), 4412–4418, doi:10.1016/j.enpol.2008.09.031.

Özcan, B., and C. Bjørnskov, 2011: Social trust and human development. *J. Socio. Econ.*, **40**(6), 753–762, doi:10.1016/j.socec.2011.08.007.

Palz, W., 2010: *Power for the world: the emergence of electricity from the sun*. Pan Stanford Publishing,.

Pant, K. P., 2008: *Estimating Health Benefits when Behaviors are Endogenous: A Case of Indoor Air Pollution in Rural Nepal*. 59 pp. www.sandeeonline.org.

Parag, Y., and K. B. Janda, 2014: More than filler: Middle actors and socio-technical change in the energy system from the "middle-out". *Energy Res. Soc. Sci.*, **3**(C), 102–112, doi:10.1016/j.erss.2014.07.011.

Parente, R. C., J.-M. G. Geleilate, and K. Rong, 2018: The Sharing Economy Globalization Phenomenon: A Research Agenda. *J. Int. Manag.*, **24**(1), 52–64, doi:10.1016/J.INTMAN.2017.10.001.

Park, S., 2015: State renewable energy governance: Policy instruments, markets, or citizens. *Rev. Policy Res.*, **32**(3), 273–296, doi:10.1111/ropr.12126.

Pasqualetti, M., and S. Stremke, 2018: Energy landscapes in a crowded world: A first typology of origins and expressions. *Energy Res. Soc. Sci.*, **36**, 94–105, doi:10.1016/j.erss.2017.09.030.

Pasqualetti, M. J., 2000: Morality, Space, and the Power of Wind-Energy Landscapes. *Geogr. Rev.*, **90**(3), 381–394, doi:10.1111/j.1931-0846.2000.tb00343.x.

Pattanayak, S., E. Sills, and R. Kramer, 2004: Seeing the forest for the fuel. *Environ. Dev. Econ.*, **9**(2), 15[illegible]–179, doi:10.1017/S1355770X03001220.

Pattanayak, S. K. et al., 2019: Experimental evidence on promotion of electric and improved biomass cookstoves. *Proc. Natl. Acad. Sci. U. S. A.*, **116**(27), 13282–13287, doi:10.1073/pnas.1808827116.

Pearce, W., S. Niederer, S. M. Özkula, and N. Sánchez Querubín, 2019: The social media life of climate change: Platforms, publics, and future imaginaries. *Wiley Interdiscip. Rev. Clim. Chang.*, **10**(2), doi:10.1002/wcc.569.

Peres, R., E. Muller, and V. Mahajan, 2010: Innovation diffusion and new product growth models: A critical review and research directions. *Int. J. Res. Mark.*, **27**(2), 91–106, doi:10.1016/j.ijresmar.2009.12.012.

Perkins, P. E. (Ellie., 2019: Climate justice, commons, and degrowth. *Ecol. Econ.*, **160**, 183–190, doi:10.1016/j.ecolecon.2019.02.005.

Perlin, J., 1999: *From Space to Earth: the Story of Solar Electricity*. AATEC Publications, Ann Arbor, MI,.

Perlin, J., 2013: *Let it shine: the 6,000-year story of solar energy*. 519 pp.

Perrot, R., and M. Sanni, 2018: Building low-carbon energy innovation systems in Africa. *https://doi.org/10.1080/20421338.2018.1523033*, **10**(5), 519–524, doi:10.1080/20421338.2018.1523033.

Persky, J., 1995: Retrospectives: The Ethology of Homo Economicus. *J. Econ. Perspect.*, **9**(2), 221–231.

Pettifor, H., C. Wilson, J. Axsen, W. Abrahamse, and J. Anable, 2017: Social influence in the global diffusion of alternative fuel vehicles – A meta-analysis. *J. Transp. Geogr.*, **62**(June), 247–261, doi:10.1016/j.jtrangeo.2017.06.009.

Phan, M. B., 2008: We're All in This Together: Context, Contacts, and Social Trust in Canada. *Anal. Soc. Issues Public Policy*, **8**(1), 23–51, doi:10.1111/j.1530-2415.2008.00151.x.

Phillips, N., T. B. Lawrence, and C. Hardy, 2004: Discourse and institutions. *Acad. Manag. Rev.*, **29**(4), 636–652, doi:10.5465/amr.2004.14497617.

Pianta, M., and M. Lucchese, 2020: Rethinking the European Green Deal: An Industrial Policy for a Just Transition in Europe. *Rev. Radic. Polit. Econ.*, **52**(4), 633–641, doi:10.1177/0486613420938207.

Pichler, P. P., I. S. Jaccard, U. Weisz, and H. Weisz, 2019: International comparison of health care carbon footprints. *Environ. Res. Lett.*, **14**(6), 064004, doi:10.1088/1748-9326/ab19e1.

Pigato, M. A. et al., 2020: *Technology Transfer and Innovation for Low-Carbon Development*. World Bank, Washington, DC, 192 pp.

Pine, K. et al., 2011: Adoption and use of improved biomass stoves in Rural Mexico. *Energy Sustain. Dev.*, **15**(2), 176–183, doi:10.1016/j.esd.2011.04.001.

Plumecocq, G. et al., 2018: The plurality of values in sustainable agriculture models: Diverse lock-in and coevolution patterns. *Ecol. Soc.*, **23**(1), 21, doi:10.5751/ES-09881-230121.

Pohjolainen, P., M. Vinnari, and P. Jokinen, 2015: Consumers' perceived barriers to following a plant-based diet. *Br. Food J.*, **117**(3), 1150–1167, doi:10.1108/BFJ-09-2013-0252.

Pollin, R., 2019: Advancing a Viable Global Climate Stabilization Project: Degrowth versus the Green New Deal: *https://doi.org/10.1177/0486613419833518*, **51**(2), 311–319, doi:10.1177/0486613419833518.

Poortinga, W., L. Whitmarsh, L. Steg, G. Böhm, and S. Fisher, 2019: Climate change perceptions and their individual-level determinants: A cross-European analysis. *Glob. Environ. Chang.*, **55**, 25–35, doi:10.1016/J.GLOENVCHA.2019.01.007.

Princen, T., 2003: Principles for Sustainability: From Cooperation and Efficiency to Sufficiency. *Glob. Environ. Polit.*, **3**(1), 33–50, doi:10.1162/152638003763336374.

Rao, N. D., and P. Baer, 2012: "Decent Living" Emissions: A Conceptual Framework. *Sustainability*, **4**(4), 656–681, doi:10.3390/su4040656.

Rao, N. D., and S. Pachauri, 2017: Energy access and living standards: some observations on recent trends. *Environ. Res. Lett.*, **12**(2), 025011, doi:10.1088/1748-9326/aa5b0d.

Rao, N. D., and J. Min, 2018a: Less global inequality can improve climate outcomes. *Wiley Interdiscip. Rev. Clim. Chang.*, **9**(2), doi:10.1002/wcc.513.

Rao, N. D., and J. Min, 2018b: Decent Living Standards: Material Prerequisites for Human Wellbeing. *Soc. Indic. Res.*, **138**(1), 225–244, doi:10.1007/s11205-017-1650-0.

Rao, N. D., J. Min, and A. Mastrucci, 2019: Energy for decent living. *Nat. Energy*,.

Raven, R., and G. Verbong, 2004: Ruling out innovations – technological regimes, rules and failures:

The cases of heat pump power generation and bio-gas production in The Netherlands. *Innovation*, **6**(2), 178–198, doi:10.5172/impp.2004.6.2.178.

Raven, R. et al., 2017: Unpacking sustainabilities in diverse transition contexts: solar photovoltaic and urban mobility experiments in India and Thailand. *Sustain. Sci.*, **12**(4), 579–596, doi:10.1007/s11625-017-0438-0.

Ravindranath, N. H., and J. Ramakrishna, 1997: Energy options for cooking in India. *Energy Policy*, **25**(1), 63–75, doi:10.1016/S0301-4215(96)00105-X.

Raymond, C. M., J. O. Kenter, C. J. van Riper, A. Rawluk, and D. Kendal, 2019: Editorial overview: theoretical traditions in social values for sustainability. *Sustain. Sci.*, **14**(5), 1173–1185, doi:10.1007/s11625-019-00723-7.

Reddy, N. M., J. D. Aram, and L. H. Lynn, 1991: The institutional domain of technology diffusion. *J. Prod. Innov. Manag.*, **8**(4), 295–304, doi:10.1016/0737-6782(91)90050-9.

Renn, J., 2018: The Evolution of Knowledge: Rethinking Science in the Anthropocene in. *HoST - J. Hist. Sci. Technol.*, **12**(1), 1–22, doi:10.2478/host-2018-0001.

Rentschler, J., and M. Bazilian, 2017: Reforming fossil fuel subsidies: drivers, barriers and the state of progress. *Clim. Policy*, **17**(7), 891–914, doi:10.1080/14693062.2016.1169393.

RESA, 2001: Act on Granting Priority to Renewable Energy Sources (Renewable Energy Sources Act, Germany, 2000). *Sol. Energy*, **70**(6), 489–504, doi:10.1016/s0038-092x(00)00144-4.

Reyes-García, V. et al., 2016: Subjective Wellbeing and Income: Empirical Patterns in the Rural Developing World. *J. Happiness Stud.*, **17**(2), 773–791, doi:10.1007/s10902-014-9608-2.

Riahi, K. et al., 2015: Locked into Copenhagen pledges — Implications of short-term emission targets for the cost and feasibility of long-term climate goals. *Technol. Forecast. Soc. Change*, **90**, 8–23, doi:10.1016/j.techfore.2013.09.016.

Richards, T. J., and S. F. Hamilton, 2018: Food waste in the sharing economy. *Food Policy*, **75**, 109–123, doi:https://doi.org/10.1016/j.foodpol.2018.01.008.

Richardson, E., E. Hughes, S. Mclennan, and L. Meo-Sewabu, 2019: Indigenous Well-Being and Development: Connections to Large-Scale Mining and Tourism in the Pacific. *Contemp. Pac.*, **31**(1), 1–34, doi:10.1353/cp.2019.0004.

Roberts, C., and F. W. Geels, 2019: Conditions for politically accelerated transitions: Historical institutionalism, the multi-level perspective, and two historical case studies in transport and agriculture. *Technol. Forecast. Soc. Chang.*, **140**(December 2018), 221–240, doi:10.1016/j.techfore.2018.11.019.

Rodrigo-Cano, D., M. J. Picó, and G. Dimuro, 2019: The Sustainable Development Goals as a base for the action and social and environmental intervention. *J. Adm. Sci. Econ.*, **9**(17), doi:10.17163/ret.n17.2019.02.

Roelich, K., and J. Giesekam, 2019: Decision making under uncertainty in climate change mitigation: introducing multiple actor motivations, agency and influence. *Clim. Policy*, **19**(2), 175–188, doi:10.1080/14693062.2018.1479238.

Rogelj, J. et al., 2018: Mitigation pathways compatible with 1.5°C in the context of sustainable development. In: *Global Warming of 1.5 °C an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change*.

Rogers, E. M., 2003: *Diffusion of Innovations*. Fifth edit. Free Press of Glencoe and Macmillan, New York, USA, and London, the UK, USA, and London, the UK, 576 pp.

Røpke, I., 2009: Theories of practice - New inspiration for ecological economic studies on consumption. *Ecol. Econ.*, **68**(10), 2490–2497, doi:10.1016/j.ecolecon.2009.05.015.

Rosenbloom, D., 2018: Framing low-carbon pathways: A discursive analysis of contending storylines surrounding the phase-out of coal-fired power in Ontario. *Environ. Innov. Soc. Transitions*, **27**, 129–145, doi:10.1016/j.eist.2017.11.003.

Rosenbloom, D., H. Berton, and J. Meadowcroft, 2016: Framing the sun: A discursive approach to understanding multi-dimensional interactions within socio-technical transitions through the case of solar electricity in Ontario, Canada. *Res. Policy*, **45**(6), 1275–1290, doi:10.1016/j.respol.2016.03.012.

Roser, M., E. Ortiz-Ospina, H. Ritchie, J. Hassel, and D. Gavrilov, 2019: Our world in data. *Univ. Oxford*,. https://ourworldindata.org/grapher/interpersonal-trust-vs-income-inequality.

Rothstein, B., and E. M. Uslaner, 2005: All for All: Equality, Corruption, and Social Trust. *World Polit.*, **58**(1), 41–72, doi:10.1353/wp.2006.0022.

Rothstein, B., and Stolle, 2008: The State and social capital: an institutional theory of generalized governance. *Comp. Polit.*, , 441–459.

Roy, J., 1997: Socio economic Evaluation of the Solar Lantern Programme in rural India. *J Sol. Energy Soc. India*, **8**(1), 27–35.

Roy, J., and S. Jana, 1998: Solar lanterns for rural households. *Energy*, **23**(1), 67–68, doi:10.1016/S0360-5442(97)00067-4.

Roy, J. et al., 2012: Lifestyles, Well-Being and Energy In: *Global Energy Assessment—Toward a Sustainable Future*, Cambridge University Press Cambridge, UK and New York, NY, USA/Laxenburg, Austria, UK and New York, NY USA/Laxenburg, Austria, pp. 1527–1548.

Roy, J., S. Dasgupta, and D. Chakravarty, 2013a: Energy Efficiency: Technology, Behavior, and Development. In: *The Handbook of Global Energy Policy*

Roy, J., D. Ghosh, A. Ghosh, and S. Dasgupta, 2013b: Fiscal instruments: Crucial role in financing low carbon transition in energy systems. *Curr. Opin. Environ. Sustain.*, **5**(2), 261–269, doi:10.1016/j.cosust.2013.05.003.

Roy, J. et al., 2018a: Sustainable Dev lopment, Poverty Eradication and Reducing Inequalities. In: *Global Warming of 1.5 °C an IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening he global response to the threat of climate change* [Zhai, P. et al., (eds.)], pp. 445–538.

Roy, J. et al., 2018b: Where is the hope? Blending modern urban lifestyle with cultural practices in India. *Curr. Opin. Environ Sustain.*, **31**, 96–103, doi:10.1016/j.cosust.2018.01.010.

Royston, S., J. Selby, and E. Sho e, 2018: Invisible energy policies: A new agenda for energy demand reduction. *Energy Policy*, **123**, 127–135, doi:10.1016/J.ENPOL.2018.08.052.

Ruepert, A. M., K. Keizer, and L. Steg, 2017: The relationship between Corporate Environmental Responsibility, employees' biospheric values and pro-environmental behaviour at work. *J. Environ. P ychol.*, **54**, 65–78, doi:10.1016/j.jenvp.2017.10.006.

Ryghaug, M., T. M. Skjølsvold, and S. Heidenreich, 2018: Creating energy citizenship through material participation. *Soc. Stud. Sci.*, **48**(2), 283–303, doi:10.1177/0306312718770286.

Safarzadeh, S., M. Rasti-Barzoki, and S. R. Hejazi, 2020: A review of optimal energy policy instruments on industrial energy efficiency programs, rebound effects, and government policies. *Energy Policy*, **139**, 111342, doi:10.1016/J.ENPOL.2020.111342.

Sahakian, M., L. Godin, and I. Courtin, 2020: Promoting 'pro', 'low', and 'no' meat consumption in Switzerland: The role of emotions in practices. *Appetite*, **150**, 104637, doi:10.1016/j.appet.2020.104637.

Samuelson, W., and R. Zeckhauser, 1988: Status quo bias in decision making. *J. Risk Uncertain.*, **1**(1), 7–59, doi:10.1007/BF00055564.

Sankhyayan, P., and S. Dasgupta, 2019: 'Availability' and/or 'Affordability':What matters in household energy access in India? *Energy Policy*, **131**(April), 131–143, doi:10.1016/j.enpol.2019.04.019.

Sanquist, T. F., H. Orr, B. Shui, and A. C. Bittner, 2012: Lifestyle factors in U.S. residential electricity consumption. *Energy Policy*, **42**, 354–364, doi:10.1016/j.enpol.2011.11.092.

Saramet, O., 2007: The Right to a Decent Living Standard or the Right to a Sufficient Living Standard. *Ann. Univ. Apulensis Ser. Jurisprudentia*, **10**.

Saramet, O., C. G. Matei, and A. Toma-Bianov, 2009: *Aspects regarding the right to a decent living standard*. https://go-gale-com.ezproxy.library.yorku.ca/ps/retrieve.do?tabID=T002&resultListType=RESULT_LIST&searchResultsType=SingleTab&searchType=AdvancedSearchForm&currentPosition=5&docId=GALE%7CA224712328&docType=Report&sort=Relevance&contentSegment=ZONE-MOD1&pr (Accessed December 16, 2019).

Saunders, H. D. et al., 2021: Energy Efficiency : What has it Delivered in the Last 40 years ? *Annu. Rev. Energy Environ.*, **46**, 135–165, doi:10.1146/ANNUREV-ENVIRON-012320-084937.

Sawer, M., F. Jenkins, and K. Downing, 2020: *How Gender Can Transform the Social Sciences*. [Sawer, M., F. Jenkins, and K. Downing, (eds.)]. Springer International Publishing,.

Scheve, K., and D. Stasavage, 2017: Wealth Inequality and Democracy. *Annu. Rev. Polit. Sci.*, **20**, 451–468, doi:10.1146/ANNUREV-POLISCI-061014-101840

Schipper, L., 1989: Linking Life-Styles And Energy Use: A Matter Of Time. *Annu. Rev. Energy Environ.*, **14**(1), 273–320, doi:10.1146/annurev.energy.14.1.273.

Schlüter, M. et al., 2017: A framework for mapping and comparing behavioural theories in models of social-ecological systems. *Ecol. Econ.*, **131**, 21–35, doi:10.1016/j.ecolecon.2016.08.008.

Schmidt, T. S., N. Schmid, and S. Sewerin, 2019: Policy Goals, Partisanship and Paradigmatic Change in Energy Policy – Analyzing Parliamentary Discourse in Germany over 30 Years. *Clim. Policy*, , 1–16, doi:10.1080/14693062.2019.1594667.

Schneider, S. M., 2016: Income Inequality and Subjective Wellbeing: Trends, Challenges, and Research Directions. *J. Happiness Stud.*, **17**(4), 1719–1739, doi:10.1007/s10902-015-9655-3.

Schor, J., 2014: *Debating the Sharing Economy*. 15 pp. https://www.greattransition.org/publication/debating-the-sharing-economy.

Schot, J., and F. W. Geels, 2008: Strategic niche management and sustainable innovation journeys: Theory, findings, research agenda, and policy. *Technol. Anal. Strateg. Manag.*, **20**(5), 537–554, doi:10.1080/09537320802292651.

Schot, J., and W. E. Steinmueller, 2018: Three frames for innovation policy: R&D, systems of innovation and transformative change. *Res. Policy*, **47**(9), 1554–1567, doi:10.1016/j.respol.2018.08.011.

Schot, J., L. Kanger, and G. Verbong, 2016: The roles of users in shaping transitions to new energy systems. *Nat. Energy*, **1**(5), 1–7, doi:10.1038/NENERGY.2016.54.

Schröder, M., 2018: Income Inequality and Life Satisfaction: Unrelated Between Countries, Associated Within Countries Over Time. *J. Happiness Stud.*, **19**(4), 1021–1043, doi:10.1007/s10902-017-9860-3.

Schultz, P. W., J. M. Nolan, R. B. Cialdini, N. J. Goldstein, and V. Griskevicius, 2007: The Constructive, Destructive, and Reconstructive Power of Social Norms. *Psychol. Sci.*, **18**(5), 429–434, doi:10.1111/j.1467-9280.2007.01917.x.

Sekulova, F., G. Kallis, and F. Schneider, 2017: Climate change, happiness and income from a degrowth perspective. In: *Handbook on Growth and Sustainability* [Victor, P.A. and B. Dolter, (eds.)], Edward Elgar Publishing, pp. 160–180.

Seto, K. C. et al., 2016: Carbon Lock-In: Types, Causes, and Policy Implications. *Annu. Rev. Environ. Resour.*, **41**(1), 425–452, doi:10.1146/annurev-environ-110615-085934.

Shao, S., L. Guo, M. Yu, L. Yang, and D. Guan, 2019: Does the rebound effect matter in energy import-dependent mega-cities? Evidence from Shanghai (China). *Appl. Energy*, **241**, 212–228, doi:10.1016/j.apenergy.2019.03.007.

Sharma, B. P. et al., 2020: Making incremental progress: Impacts of a REDD+ pilot initiative in Nepal. *Environ. Res. Lett.*, **15**(10), doi:10.1088/1748-9326/ABA924.

Sheller, M., 2004: Automotive Emotions: Feeling the Car. *Theory, Cult. Soc.*, **21**(4–5), 221–242, doi:10.1177/0263276404046068.

Sheller, M., 2018: Teorizando sobre mobilidades justas. *Tempo Soc.*, **30**(2), 17–34, doi:10.11606/0103-2070.TS.2018.142763.

Shields, L. (Liam P., 2016: *Just enough : sufficiency as a demand of justice*. Edinburgh University Press, Edinburgh, 224 pp.

Shimamoto, M., 2014: *Keikaku no sohatsu: Sunshine keikaku to taiyoko hatsuden (National project management: the development of photovoltaicpower generation system under the Sunshine Project)*. Yuhikaku (in Japanese), Tokyo,.

Short, L., 2002: Wind Power and English Landscape Identity. In: *Wind Power in View* [Pasqualetti, M.J., P. Gipe, and R.W. Righter, (eds.)], Elsevier, pp. 43–58.

Shove, E., 2003: *Comfort, Cleanliness and Convenience: The Social Organization of Normality*. 1st ed. [Shove, E., (ed.)]. Berg Publishers/Bloomsbury, Oxford, 240 pp

Shove, E., and D. Southerton, 2000: Defrosting the freezer: From Novelty to convenience. A Narrative of Normalization. *J. Mater. Cult.*, **5**(3), 301 319, doi:10.1177/135918350000500303.

Shove, E., and G. Walker, 2014: What Is Energy For? Social Practice and Energy Demand. *Theory, Cult. Soc.*, **31**(5), 41–58, doi:10.1177/0263276414536746.

Shove, E., G. Walker, and S Brown 2014: Material culture, room temperature and the social organisation of thermal energy. *J Mater Cult* **19**(2), 113–124, doi:10.1177/1359183514525084.

Shum, K. L., and C. Watanabe, 2009: An innovation management approach for renewable energy deployment-the case of solar photovoltaic (PV) technology. *Energy Policy*, **37**(9), 3535–3544, doi:10.1016/j enpol 2009.04.007.

Siciliano, G., L Wallbott, F. Urban, A. N. Dang, and M. Lederer, 2021: Low-carbon energy, sustainable development, and justice: Towards a just energy transition for the society and the environment. *Sustain. Dev* , , doi:10.1002/SD.2193.

Silaen, M et al., 2020: Lessons from Bali for small-scale biogas development in Indonesia. *Environ. Innov Soc. Trans tions*, **35**, 445–459, doi:10.1016/J.EIST.2019.09.003.

Simon, D. R., 2003: *Meatonomics : how the rigged economics of meat and dairy make you consume too much-- and how to eat better, live longer, and spend smarter*. Conari Press, 289 pp.

Singer, M., 2018: *Climate change and social inequality : the health and social costs of global warming*. Earthscan, 247 pp.

Singh, D., S. Pachauri, and H. Zerriffi, 2017: Environmental payoffs of LPG cooking in India. *Environ. Res. Lett.*, **12**(11), doi:10.1088/1748-9326/aa909d.

Skjølsvold, T. M., and C. Lindkvist, 2015: Ambivalence, designing users and user imaginaries in the European smart grid: Insights from an interdisciplinary demonstration project. *Energy Res. Soc. Sci.*, **9**, 43–50, doi:10.1016/j.erss.2015.08.026.

Sloot, D., L. Jans, and L. Steg, 2018: Can community energy initiatives motivate sustainable energy behaviours? The role of initiative involvement and personal pro-environmental motivation. *J. Environ. Psychol.*, **57**(November 2017), 99–106, doi:10.1016/j.jenvp.2018.06.007.

Smil, V., 2016: Examining energy transitions: A dozen insights based on performance. *Energy Res. Soc. Sci.*, **22**, 194–197, doi:10.1016/j.erss.2016.08.017.

Smink, M. M., M. P. Hekkert, and S. O. Negro, 2015: Keeping sustainable innovation on a leash? Exploring incumbents' institutional strategies. *Bus. Strateg. Environ.*, **24**(2), 86–101, doi:10.1002/bse.1808.

Smith, A., and R. Raven, 2012: What is protective space? Reconsidering niches in transitions to sustainability. *Res. Policy*, **41**(6), 1025–1036, doi:10.1016/j.respol.2011.12.012.

Smith, J. et al., 2017: Gathering around stories: Interdisciplinary experiments in support of energy system transitions. *Energy Res. Soc. Sci.*, **31**, 284–294, doi:10.1016/j.erss.2017.06.026.

Smith, K. R., G. U. Shuhua, H. Kun, and Q. Daxiong, 1993: One hundred million improved cookstoves in China: How was it done? *World Dev.*, **21**(6), 941–961, doi:10.1016/0305-750X(93)90053-C.

Smith, N., and A. Leiserowitz, 2013: American evangelicals and global warming. *Glob. Environ. Chang.*, **23**(5), 1009–1017, doi:10.1016/j.gloenvcha.2013.04.001.

Solér, C., B. Koroschetz, and E. Salminen, 2020: An infrastructural perspective on sustainable consumption - Activating and obligating sustainable consumption through infrastructures. *J. Clean. Prod.*, **243**, doi:10.1016/j.jclepro.2019.118601.

Somanathan, E., and R. Bluffstone, 2015: *Biogas: Clean Energy Access with Low-Cost Mitigation of Climate Change | SpringerLink*. http://econ.worldbank.org

Sopjani, L., J. J. Stier, S. Ritzén, M. Hesselgren, and P. Georén, 2019: Involving users and user roles in the transition to sustainable mobility systems: The case of light electric vehicle sharing in Sweden. *Transp. Res. Part D Transp. Environ.*, **71**, 207–221, doi:10.1016/j.trd.2018.12.011.

Sorrell, S., B. Gatersleben, and A. Druckman, 2020: The limits of energy sufficiency: A review of the evidence for rebound effects and negative spillover from behavioural change. *Energy Res. Soc. Sci.*, **64**, 101439, doi:10.1016/j.erss.2020.101439.

Sovacool, B. K., 2016: How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Res. Soc. Sci.*, **13**, 202–215, doi:10.1016/j.erss.2015.12.020.

Sovacool, B. K., and F. W. Geels, 2016: Further reflections on the temporality of energy transitions: A response to critics. *Energy Res. Soc. Sci.*, **22**, 232–237, doi:10.1016/j.erss.2016.08.013.

Sovacool, B. K., and D. J. Hess, 2017: Ordering theories: Typologies and conceptual frameworks for sociotechnical change. *Soc. Stud. Sci.*, **47**(5), 703–750, doi:10.1177/0306312717709363.

Sovacool, B. K., J. Kester, L. Noel, and G. Z. de Rubens, 2018: The demographics of decarbonizing transport: The influence of gender, education, occupation, age, and household size on electric mobility preferences in the Nordic region. *Glob. Environ. Chang.*, **52**, 86–100, doi:10.1016/j.gloenvcha.2018.06.008.

Spangenberg, J. H., and S. Lorek, 2019: Sufficiency and consumer behaviour: From theory to policy. *Energy Policy*, **129**, 1070–1079, doi:10.1016/j.enpol.2019.03.013.

Star, S. L., and K. Ruhleder, 1996: Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces. *Inf. Syst. Res.*, **7**(1), 111–134, doi:10.1287/isre.7.1.111.

Steg, L., 2005: Car use: Lust and must. Instrumental, symbolic and affective motives for car use. *Transp. Res. Part A Policy Pract.*, **39**(2-3 SPEC. ISS.), 147–162, doi:10.1016/j.tra.2004.07.001.

Steg, L., G. Perlaviciute, E. van der Werff, and J. Lurvink, 2014: The Significance of Hedonic Values for Environmentally Relevant Attitudes, Preferences, and Actions. *Environ. Behav.*, **46**(2), 163–192, doi:10.1177/0013916512454730.

Steijn, S., and B. Lancee, 2011: *Does Income Inequality Negatively Affect General Trust?* www.gini-research.org. (Accessed November 30, 2019).

Steinmo, S., K. A. Thelen, and F. Longstreth, 1992: *Structuring politics : historical institutionalism in* *comparative analysis*. Cambridge University Press, 257 pp.

Stephenson, J. et al., 2015: The energy cultures framework: Exploring the role of norms, practices and material culture in shaping energy behaviour in New Zealand. *Energy Res. Soc. Sci.*, **7**, 117–123, doi:10.1016/j.erss.2015.03.005.

Stern, N., 2016: Economics: Current climate models are grossly misleading. *Nature*, **530**(7591), 407–409, doi:10.1038/530407a.

Stern, P. C., B. K. Sovacool, and T. Dietz, 2016: Towards a science of climate and energy choices. *Nat. Clim. Chang.*, **6**(6), 547–555, doi:10.1038/nclimate3027.

Stiglitz, J., 2012: *The Price of Inequality: How Today's Divided Society Endangers Our Future*. W. W. Norton & Company,.

Stone, A. A., S. Schneider, A. Krueger, J. E. Schwartz, and A. Deaton, 2018: Experiential Wellbeing Data from the American Time Use Survey: Comparisons with Other Methods and Analytic Illustrations with Age and Income. *Soc. Indic. Res.*, **136**(1), 359–378, doi:10.1007/s11205-016-1532-x.

Streeby, S., 2018: *Imagining the Future of Climate Change World-Making through Science Fiction and Activism*. University of California Press,.

Stryker, R., 1994: Rules, Resources, and Legitimacy Processes: Some Implications for Social Conflict, Order, and Change. *Am. J. Sociol.*, **99**(4), 847–910.

Sturm, S., 2007: The Architecture of Inclusion: Interdisciplinary Insights on Pursuing Institutional Citizenship. *Harvard J. Law Gend.*, **30**, 409–419

Sugiawan, Y., and S. Managi, 2019: New evidence of energy-growth nexus from inclusive wealth. *Renew. Sustain. Energy Rev.*, **103**(December 2018), 40–48, doi:10.1016/j.rser.2018.12.044.

Sunstein, C. R., 1996: Social norms and social roles. *Columbia Law Rev.*, **96**(4), 903, doi:10.2307/1123430.

Sunstein, C. R., and L. A. Reisch, 2014: Automatically Green: Behavioral Economics and Environmental Protection. *Harvard Environ. Law Rev.*, **38**(1), 127–158, doi:10.2139/ssrn.2245657.

Supran, G., and N. Oreskes, 2017: Assessing ExxonMobil's climate change communications. *Environ. Res. Lett.*, **12**(8).

Sur, M., 2017 Mobility and art: Life cycle. *Transfers*, **7**(1), 130–136, doi:10.3167/TRANS.2017.070110.

Taufik, D., M. C. D. Verain, E. P. Bouwman, and M. J. Reinders, 2019: Determinants of real-life behavioural interventions to stimulate more plant-based and less animal-based diets: A systematic review. *Trends Food Sci. Technol.*, **93**, 281–303, doi:10.1016/j.tifs.2019.09.019.

Taylor, R., H. Wanjiru, O. W. Johnson, and F. X. Johnson, 2020: Modelling stakeholder agency to investigate sustainable charcoal markets in Kenya. *Environ. Innov. Soc. Transitions*, **35**, 493–508, doi:10.1016 J.EIST.2019.10.001.

Thacker, S. et al., 2019: Infrastructure for sustainable development. *Nat. Sustain.*, **2**(4), 324–331, doi:10.1038/s41893-019-0256-8.

Thakuri, M. B. M., 2009: *Revisiting the Need of Improved Stoves: Estimating Health, Time and Carbon Benefits*. 46 pp. www.sandeeonline.org.

Thaler, R., and C. Sunstein, 2009: *Nudge: Improving decisions about health, wealth, and happiness*. Penguin Books Ltd,.

Thaler, R. H., 2015: *Misbehaving : the making of behavioral economics*. W.W. Norton & Co., New York, 415 pp.

Thaler, R. H., and C. R. Sunstein, 2003: Libertarian Paternalism. *Am. Econ. Rev.*, **93**(2), 175–179, doi:10.2307/3132220.

Thøgersen, J., 2017a: Sustainable food consumption in the nexus between national context and private lifestyle: A multi-level study. *Food Qual. Prefer.*, **55**, 16–25, doi:10.1016/j.foodqual.2016.08.006.

Thøgersen, J., 2017b: Housing-related lifestyle and energy saving: A multi-level approach. *Energy Policy*, **102**(December 2016), 73–87, doi:10.1016/j.enpol.2016.12.015.

Thøgersen, J., 2018: Transport-related lifestyle and environmentally-friendly travel mode choices: A multi-level approach. *Transp. Res. Part A Policy Pract.*, **107**(June 2016), 166–186, doi:10.1016/j.tra.2017.11.015.

Thomas, S. et al., 2019: Energy sufficiency policy for residential electricity use and per-capita dwelling size. *Energy Effic.*, **12**(5), 1123–1149, doi:10.1007/s12053-018-9727-4.

Tiwari, G., D. Jain, and K. Ramachandra Rao, 2016: Impact of public transport and non-motorized transport infrastructure on travel mode shares, energy, emissions and safety: Case of Ind an cities. *Transp. Res. Part D Transp. Environ.*, **44**, 277–291, doi:10.1016/j.trd.2015.11.004

Toke, D., S. Breukers, and M. Wolsink, 2008: Wind power deployment outcomes: How can we account for the differences? *Renew. Sustain. Energy Rev.*, **12**(4), 1129–1147, doi:10.1016/j.rser.2006.10.021.

Tokuda, Y., S. Fujii, and T. Inoguchi, 2017: Individual and Country-Level Effects of Social Trust on Happiness: The Asia Barometer Survey. Springer, Singapore, pp. 123–139.

Tornatzky, L. G., and K. J. Klein, 1982: Innovation Charactersitic and Innovation Adoption-Implementation : Meta Analysis of the Finding *IEEE Trans. Eng. Manag.*, **EM-29**(1), 28–45, doi:10.1109/TEM.1982.6447463.

Tozer, L., and N. Klenk, 2019: Urban configurations of carbon neutrality: Insights from the Carbon Neutral Cities Alliance. *Environ. Plan C Polit. Sp.*, **37**(3), 539–557, doi:10.1177/2399654418784949.

Troncoso, K., and A. Soares da Silva, 2017: LPG fuel subsidies in Latin America and the use of solid fuels to cook. *Energy Policy* **107**, 188–196, doi:10.1016/j.enpol.2017.04.046.

Troncoso, K., P. Segurado, M. Aguilar, and A. Soares da Silva, 2019: Adoption of LPG for cooking in two rural communities of Chiapas, Mexico. *Energy Policy*, **133**, 110925, doi:10.1016/j.enpol.2019.110925.

Truffer, B., 2003: User-led innovation processes: The development of professional car sharing by environmentally concerned citizens. *Innovation*, **16**(2), 139–154, doi:10.1080/13511610304517.

Tu, Y., and C. K. Hsee 2018: Hedonomics: On Subtle Yet Significant Determinants of Happiness. In: *Handbook of Well-being* [Diener, E., S. Oishi, and L. Tay, (eds.)], DEF Publishers, Salt Lake City, UT, UT.

Tudor, T. et al., 2016 Sustainability practices and lifestyle groups in a rapidly emerging economy: a case study of Chennai, India. *Int. J. Environ. Sustain. Dev.*, **15**(4), 337–351, doi:10.1504/IJESD.2016.079475.

TWI2050, 2019: *The Digital Revolution and Sustainable Development: Opportunities and Challenges*. , Laxenburg, Austria, Austria, 100 pp.

Ulgiati, S., M. T. Brown, S. Bastianoni, and N. Marchettini, 1995: Emergy-based indices and ratios to evaluate the sustainable use of resources. *Ecol. Eng.*, **5**(4), 519–531, doi:10.1016/0925-8574(95)00043-7.

UNEP, 2018: *Inclusive wealth report 2018: measuring progress towards sustainability*. 14 pp.

Ungemach, C., A. R. Camilleri, E. J. Johnson, R. P. Larrick, and E. U. Weber, 2017: Translated Attributes as Choice Architecture: Aligning Objectives and Choices Through Decision Signposts.

Manage. Sci., **65**(5), 1975–2471, doi:10.1287/mnsc.2016.2703.

United Nations Environment Programme, 2020: *Emissions Gap Report 2020.* , Nairobi, 128 pp. https://www.unenvironment.org/emissions-gap-report-2020.

Unruh, G. C., 2002: Escaping carbon lock-in. *Energy Policy*, **30**(4), 317–325, doi:10.1016/S0301-4215(01)00098-2.

Van de Ven, D.-J. et al., 2019: Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa. *Environ. Res. Lett.*, **14**(9), 094001, doi:10.1088/1748-9326/AB375D.

Van den Berg, N. J. et al., 2019: Improved modelling of lifestyle changes in Integrated Assessment Models: Cross-disciplinary insights from methodologies and theories. *Energy Strateg. Rev.*, **26**, 100420, doi:10.1016/j.esr.2019.100420.

van den Bergh, J. C. J. M., 2010: Energy Conservation More Effective With Rebound Policy. *Environ. Resour. Econ. 2010 481*, **48**(1), 43–58, doi:10.1007/S10640-010-9396-Z.

Van den Bulte, C., and S. Stremersch, 2004: Social Contagion and Income Heterogeneity in New Product Diffusion: A Meta-Analytic Test. *Mark Sci.*, **23**(4) 530–544, doi:10.1287/mksc.1040.0054.

van der Vleuten, E., 2004: Infrastructures and societal change. A view from the large technical systems field. *Technol. Anal. Strateg. Manag.*, **16**(3), 395–414, doi:10.1080/0953732042000251160.

van der Weele, C., P. Feindt, A. Jan van der Goot, B. van Mierlo, and M. van Boekel, 2019: Meat alternatives: an integrative comparison. *Trends Food Sci. Technol.*, **88**, 505–512, doi:10.1016/J.TIFS.2019.04.018.

Van Lange, P. A. M., J. Joireman, and M. Milinski, 2018: Climate Change: What Psychology Can Offer in Terms of Insights and Solutions. *Curr Dir. Psychol. Sci.*, **27**(4), 269–274, doi:10.1177/0963721417753945.

van Sluisveld, M. A. E., S. H. Martínez, V. Daioglou, and D. P. van Vuuren, 2016: Exploring the implications of lifestyle change in 2°C mitigation scenarios using the IMAGE integrated assessment model. *Technol. Forecast. Soc. Change*, **102**, 309–319, doi:10.1016/j.techfore.2015.08.013.

Van Vuuren, D. P. et al., 2018: Alternative pathways to the 1.5 °C target reduce the need for negative emission technologies. *Nat. Clim. Chang.*, **8**(5), 391–397, doi:10.1038/s41558-018-0119-8.

van Waes, A., J. Farla, K. Frenken, J. P. J. de Jong, and R. Raven, 2018: Business model innovation and socio-technical transitions. A new prospective framework with an application to bike sharing. *J. Clean. Prod.*, **195**, 1300–1312, doi:10.1016/j.jclepro.2018.05.223.

Vanloqueren, G., and P. V. Baret, 2009: How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. *Res. Policy*, **38**(6), 971–983, doi:10.4324/9781315666396.

Vatn, A., 2015: *Environmental governance : institutions, policies and actions*. Edward Elgar Publications,.

Veland, S. et al., 2018: Narrative matters for sustainability: the transformative role of storytelling in realizing 1.5°C futures. *Curr. Opin. Environ. Sustain.*, **31**, 41–47, doi:10.1016/j.cosust.2017.12.005.

Velazquez, L., N. Munguia, A. Platt, and J. Taddei, 2006: Sustainable university: what can be the matter? *J. Clean. Prod.*, **14**(9–11), 810–819, doi:10.1016/j.jclepro.2005.12.008.

Vinnari, M., and E. Vinnari, 2014: A Framework for Sustainability Transition: The Case of Plant-Based Diets. *J. Agric. Environ. Ethics*, **27**(3), 369–396, doi:10.1007/s10806-013-9468-5.

Vita, G., E. G. Hertwich, K. Stadler, and R. Wood, 2019a: Connecting global emissions to fundamental human needs and their satisfaction. *Environ. Res. Lett.*, **14**(1), 014002, doi:10.1088/1748-9326/aae6e0.

Vita, G. et al., 2019b: The Environmental Impact of Green Consumption and Sufficiency Lifestyles Scenarios in Europe: Connecting Local Sustainability Visions to Global Consequences. *Ecol. Econ.*, **164**(March), 106322, doi:10.1016/j.ecolecon.2019.05.002.

Vita, G. et al., 2020: Happier with less? Members of European environmental grassroots initiatives reconcile lower carbon footprints with higher life satisfaction and income increases. *Energy Res. Soc. Sci.*, **60**, doi:10.1016/j.erss.2019.101329.

Vivanco, D. F., S. Sala, and W. McDowall, 2018: Roadmap to Rebound: How to Address Rebound Effects from Resource Efficiency Policy. *Sustain. 2018, Vol. 10, Page 2009*, **10**(6), 2009, doi:10.3390/SU10062009.

Walker, C., and J. Baxter, 2017: "It's easy to throw rocks at a corporation": wind energy development and distributive justice in Canada. *J. Environ. Policy Plan.*, **19**(6), 754–768, doi:10.1080/1523908X.2016.1267614.

Walker, G., P. Devine-Wright, S. Hunter, H. High, and B. Evans, 2010: Trust and community: Exploring the meanings, contexts and dynamics of community renewable energy. *Energy Policy*, **38**(6), 2655–2663, doi:10.1016/j.enpol.2009.05.055.

Walker, W., 2000: Entrapment in large technology systems: institutional commitment and power relations. *Res. Policy*, **29**(7–8), 833–846, doi:10.1016/s0048-7333(00)00108-6.

Wang, D., T. Schwanen, and Z. Mao, 2019: Does exposure to richer and poorer neighborhoods influence wellbeing? *Cities*, **95**, doi:10.1016/j.cities.2019.102408

Ward, J. D. et al., 2016: Is Decoupling GDP Growth from Environmental Impact Possible? *PLoS One*, **11**(10), e0164733, doi:10.1371/journal.pone.0164733.

Weenig, M. W. H., and C. J. H. Midden, 1991: Communication Network Influences on Information Diffusion and Persuasion. *J. Pers. Soc. Psychol.*, **61**(5), 734–742, doi:10.1037/0022-3514.61.5.734.

Wellesley, L., and A. Froggatt, 2015: Changing Climate, Changing Diets: Pathways to Lower Meat Consumptiontle. https://www.chathamhouse.org/2015/11/changing-climate-changing-diets-pathways-lower-meat-consumption

Wester, P., A. Mishra, A. Mukherji, and A. B. Shrestha, 2019: *The Hindu Kush Himalaya Assessment - Mountains, Climate Change, Sustainability and People*. Springer,.

White, S. C., 2017: Relational wellbeing: re-centring the politics of happiness, policy and the self. *Policy Polit.*, **45**(2), 121–136, doi:10.1332/030557317X14866576265970.

Whitmarsh, L., and A. Corner, 2017: Tools for a new climate conversation: A mixed-methods study of language for public engagement across the political spectrum. *Glob. Environ. Chang.*, **42**, 122–135, doi:10.1016/j.gloenvcha.2016.12.008.

Whitmarsh, L., S. Capstick, and N. Nash, 2017: Who is reducing their material consumption and why? A cross-cultural analysis of dematerialization behaviours. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*, **375**(2095), doi:10.1098/rsta.2016.0376.

Whittle, C., L. Whitmarsh, P. Hagger, P. Morgan, and G. Parkhurst, 2019: User decision-making in transitions to electrified, autonomous, shared or reduced mobility. *Transp. Res. Part D Transp. Environ.*, **71**(January), 302–319, doi:10.1016/j.trd.2018.12.014.

Wiedenhofer, D. et al., 2020: A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part I: Bibliometric and conceptual mapping. *Environ. Res. Lett.*, **15**(6), 063002, doi:10.1088/1748-9326/ab842a.

Wiedinmyer, C. et al., 2017: Rural-urban differences in cooking practices and exposures in Northern Ghana. *Environ. Res. Lett.*, **12**(6), doi:10.1088/1748-9326/aa7036.

Wiedmann, T., and J. Minx, 2008: A Definition of "Carbon Footprint." In: *Ecological Economics Research Trends* [Pertsova, C.C., (ed.)], Nova Science Publishers.

Wilkinson, R., and K. Pickett, 2009: *The Spirit Level: Why Greater Equality Makes Societies Stronger*. Bloomsbury Press,.

Wilkinson, R., and K. Pickett, 2019: *The Inner Level: How More Equal Societies Reduce Stress, Restore Sanity and Improve Everyone's Well-Being*. Penguin,.

Wilkinson, R., K. Pickett, and R. De Vogli, 2010: Equality, sustainability, and quality of life. *BMJ*, **341**(7783), 1138–1140, doi:10.1136/bmj.c5816.

Wilkinson, R. G., 2005: *The impact of inequality*. The New Press, New York,.

Wilson, C., 2009: *Meta-analysis of unit and industry level scaling dynamics in energy technologies and climate change mitigation scenarios*. 119 pp.

Wilson, C., 2012: Up-scaling , formative phases , and learning in the historical diffusion of energy technologies. *Energy Policy*, **50**, 81–94, doi:10.1016/j.enpol.2012.04.077.

Wilson, C., A. Grubler, N. Bauer, V. Krey, and K. Riahi, 2013: Future capacity growth of energy technologies: Are scenarios consistent with historical evidence *Clim Change*, **118**(2), 381–395, doi:10.1007/s10584-012-0618-y.

Wilson, C., T. Hargreaves, and R. Hauxwell-Baldwin, 2017: Benefits and risks of smart home technologies. *Energy Policy*, **103**, 72–83, doi:10.1016/j enpol.2016.12.047

Wolsink, M., 2007: Wind power implementation: The nature of public ttitudes: Equity and fairness instead of "backyard motives." *Renew. Sustain. Energy Rev.*, **11**(6), 1188–1207, doi:10.1016/j.rser.2005.10.005.

Wolsink, M., 2010: Near-shore wind power-Protected seasc pes environmentalists' attitudes, and the technocratic planning perspective *Land use policy*, **27**(2), 195–203, doi:10.1016/j.landusepol.2009 04.004.

Women's Budget Group, 2020: *Creat ng and Caring Economy: A Call to Action*. , London, https://wbg.org.uk/wp-content/uploads/2020/09/CGEE-Creating-a-Caring-Economy-A-Call-to-Action-WBG.pdf (Accessed October 2, 2020).

Wood, R. et al., 2020: The structure, drivers and policy implications of the European carbon footprint. *Clim. Policy*, **20**(sup1), S39–S57, doi 10.1080/14693062.2019.1639489.

Woods, M., 2003: Conflicting environmental visions of the rural: Windfarm development in mid Wales. *Sociol. Ruralis*, **43**(3), 271–288, doi:10.1111/1467-9523.00245.

Woodward, K , and S. Woodw rd, 2015: Gender studies and interdisciplinarity. *Nat.* , **1**(1), 1–5, doi:10.1057/palcomms 2015.18.

Xie, B , M. J. Hurlstone, and I. Walker, 2018: Correct me if I'm wrong: groups outperform individuals in the climate sta ilization task. *Front. Psychol.*, , 17–28, doi:10.3389/fpsyg.2018.02274.

Yamamura, E , 2014: Trust in government and its effect on preferences for income redistribution and perceived tax burden. *Econ. Gov.*, **15**(1), 71–100, doi:10.1007/s10101-013-0134-1.

Yan, Z., X. Ouyang, and K. Du, 2019: Economy-wide estimates of energy rebound effect: Evidence from China's provinces. *Energy Econ.*, **83**, 389–401, doi:10.1016/j.eneco.2019.07.027.

Yellowfly, C. L., 1992: An alternative strategy for resource development : a Gitksan Wet'suwet'en proposal. , doi:10.14288/1.0086566.

You, J., 2012: Social Trust: Fairness Matters More Than Homogeneity. *Polit. Psychol.*, **33**(5), 701–721, doi:10.1111/j.1467-9221.2012.00893.x.

Yunani, A., J. Dalle, and S. Maulida, 2020: Can life quality dimensions alter ecological footprint for sustainability of asean countries? Role of per capita income, happiness and human development.

J. Secur. Sustain. Issues, **10**, doi:10.9770/jssi.2020.10.Oct(18).

Zhang, H. et al., 2020: Solar photovoltaic interventions have reduced rural poverty in China. *Nat. Commun.*, **11**(1), doi:10.1038/s41467-020-15826-4.

Zhang, L. X., C. B. Wang, and B. Song, 2013: Carbon emission reduction potential of a typical household biogas system in rural China. *J. Clean. Prod.*, **47**, 415–421, doi:10.1016/j.jclepro.2012.06.021.

Zheng, J., and S. Suh, 2019: Strategies to reduce the global carbon footprint of plastics. *Nat. Clim. Chang.*, **9**(5), 374–378, doi:10.1038/s41558-019-0459-z.

Zimmerer, K. S., 2012: The Indigenous Andean Concept of Kawsay, the Politics of Knowledge and Development, and the Borderlands of Environmental Sustainability in Latin America. *PMLA*, **127**(3), 600–606, doi:doi.org/10.1632/pmla.2012.127.3.600.

Zubi, G., F. Spertino, M. Carvalho, R. S. Adhikari, and T. Khatib, 2017: Development and assessment of a solar home system to cover cooking and lighting needs in developing regions as a better alternative for existing practices. *Sol. Energy*, **155**, 7–17, doi:10.1016/j.solener.2017 05.077.

Chapter 5: Supplementary Material II

Table SM5.2 Demand side mitigation: indicative potential by 2050 - Data and References

Sector/ Service	Emissions in 2050	Demand side mitigation achieved through	Specific mitigation strategies	Explanation	Reduction potentials for SIT in 2050	References
Food / Nutrition *Demand side mitigation potential: 44.2% (7.96 Gt CO_2eq)*	18 Gt CO_2eq *(bottom-up studies: including 9.08 land use change)*	**Socio-cultural factors**	**a)** shift in dietary choice with reduced animal protein; **b)** avoid food waste; **c)** avoid over-consumption	**a)** green procurement; diet shifts; plant-based or plant forward eating; **b)** food waste prevention; food sharing programs; **c)** lifestyl changes, avoid over consumption	40% = 7 2 GtCO_2eq Range: 18%-87% *(High confidence)* (1.9 Gt CO_2eq "economic" potential in the AFOLU sector accounting only for diverted agricultural production and excluding land use change)	(Bajželj et al. 2014; Aleksandrowicz et al. 2016; Erb et al. 2016; Hiç et al. 2016; Springmann et al. 2016; Birney et al. 2017; Gunders et al. 2017; Hadjikakou 2017; Muller et al. 2017; Parodi et al. 2018; Poore and Nemecek 2018; Schanes et al. 2018; Springmann et al. 2018a,b; Willett and al. 2018; Graça et al. 2019; Pendrill et al. 2019; Willett et al. 2019; Bajželj et al. 2020; Clark et al. 2020; Jarmul et al. 2020; Makov et al. 2020; Crippa et al. 2021; Xu et al. 2021) Also see 5.3.1.1, 5.6.2.2, Chapter 7 (7.4.5), and Chapter 12 (12.4)
		Infrastructure use	**a)** Enhances role of choice architectures, information; and incen ive through financial instruments; **b)** waste man gement; recycling infrastructure	**a)** choice architecture instruments; food labels; food-based dietary guidelines; regulations on novel oods; marketing restrictions on energy-dense food; taxes/subsidies to steer food choices towards options contributing to sustainable and healthy dietary pattern; **b)** food waste management and recycling: use of food waste as animal feed (including insects); improved collection & composting, anaerobic digestion	7% = 0.76 GtCO_2eq *(Medium confidence)*	(Smith et al. 2013; Muller et al. 2017; Mbow et al. 2019; Clark et al. 2020; Makov et al. 2020; Xu et al. 2021) Also see 5.3.1.1, Chapter 7 (7.4.5), and Chapter 12 (12.4)

		Technology adoption	-	-	-	-
Industry / Manufactured product *Demand side mitigation potential: 28.7% (4.13 Gt CO_2)*	14.4 Gt CO_2 *(IEA WEO2020, STEPS)*	**Socio-cultural factors**	Avoid short life span products in favour of products with longer lifespan	Promoting products designed with longer life span so users can extend their lifetime through repair, refurbishing, and remanufacturing, instigated via standardization, modularity and functional segregation. Standardization, modularity and functional segregation can help extending the lifespan of steel in products and therefore present a significant opportunity to reduce demand and carbon dioxide emissions from steel production. Similar approaches are possible with other emission intensive material	5% = 0.72 $GtCO_2$ Range: 3%-7% *(High confidence)*	(Cao et al. 2009; Cooper et al. 2014; Ryen et al. 2015; Grubler et al. 2018; Cao et al. 2019; IEA 2019a, 2020a,b; Lausselet et al. 2021) Also see 5.3.1.1, and Chapter 11 (11.2.1, 11.3.2). Note that the range cited here includes material sufficiency strategies that are beyond the scope of Chapter 11.
		Infrastructure use	reuse and recycling	Once a product is at the end of its technical lifespan, increasing the re-usability and recyclability of a product's components and materials. For example, old cars are dismantled into components to be re-used for repairing cars while old components that cannot be reused are recycled as scrap metals; both approaches can reduce demand for primary materials	5% = 0.68 $GtCO_2$ Range: 4%-7% *(High confidence)*	(Petersen and Solberg 2005; Cooper and Gutowski 2017; Material Economics and Economics 2018; Ellen MacArthur Foundation and Foundation 2019; Hertwich et al. 2019; IEA 2019b, 2020a,b; IRP et al. 2020; Pauliuk et al. 2021) Also see 5.3.1.1, and Chapter 11 (11.3.3)
		Technology adoption	**a)** Access to materials-efficient services; **b)** Access to energy-efficient and CO2-neutral materials	**a)** materials-efficient service provision involves avoided material demand through dematerialization, the sharing economy, materials-efficient designs, and yield improvements in manufacturing;	21% = 2.72 $GtCO_2$ Range: 15%-28% *(High confidence)*	(Carruth et al. 2011; Milford et al. 2011; Allwood and Cullen 2012; Das et al. 2016; Gutowski et al. 2017; IEA 2017; UNEP 2017; Grubler et al. 2018; Material Economics and Economics 2018; Cabrera Serrenho et al. 2019; Hertwich et al. 2019; Horton et al. 2019; Shanks et al. 2019; IEA 2020a,b; IRP et al.

				b) reducing the need for energy consumption through the installation of new efficient technologies in material production plants and through plant systems and operating practices that contribute to reduce energy needs.		2020; Coenen et al. 2021; Cordella et al. 2021; Fishman et al. 2021; Glöser-Chahoud et al. 2021; Hart et al. 2021; IEA 2021; Lausselet et al. 2021; Pauliuk et al. 2021; Pauliuk and Heeren 2021; Reis et al. 2021; Wolfram et al. 2021) (Rakib et al. 2017; Material Economics and Economics 2018; Crijns-Graus et al. 2020; IEA 2020a,b, 2021) Also see 5.3.1.1, and Chapter 11 (11.2.1, 11.3.2). Note that the range cited here includes material sufficiency strategies that are beyond the scope of Chapter 11.
Shipping / Mobility *Demand side mitigation potential: 30 % (0.348 Gt CO_2)*	1.16 Gt CO_2 *(IEA WEO2020, STEPS)*	**Socio-cultural factors**	-	-	-	
		Infrastructure use	-	-	-	
		Technology adoption	adoption of energy efficient technology/systems	Technology measures and management measures, such as slow steaming, weather routing, and propulsion efficiency devices can deliver more fuel savings than the investment required	30% = 0.348 GtCO_2 Range: 1%-40% *(Low confidence)*	(Faber et al. 2009; Wang et al. 2010; Psaraftis and Kontovas 2013; Gilbert 2014; Lindstad et al. 2015; Tillig et al. 2015; Lindstad et al. 2016; Bouman et al. 2017; ITF 2018) Also see 5.3.1.1
Aviation / Mobility *Demand side mitigation potential: 53.80 % (0.968 Gt CO_2)*	1.8 Gt CO_2 *(IEA WEO2020, STEPS)*	**Socio-cultural factors**	avoid long haul flights; shift to trains wherever possible	avoid long-haul flights and shifting to train wherever possible can contribute to aviation GHG emissions reduction	40% = 0.72Gt CO_2 Range: 0-50% *(Medium confidence)*	(Wynes and Nicholas 2017; GOV.UK 2020; Schäfer et al. 2019; Timperley 2019; IATA 2020; Gössling et al. 2021; IEA 2021; Sharmina et al. 2021) Also see 5.3.1.1, 5.4.2
		Infrastructure use		-	-	
		Technology adoption	adoption of energy efficient technologies; technologies with improved aerodynamics	adopting energy-efficient/ evolutionary technologies, like engine efficiency or aerodynamics improvement	23% = 0.248 Gt CO_2 Range: 0-30% *(Medium confidence)*	(Zeinali et al. 2013; Wynes and Nicholas 2017; Schäfer et al. 2019; Falter et al. 2020; IATA 2020; IEA 2021; Sharmina et al. 2021) Also see 5.3.1.1

Land Transport / Mobility *Demand side mitigation potential: 66.75 % (4.671Gt CO_2)*	7.0 Gt CO_2 *(IEA WEO 2020, STEPS)*	**Socio-cultural factors**	**a)** teleworking or telecommuting; **b)** active mobility such as walking and cycling	**a)** key avoid strategies involve telecommuting and teleworking behaviour and lifestyle changes; **b)** active mobility, such as walking and cycling; behavioural and lifestyle changes; change travel behaviour, prioritizing care-free mobility	5% = 0.350 Gt CO_2 Range: 0-15% *(High confidence)*	(Kitou and Horvath 2003; Roth et al. 2008; Fu et al. 2012; Lari 2012; Zhu and Mason 2014; Creutzig et al. 2016; O'Keefe et al. 2016; Martínez-Jaramillo et al. 2017; Asgari and Jin 2018; Shabanpour et al. 2018; Akbari and Hopkins 2019; Brand et al. 2021; Elldér 2020; Hook et al. 2020; Ivanova et al. 2020; O'Brien and Yazdani Aliabadi 2020; Riggs 2020; Pomponi et al. 2021) (Senbel et al. 2014; Mrkajic et al. 2015; Creutzig et al. 2016; Zahabi et al. 2016; Maizlish et al. 2017; Wynes and Nicholas 2017; Keall et al. 2018; Neves and Brand 2019; Gilby et al. 2019; Zhang et al. 2019; Bagheri et al. 2020; Brand et al. 2021; IEA 2020c) Also see 5.3.1.1, 5.3.3, 5.3.4.1 Chapter 10 (10.2)
		Infrastructure use	**a)** public transport; **b)** shared mobility; **c)** compact city	Infrastructure use (specifically urban planning and shared pooled mobility) has about 20-50% (on average) potential in the land transport GHG emissions reduction, especially via redirecting the ongoing design of existing infrastructures in developing countries, and with 30% as our central estimate	30% = 1.994 GtCO_2 Range: 20%-50% *(High confidence)*	(Lu et al. 2018; Baptista et al. 2012; Wang et al. 2013; Baptista et al. 2015; Husnjak et al. 2015; Namazu and Dowlatabadi 2015; Creutzig et al. 2016; Samaras et al. 2016; International Transport Forum 2016; Barann et al. 2017; Basarić et al. 2017; Fan et al. 2017; Fournier et al. 2017; ITF 2017a,b,c; Monzon et al. 2017; Tarulescu et al. 2017; Jung and Koo 2018; d'Orey et al. 2012; Namazu et al. 2018; Underwood and Fremstad 2018; Yin et al. 2018; Wu et al. 2018; Coulombel et al. 2019; Ding et al. 2019; Simpson et al. 2019; Alarfaj et al. 2020; IEA 2020a,c,d; ITF 2020a; Noussan and Tagliapietra 2020; Te and Lianghua 2020; Wilson et al. 2020; Yi and Yan 2020; Zhang et al. 2020; Arbeláez Vélez and Plepys 2021; Sheppard et al. 2021) Also see 5.3.1.1, 5.3.4.2, 5.6.2.2, Chapter 8 (8.2, 8.4), and Chapter 10 (10.2)

		Technology adoption	**a)** electric vehicles; **b)** efficient cars/smart cars	Technology adoption, particularly banning ICEs and EV targets and efficient lightweight cars	50% = 2.327 $GtCO_2$ Range: 30%-70% *(High confidence)*	(Lutsey 2015; Majumdar and Jash 2015; Sato and Saijo 2016; Plötz et al. 2017; EEA 2018; Broadbent et al. 2018; Biresselioglu et al. 2018; Liu et al. 2018; Onn et al. 2018; Hill et al. 2019; ITF 2019; Khalili et al. 2019; Shi et al. 2019; Skrúcaný et al. 2019; Zhuge et al. 2019; Ayetor et al. 2020; Bastida-Molina et al. 2020; Bhardwaj et al. 2020; Costa et al. 2020; IEA 2020c,a; ITF 2020b; Nimesh et al. 2020; Rajper and Albrecht 2020; Rodriguez et al. 2020; Xu et al. 2020; Peters et al. 2020; Gómez Vilchez and Jochem 2020; Ehrenberger et al. 2021; Hou et al. 2021) Also see 5.3.1.1, 5.3.3, 5.6.2.3, Chapter 8 (8.2, 8.4), and Chapter 10 (10.4 and 10.7)
Buildings /Shelter *Demand side mitigation potential: 66% (5.763 $GtCO_2$)*	8.73 Gt CO_2 *(IEA WEO2020, STEPS)*	**Socio-cultural factors**	social practices in energy saving; and lifestyle and behavioural changes	social practices in energy saving including passive management and flexibility over time; beh vioural and lifestyle changes; adaptive heating and cool ng by changing temperature set point; changing dress code; saving energy in water-heating (e g., shorter showers); switching off extra lights, and appliances	15% = 1.310 $GtCO_2$ Range: 5%-50% *(High confidence)*	(Alders 2017; Darby 2006; Wei et al. 2007; Fujino et al. 2008; Dietz et al. 2009; Murakami et al. 2009; Eyre et al. 2010; Brown et al. 2013; Creutzig et al. 2016; Podgornik et al. 2016; Rai and Henry 2016; Smith et al. 2007; Chang et al. 2017; Niamir et al. 2018; Zhang et al. 2018; Ahl et al. 2019; Niamir 2019; Strategies 2019; IEA 2020a,b; Niamir et al. 2020b; Khanna et al. 2021) Also see 5.3.1.1,5.4.1, 5.4.2, Chapter 8 (8.3.3), and Chapter 9 (9.5, 9.6)
		Infrastructure use	**a)** compact cities; **b)** living floor space rationalization; **c)** architectural design	**a)** making choice towards urban planning interventions, e.g. ncreasing density, mixed-use, makes large building spaces unnecessary; spatial planning; innovation in urban institutional structure; promote regenerative culture, behaviour **b)** decent living standard, floor space per capita, sharing economy **c)** architectural design; passive building; increase green, blue	20% = 1.484 Range: 10%-40% *(High confidence)*	(Raman 2010; NégaWatt 2011; Volochovic et al. 2012; Van Den Wymelenberg 2012; Lin et al. 2013; Fell et al. 2014; Rafsanjani et al. 2015; Creutzig et al. 2016; Lohrey and Creutzig 2016; Taniguchi et al. 2016; Hasegawa 2016; Darby et al. 2016; Borck and Brueckner 2017; Sun and Hong 2017; Bai et al. 2018; Grubler et al. 2018; Levesque et al. 2018; Negawatt 2018; Peng and Bai 2018; Rao and Min 2018; Ürge-Vorsatz et al. 2018; Bierwirth and Thomas 2019; Cabrera Serrenho et al. 2019; Levesque et al. 2019; Ellsworth-Krebs et al. 2019; Mastrucci and

			spaces; ecosystem based/nature-based solutions		Rao 2019; Rao et al. 2019a,b; Elnagar and Köhler 2020; Ivanova and Büchs 2020; Millward-Hopkins et al. 2020; Kuhnhenn et al. 2020; IEA 2020e,a; Mata et al. 2020; Kikstra et al. 2021; Seto et al. 2021) Also see 5.2, 5.3.1.1, 5.4, Chapter 8 (8.2, 8.3, 8.4, 8.5.1, 8.6), and Chapter 9 (9.3, 9.4, 9.5, 9.6, 9.9)
	Technology adoption	**a)** energy efficiency; **b)** shift to renewables	**a**) adopting energy efficient solutions: preference for net zero new buildings retrofits including improved building envelope improved building technical systems for HVAC, cooking and electrical uses; choice for smart home and digitalization; efficient appliances, control systems; **b)** choice for installation of renewables: on-site/rooftop renewables (e.g. solar thermal and solar pv) microgrids, switch to lower carbon fuels	50% = 2.969 Range: 30%-70% *(High confidence)*	(Hidalgo 2013; Novikova et al. 2015; Oluleye and Smith 2016; Purohit et al. 2016; Ruparathna et al. 2016; Timilsina et al. 2016; Virage-énergie Nord-Pas de Calais 2016; Wittchen et al. 2016; Braulio-Gonzalo and Bovea 2017; Purohit and Höglund-Isaksson 2017; Sharma et al. 2017; ECF 2018; Oluleye et al. 2018; Strategies 2019; IEA 2020a,e; Mata et al. 2020; Mastrucci et al. 2020; Brown et al. 2013; Hansen and Hauge 2017; Niamir et al. 2020a; Grubler et al. 2016; Niamir 2019; Mastrucci and Rao 2017; Mahadevan et al. 2020; Puzzolo and Pope 2017; Baranzini et al. 2017; Dolman Abu-Ebid, M. and Stambaugh, J. 2012; Ürge-Vorsatz et al. 2014; Markandya et al. 2015; Markewitz et al.; Iten et al. 2017; Economidou et al. 2018; Peñaloza et al. 2018; Giraudet et al. 2018; Mata et al. 2018; Niamir et al. 2018; González-Mahecha et al. 2019; Irshad et al. 2019; Langevin et al. 2019; Mastrucci and Rao 2019; Cabeza and Chàfer 2020; van der Grijp et al. 2019; UNFCCC 2015; Hazra et al. 2014; Niamir et al. 2020c; Krey et al. 2014) Also see 5.3.1.1, 5.6, and Chapter 9 (9.4, 9.6, 9.9)

Table SM5.3 Electricity illustrative scenario by 2050: electrification and demand side measures - Data and References

Emissions in 2050	Electrification and demand side measures	Gt CO_2 Changes in 2050	References
10.5 Gt CO_2 *(IEA WEO2020, STEPS)*	additional electrification of industry	+1.93	(Bruckner et al. 2014; BloombergNEF 2020; IEA 2021)
	additional electrification of transport	+1.98	(Bruckner et al. 2014; Sims et al. 2014; Creutzig et l. 2015; BloombergNEF 2020; IEA 2021)
	additional electrification of buildings	+2.39	(Bruckner et al. 2014; Lucon et al 2014; BloombergNEF 2020; IEA 2021)
	demand-side measures of industry	-1.4	See socio-cultural factors and infrastructur use under industry
	demand-side measures of transport	-2.3	See socio-cultural factors and infrastructure use under land transport
	demand-side measures of buildings	-2.8	See socio-cultural factors and infrastructure use under buildings
	load/demand management	-1.22	(Bruckner et al 2014; IRENA 2018; BloombergNEF 2020)

References

Ahl, A., G. Accawi, B. Hudey, M. Lapsa, and T. Nichols, 2019: Occupant Behavior for Energy Conservation in Commercial Buildings: Lessons Learned from Competition at the Oak Ridge National Laboratory. *Sustainability*, **11**(12), 3297, doi:10.3390/su11123297.

Akbari, M., and J. L. Hopkins, 2019: An investigation into anywhere working as a system for accelerating the transition of Ho Chi Minh city into a more livable city. *J. Clean. Prod.*, **209**, 665–679, doi:10.1016/j.jclepro.2018.10.262.

Alarfaj, A. F., W. M. Griffin, and C. Samaras, 2020: Decarbonizing US passenger vehicle transport under electrification and automation uncertainty has a travel budget. *Environ. Res. Lett.*, **15**(9), 0940c2, doi:10.1088/1748-9326/ab7c89.

Alders, E. E., 2017: Adaptive heating, ventilation and solar shading for dwellings. *Archit. Sci. Rev.*, **60**(3), 150–166, doi:10.1080/00038628.2017.1300132.

Aleksandrowicz, L., R. Green, E. J. M. Joy, P. Smith, and A. Haines, 2016: The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: A systematic review. *PLoS One*, **11**(11), 1–16, doi:10.1371/journal.pone.0165797.

Allwood, J. M., and J. M. Cullen, 2012: *Sustainable Materials: with both eyes open*. UIT Cambridge Ltd., Cambridge, 373 pp.

Arbeláez Vélez, A. M., and A. Plepys, 2021: Car Sharing as a Strategy to Address GHG Emissions in the Transport System: Evaluation of Effects of Car Sharing in Amsterdam. *Sustainability*, **13**(4), 2418, doi:10.3390/su13042418.

Asgari, H., and X. Jin, 2018: An evaluation of part-day telecommute impacts on work trip departure times. *Travel Behav. Soc.*, **12**, 84–92, doi:10.1016/j.tbs.2017.04.002.

Ayetor, G. K., D. A. Quansah, and E. A. Adjei, 2020: Towards zero vehicle emissions in Africa: A case study of Ghana. *Energy Policy*, **143**, 111606, doi:10.1016/j.enpol.2020.111606.

Bagheri, M., M. N. Mladenović, I. Kosonen, and J. K. Nurminen, 2020: Analysis of Potential Shift to Low-Carbon Urban Travel Modes: A Computational Framework Based on High-Resolution Smartphone Data. *Sustainability*, **12**(15), 5901, doi:10.3390/su12155901.

Bai, X. et al., 2018: Six research priorities for cities and climate change. *Nature*, **555**(7694), 23–25, doi:10.1038/d41586-018-02409-z.

Bajželj, B. et al., 2014: Importance of food-demand management for climate mitigation. *Nat. Clim. Chang.*, **4**(10), 924–929, doi:10.1038/nclimate2353.

Bajželj, B., T. E. Quested, E. Röös, and R. P. J. Swannell, 2020: The role of reducing food waste for resilient food systems. *Ecosyst. Serv.*, **45**, 101140, doi:10.1016/j.ecoser.2020.101140.

Baptista, P., S. Melo, and C. Rolim, 2015: Car Sharing Systems as a Sustainable Transport Policy: A Case Study from Lisbon, Portugal. In: *Sustainable Urban Transport*, Vol. 7 of *Transport and Sustainability*, Emerald Group Publishing Limited, pp. 205–227.

Baptista, P. C., I. L. Azevedo, and T. L. Farias, 2012: ICT Solutions in Transportation Systems: Estimating the Benefits and Environmental Impacts in the Lisbon. *Procedia - Soc. Behav. Sci.*, **54**, 716–725, doi:10.1016/j.sbspro.2012.09.789.

Barann, B., D. Beverungen, and O. Müller, 2017: An open-data approach for quantifying the potential of taxi ridesharing. *Decis. Support Syst.*, **99**, 86–95, doi:10.1016/j.dss.2017.05.008.

Baranzini, A., S. Carattini, and M. Péclat, 2017: *What drives social contagion in the adoption of solar photovoltaic technology?* 38 pp. http://www.lse.ac.uk/GranthamInstitute/publication/what-drives-social-contagion-in-the-adoption-of-solar-photovoltaic-technology/.

Basarić, V. B. et al., 2017: Positive effects of eco-driving in public transport: A case study of the City Novi Sad. *Therm. Sci.*, **21**(1 Part B), 683–692.

Bastida-Molina, P., E. Hurtado-Pérez, E. Peñalvo-López, and M. Cristina Moros-Gómez, 2020: Assessing transport emissions reduction while increasing electric vehicles and renewable generation levels. *Transp. Res. Part D Transp. Environ.*, **88**, 102560, doi:10.1016/j.trd.2020.102560.

Bhardwaj, C., J. Axsen, F. Kern, and D. McCollum, 2020: Why have multiple climate policies for light-duty vehicles? Policy mix rationales, interactions and research gaps. *Transp. Res. Part A Policy Pract.*, **135**, 309–326, doi:10.1016/j.tra.2020.03.011.

Bierwirth, A., and S. Thomas, 2019: *Estimating the sufficiency potential in buildings: the space between under-dimensioned and oversized*. https://ec.europa.eu/eurostat/.

Biresselioglu, M. E., M. Demirbag Kaplan, and B. K. Yilmaz, 2018: Electric mobility in Europe: A comprehensive review of motivators and barriers in decision making processes. *Transp. Res. Part A Policy Pract.*, **109**, 1–13, doi:10.1016/j.tra.2018.01.017.

Birney, C. I., K. F. Franklin, F. T. Davidson, and M. E. Webber, 2017: An assessment of individual foodprints attributed to diets and food waste in the United States. *Environ. Res. Lett.*, **12**(10), 105008, doi:10.1088/1748-9326/aa8494.

BloombergNEF, 2020: *Sector Coupling in Europe: Powering Decarbonisation*. https://www.eaton.com/za/en-gb/company/news-insights/energy-transition/sector-coupling.html (Accessed December 23, 2020).

Borck, R., and J. K. Brueckner, 2017: Optimal Energy Taxation in Cities. *J. Assoc. Environ. Resour. Econ.*, **5**(2), 481–516, doi:10.1086/695614.

Bouman, E. A., E. Lindstad, A. I. Rialland, and A. H. Strømman, 2017: State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping – A review. *Transp. Res. Part D Transp. Environ.*, **52**, 408–421, doi:10.1016/j.trd.2017.03.022.

Brand, C. et al., 2021: The climate change mitigation effect of daily active travel in cities. *Transp. Res. Part D Transp. Environ.*, **93**, 102764, doi:10.1016/j.trd.2021.102764.

Braulio-Gonzalo, M., and M. D. Bovea, 2017: Environmental and cost performance of building's envelope insulation materials to reduce energy demand: Thickness optimisation. *Energy Build.*, **150**, 527–545, doi:10.1016/J.ENBUILD.2017.06.005.

Broadbent, G. H., D. Drozdzewski, and G. Metternicht, 2018: Electric vehicle adoption: An analysis of best practice and pitfalls for policy making from experiences of Europe and the US. *Geogr. Compass*, **12**(2), e12358, doi:https://doi.org/10.1111/gec3.12358.

Brown, Z., N. Johnstone, I. Haščič, L. Vong, and F. Barascud, 2013: Testing the effect of defaults on the thermostat settings of OECD employees. *Energy Econ.*, **39**, 128–134, doi:10.1016/j.eneco.2013.04.011.

Bruckner, T. et al., 2014: Energy Systems. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E., C. Von Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, and T.Z. and J.C.M. Stechow, (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. pp. 88.

Cabeza, L. F., and M. Chàfer, 2020: Technological options and strategies towards zero energy buildings contributing to climate change mitigation: A systematic review. *Energy Build.*, **219**, 110009, doi:10.1016/J.ENBUILD.2020.110009.

Cabrera Serrenho, A., M. Drewniok, C. Dunant, and J. M. Allwood, 2019: Testing the greenhouse gas emissions reduction potential of alternative strategies for the english housing stock. *Resour. Conserv. Recycl.*, **144**, 267–275, doi:10.1016/j.resconrec.2019.02.001.

Cao, X., P. L. Mokhtarian, and S. L. Handy, 2009: Examining the impacts of residential self-selection on travel behaviour: A focus on empirical findings. *Transp. Rev.*, **29**(3), 359–395, doi:10.1080/01441640802539195.

Cao, Z. et al., 2019: Unravelling the mystery of Chinese building lifetime: A calibration and verification based on dynamic material flow analysis. *Appl. Energy*,.

Carruth, M. A., J. M. Allwood, and M. C. Moynihan, 2011: The technical potential for reducing metal requirements through lightweight product design. *Resour. Conserv. Recycl.*, **57**, 48–60, doi:10.1016/j.resconrec.2011.09.018.

Chang, C., N. Zhu, and J. Shang, 2017: The study of occupant behavior analysis of Inner Mongolia in regard to heating energy consumption. *Procedia Eng.*, **205**, 915–922, doi:10.1016/j.proeng.2017.10.122.

Clark, M. A. et al., 2020: Global food system emissions could preclude achieving the 1.5° and 2° C climate change targets. *Science*, **370**(6517), 705–708, doi:10.1126/science.aba7357.

Coenen, T. B. J., J. Santos, S. A. A. M. Fennis, and J. I. M. Halman, 2021: Development of a bridge circularity assessment framework to promote resource efficiency in infrastructure projects. *J. Ind. Ecol.*, **25**(2), 288–304, doi:https://doi.org/10.1111/jiec.13102.

Cooper, C. L., Y. Liu, and S. Y. Tarba, 2014: Resilience, HRM practices and impact on organizational performance and employee well-being. *Int. J. Hum. Resour. Manag.*, **25**(17), 2466–2471, doi:10.1080/09585192.2014.926688

Cooper, D. R., and T. G. Gutowski, 2017: The Environmental Impacts of Reuse: A Review. *J. Ind. Ecol.*, **21**(1), 38–56, doi:https://doi.org/10.1111 jiec.12388.

Cordella, M., F. Alfieri, and J. Sanfelix, 2021: Reducing the carbon footprint of ICT products through material efficiency strategies: A life cycle analysis of smartphones. *J. Ind. Ecol.*, **25**(2), 448–464, doi:10.1111/jiec.13119

Costa, E. et al., 2020: Diffusion of electric vehicles in Brazil from the stakeholders' perspective. *Int. J. Sustain. Transp.*, **0**(0), 1–14, doi:10.1080/15568318.2020.1827317.

Coulombel, N., V. Boutueil, L. Liu, V Viguié and B. Yin, 2019: Substantial rebound effects in urban ridesharing: Simulating travel decisions in Paris, France. *Transp. Res. Part D Transp. Environ.*, **71**(December 2018), 110 126, doi:10.1016/j.trd.2018.12.006.

Creutzig, F. et al., 2015: Transport: A roadblock to climate change mitigation? *Science*, **350**(6263), 911–912, doi:10.1126/science.aac8033.

Creutzig, F. et al , 2016: Urban infrastructure choices structure climate solutions. *Nat. Clim. Chang.*, **6**(12), 1054, doi:10.1038/nclimate3169.

Crijns-Graus, W., H. Yue, S. Zhang, K. Kermeli, and E. Worrell, 2020: Energy Efficiency Improvement Opportunities in the Global Industrial Sector. In: *Encyclopedia of Renewable and Sustainable Materials* [Hashmi, S. and I.A. Choudhury, (eds.)], Elsevier, Amsterdam, pp 377–388.

Crippa, M. et al., 2021: Food systems are responsible for a third of global anthropogenic GHG emissions. *Nat Food*, **2**(3), 198–209, doi:10.1038/s43016-021-00225-9.

d'Orey, P. M , R Fernandes, and M. Ferreira, 2012: Reducing the environmental impact of taxi operation: The taxi-sharing use case. *2012 12th International Conference on ITS Telecommunications*, 319–323.

Darby, H., A. Elmualim, D. Clements-Croome, T. Yearley, and W. Box, 2016: Influence of occupants' behaviour on energy and carbon emission reduction in a higher education building in the UK. *Intell. Build. Int.*, **8**(3), 157–175, doi:10.1080/17508975.2016.1139535.

Darby, S., 2006: *The effectiveness of feedback on energy consumption a review for defra of the literature on metering, billing and direct displays*. 24 pp. https://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf (Accessed November 28, 2020).

Das, S. et al., 2016: Vehicle lightweighting energy use impacts in U.S. light-duty vehicle fleet. *Sustain. Mater. Technol.*, **8**, 5–13, doi:10.1016/j.susmat.2016.04.001.

Dietz, T., G. T. Gardner, J. Gilligan, P. C. Stern, and M. P. Vandenbergh, 2009: Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proc. Natl. Acad. Sci.*, **106**(44), 18452–18456, doi:10.1073/pnas.0908738106.

Ding, N., J. Pan, Z. Zhang, and J. Yang, 2019: Life cycle assessment of car sharing models and the effect on GWP of urban transportation: A case study of Beijing. *Sci. Total Environ.*, **688**, 1137–1144, doi:10.1016/j.scitotenv.2019.06.111.

Dolman Abu-Ebid, M. and Stambaugh, J., E., 2012: Decarbonising heat in buildings: 2030–2050. (April 2012), 2030–2050.

ECF, 2018: *Net Zero by 2050: from whether to how*. 35 pp. https://europeanclimate.org/wp-content/uploads/2019/11/09-18-net-zero-by-2050-from-whether-to-how.pdf.

Economidou, M., P. Zangheri, A. Müller, and L. Kranzl, 2018: Financing the Renovation of the Cypriot Building Stock: An Assessment of the Energy Saving Potential of Different Policy Scenarios Based on the Invert/EE-Lab Model. *Energies*, **11**(11), 3071, doi:10.3390/en11113071.

EEA, 2018: *Electric vehicles from life cycle and circular economy perspectives*. , Luxembourg, https://www.eea.europa.eu/publications/electric-vehicles-from-life-cycle (Accessed December 23, 2020).

Ehrenberger, S. et al., 2021: Land transport development in three integrated scenarios for Germany – Technology options, energy demand and emissions. *Transp. Res. Part D Transp. Environ.*, **90**, 102669, doi:10.1016/j.trd.2020.102669.

Elldér, E., 2020: Telework and daily travel: New evidence from Sweden. *J. Transp. Geogr.*, **86**, 102777, doi:10.1016/J.JTRANGEO.2020.102777.

Ellen MacArthur Foundation, and E. M. Foundation, 2019: *Completing the Picture: How the Circular Economy Tackles Climate Change*. https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-_Tackles_Climate_Change_V3_26_September.pdf (Accessed December 23, 2020).

Ellsworth-Krebs, K., L. Reid, and C. J. Hunter, 2019: Home Comfort and "Peak Household": Implications for Energy Demand. *Housing, Theory Soc.*, , doi:10.1080/14036096.2019.1694579.

Elnagar, E., and B. Köhler, 2020: Reduction of the Energy Demand With Passive Approaches in Multifamily Nearly Zero-Energy Buildings Under Different Climate Conditions. *Front. Energy Res.*, **8**, doi:10.3389/fenrg.2020.545272.

Erb, K.-H. et al., 2016: Exploring the biophysical option space for feeding the world without deforestation. *Nat. Clim. Chang.*, **48**(7), 829–834, doi:https://doi.org/10.1038/ncomms11382.

Eyre, N., C. Anable, R. Brand, R. Layberry, and N. Strachan, 2010: The way we live from now on: lifestyle and energy consumption. In: *Energy 2050: Making the Transition to a Secure Low-Carbon Energy System* [Ekins, P., J. Skea, and M. Winskel, (eds.)], Earthscan, London, pp. 258–293.

Faber, J. et al., 2009: *Technical Support for European Action to Reducing Greenhouse Gas Emissions from International Maritime Transport*. , Delft, 352 pp. https://hdl.handle.net/11245/1.401570.

Falter, C., N. Scharfenberg, and A. Habersetzer, 2020: Geographical Potential of Solar Thermochemical Jet Fuel Production. *Energies*, **13**(4), 802, doi:10.3390/en13040802.

Fan, J.-L., J.-X. Wang, F. Li, H. Yu, and X. Zhang, 2017: Energy demand and greenhouse gas emissions of urban passenger transport in the Internet era: A case study of Beijing. *J. Clean. Prod.*, **165**, 177–189, doi:10.1016/j.jclepro.2017.07.106.

Fell, M. J., D. Shipworth, G. M. Huebner, and C. A. Elwell, 2014: Exploring perceived control in domestic electricity demand-side response. *Technol. Anal. Strateg. Manag.*, **26**(10), 1118–1130, doi:10.1080/09537325.2014.974530.
Fishman, T. et al., 2021: A comprehensive set of global scenarios of housing, mobility, and material efficiency for material cycles and energy systems modeling. *J. Ind. Ecol.*, **25**(2), 305–320, doi:https://doi.org/10.1111/jiec.13122.
Fournier, G., C. Pfeiffer, M. Baumann, and R. Wörner, 2017: Individual mobility by shared autonomous electric vehicle fleets: Cost and CO2 comparison with internal combustion engine vehicles in Berlin, Germany. *2017 International Conference on Engineering, Technology and Innovation (ICE/ITMC)*, 368–376.
Fu, M., J. Andrew Kelly, J. Peter Clinch, and F. King, 2012: Environmental policy implications of working from home: Modelling the impacts of land-use, infrastructure and socio-demographics. *Energy Policy*, **47**, doi:10.1016/j.enpol.2012.05.014.
Fujino, J. et al., 2008: Back-casting analysis for 70% emission reduction in Japan by 2050. *Clim. Policy*, **8**(sup1), S108–S124, doi:10.3763/cpol.2007.0491.
Gilbert, P., 2014: From reductionism to systems thinking: How the shipping sector can address sulphur regulation and tackle climate change. *Mar. Policy*, **43**, 376–378, doi:10.1016/J.MARPOL.2013.07.009.
Gilby, S. et al., 2019: *Sustainable Lifestyles Policy and Practice Challenges and Way Forward - Annex: Case Studies.* Institute for Global Environmental Strategies, Hayama, Japan, https://www.iges.or.jp/en/publication_documents/pub/discussionpaper/en/10374/Sustainable+Lifestyles+Policy+and+Practice+Annex_Lo+Res.pdf.
Giraudet, L. et al., 2018: Long-term efficiency and distributional impacts of energy saving policies in the French residential sector To cite th s ve sion : HAL Id : hal-01890642 Long-term efficiency and distributional impacts of energy saving policies.
Glöser-Chahoud, S., M. Pfaff, and F. Schultmann, 2021: The link between product service lifetime and GHG emissions: A comparative study for different consumer products. *J. Ind. Ecol.*, **25**(2), 465–478, doi:https //doi.org/10.1111/jiec.13123.
Gómez Vilchez, J. J., and P. Jochem, 2020: Powertrain technologies and their impact on greenhouse gas emissions in key car markets. *Transp. Res. Part D Transp. Environ.*, **80**, 102214, doi:10 1016/j.trd.2019.102214.
González-Mahecha, R. E. et al., 2019: Greenhouse gas mitigation potential and abatement costs in the Brazilian residentia sector. *Energy Build.*, **184**(December), 19–33, doi:10.1016/j enbuild 2018.11.039.
Gössling, S., A Humpe, F. Fichert, and F. Creutzig, 2021: COVID-19 and pathways to low-carbon air transport until 2050. *Environ. Res. Lett.*, **16**(3), 34063, doi:10.1088/1748-9326/abe90b
GOV.UK, 2020: *Greenhouse gas reporting: conversion factors 2019*. https://www gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors 2019.
Graça, J., C. A. Godinho, and M. Truninger, 2019: Reducing meat consumption and following plant-based diets: Current evidence and future directions to inform integrated transitions. *Trends Food Sci. Technol.*, **91**, 380–390, doi:10.1016/j.tifs.2019.07.046.
Grubler, A., C. Wilson, and G. Nemet, 2016: Apples, oranges, and consistent comparisons of the temporal dynamics of energy transitions. *Energy Res. Soc. Sci.*, **22**, 18–25, doi:10.1016/j.erss.2016.08.015.
Grubler, A. et al., 2018: A low energy demand scenario for meeting the 1.5° C target and sustainable development goals without negative emission technologies. *Nat. Energy*, **3**(6), 515–527, doi:10.1038/s41560-018-0172-6.
Gunders, D. et al., 2017: Wasted: How America is Losing up to 40% of its Food from Farm to

Fork to Landfill. *NRDC*,.
Gutowski, T., D. Cooper, and S. Sahni, 2017: Why we use more materials. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.*, **375**(2095), 20160368, doi:10.1098/rsta.2016.0368.
Hadjikakou, M., 2017: Trimming the excess: environmental impacts of discretionary food consumption in Australia. *Ecol. Econ.*, **131**(C), 119–128.
Hansen, M., and B. Hauge, 2017: Prosumers and smart grid technologies in Denmark: developing user competences in smart grid households. *Energy Effic.*, **10**(5), 1215–1234, doi:10.1007/s12053-017-9514-7.
Hart, J., B. D'Amico, and F. Pomponi, 2021: Whole-life embodied carbon in multistory buildings: Steel, concrete and timber structures. *J. Ind. Ecol.*, **25**(2), 403–418, doi:https://doi.org/10.1111/jiec.13139.
Hasegawa, K., 2016: Stimation on the effect of CO2 reduction through the action of cool share and warm share in Akita city. *AIJ J. Technol. Des.*, **22**(51), 1–4, doi:10.3130/aijt.22.641.
Hazra, S., Lewis Jessica, Das Ipsita, and Kumar Singha Ashok, 2014: *Adoption and use of improved stoves and biogas plants in rural India*. South Asian Network for Development and Environmental Economics., 22 pp.
Hertwich, E. G. et al., 2019: Material efficiency strategies to reducing greenhouse gas emissions associated with buildings, vehicles, and electronics—a review. *Environ. Res. Lett.*, **14**(4), 043004, doi:10.1088/1748-9326/ab0fe3
Hiç, C., P. Pradhan, D. Rybski, and J. P. Kropp, 2016: Food Surplus and Its Climate Burdens. *Environ. Sci. Technol.*, **50**(8), 4269–4277, doi:10.1021/acs.est.5b05088.
Hidalgo, K. B. and A., 2013: Integrated assessment modelling for building sectors – a technical, economic and ecological analysis for Germany and the EU until 2050. 1365–1376.
Hill, G., O. Heidrich, F. Creutzig, and P. Blythe, 2019: The role of electric vehicles in near-term mitigation pathways and achieving the UK s carbon budget. *Appl. Energy*, **251**, 113111, doi:10.1016/j.apenergy 2019.04.107.
Hook, A., V. Court, B. K. Sovacool, and S. Sorrell, 2020: A systematic review of the energy and climate impacts of teleworking. *Environ. Res. Lett.*, **15**(9), doi:10.1088/1748-9326/ab8a84.
Horton, P. M., J. M. Allwood, and C. Cleaver, 2019: Implementing material efficiency in practice: A case study to improve the material utilisation of automotive sheet metal components *Resour. Conserv. Recycl.*, **145**, 49–66, doi:10.1016/j.resconrec.2019.02.012.
Hou, F. et al., 2021: Comprehensive analysis method of determining global long-term GHG mitigation potential of passenger battery electric vehicles. *J. Clean. Prod.*, **289**, 125137, doi:10.1016/j.jclepro 2020 125137.
Husnjak, S., I. Forenbacher and T. Bucak, 2015: Evaluation of Eco-Driving Using Smart Mobile Devices. *Promet - Traffic&Transportation*, **27**(4), 335–344, doi:10.7307/ptt v27i4.1712.
IATA, 2020: *IATA Annual Review 2020*. , Amsterdam, 56 pp. https://www.iata.org/en/publications/annual-review/.
IEA, 2017: *Energy Technology Perspectives 2017: Catalysing Energy Technology Transformations*. OECD, 443 pp.
IEA, 2019a: *Material efficiency in clean energy transitions*. OECD, 162 pp.
IEA, 2019b: *Material efficiency in clean energy transitions – Analysis*. https://www.iea.org/reports/material-efficiency-in-clean-energy-transitions.
IEA, 2020a: *World Energy Outlook 2020*. OECD, Paris,.
IEA, 2020b: *Tracking Industry 2020*. https://www.iea.org/reports/tracking-industry-2020 (Accessed December 23, 2020).
IEA, 2020c: *Tracking Transport 2020* . https://www.iea.org/reports/tracking-transport-2020 (Accessed December 23, 2020).

IEA, 2020d: *World Energy Balances: Overview*. , Paris, France, https://www.iea.org/reports/world-energy-balances-overview.
IEA, 2020e: *Tracking Buildings 2020*. https://www.iea.org/reports/tracking-buildings-2020 (Accessed December 23, 2020).
IEA, 2021: *Net Zero by 2050: A Roadmap for the Global Energy Sector*. , Paris, 224 pp.
International Transport Forum, 2016: *Shared mobility: innovation for liveable cities*. 56 pp.
IRENA, 2018: *Renewable Power Generation Costs in 2017*. International Renewable Energy Agency, Abu Dhabi, 160 pp.
IRP et al., 2020: *Resource Efficiency and Climate Change: Material Efficiency Strategies for a Low-Carbon Future.* United Nations Environment Programme, Nairobi, Kenya, Kenya, 173 pp. https://stg-wedocs.unep.org/bitstream/handle/20.500.11822/34351/RECCR.pdf?sequence=1&isAllowed=y.
Irshad, K., K. Habib, R. Saidur, M. W. Kareem, and B. B. Saha, 2019: Study of thermoelectric and photovoltaic facade system for energy efficient building development: A review. *J. Clean. Prod.*, **209**, 1376–1395, doi:10.1016/J.JCLEPRO.2018.09.245.
Iten, R. et al., 2017: *Auswirkungen eines subsidiären Verbots fossiler Heizungen*. , Zürich/Bern,.
ITF, 2017a: *Transition to Shared Mobility: How large cities can deliver inclusive transport services*. , Paris,.
ITF, 2017b: *Shared Mobility Simulations for Auckland*. 91 pp.
ITF, 2017c: *Shared Mobility Simulations for Helsinki*. 95 pp.
ITF, 2018: *Decarbonising Maritime Transport: Pathways to zero-carbon shipping by 2035*. 86 pp. https://www.itf-oecd.org/decarbonising-maritime-transport (Accessed December 23, 2020).
ITF, 2019: *ITF Transport Outlook 2019*. OECD Publishing, Paris, France, 200 pp.
ITF, 2020a: *Shared Mobility Simulations for Lyon*. 91 pp.
ITF, 2020b: *Good to Go? Assessing the Environmental Performance of New Mobility*. https://www.itf-oecd.org/good-go-assessing-environmental-performance-new-mobility.
Ivanova, D., and M. Büchs, 2020: Household Sharing for Carbon and Energy Reductions: The Case of EU Countries. *Energies*, **13**(8), 1–28.
Ivanova, D. et al., 2020: Quantifying the potential for climate change mitigation of consumption options. *Environ. Res. Lett.*, **15**(9), 093001, doi:10.1088/1748-9326/ab8589.
Jarmul, S. et al., 2020: Climate change mitigation through dietary change: a systematic review of empirical and modelling studies on the environmental footprints and health effects of 'sustainable diets.' *Environ. Res. Lett.*, **15**(12), 123014, doi:10.1088/1748-9326/abc2f7.
Jung, J., and Y. Koo, 2018: Analyzing the effects of car sharing services on the reduction of greenhouse gas (GHG) emissions. *Sustainability*, **10**(2), doi:10.3390/su10020539.
Keall, M. D., C. Shaw, R. Chapman, and P. Howden-Chapman, 2018: Reductions in carbon dioxide emissions from an intervention to promote cycling and walking: A case study from New Zealand. *Transp. Res. Part D Transp. Environ.*, **65**, 687–696, doi:10.1016/j.trd.2018.10.004.
Khalili, S., E. Rantanen, D. Bogdanov, and C. Breyer, 2019: Global Transportation Demand Development with Impacts on the Energy Demand and Greenhouse Gas Emissions in a Climate-Constrained World. *Energies*, **12**(20), 3870, doi:10.3390/en12203870.
Khanna, T. M. et al., 2021: A multi-country meta-analysis on the role of behavioural change in reducing energy consumption and CO2 emissions in residential buildings. *Nat. Energy*, **6**(September 2021), 925–932, doi:10.1038/s41560-021-00866-x.
Kikstra, J. S., A. Mastrucci, J. Min, K. Riahi, and N. D. Rao, 2021: Decent living gaps and energy needs around the world. *Environ. Res. Lett.*, **16**(9), 095006, doi:10.1088/1748-

9326/AC1C27.
Kitou, E., and A. Horvath, 2003: Energy-related emissions from telework. *Environ. Sci. Technol.*, **37**(16), 3467–3475, doi:10.1021/es025849p.
Krey, V., G. Luderer, L. Clarke, and E. Kriegler, 2014: Getting from here to there - energy technology transformation pathways in the EMF27 scenarios. *Clim. Change*, **123**(3–4), 369–382, doi:10.1007/s10584-013-0947-5.
Kuhnhenn, K., L. Costa, E. Mahnke, L. Schneider, and S. Lange, 2020: *A Societal Transformation Scenario for Staying Below 1.5°C | Heinrich Böll Stiftung*.
Langevin, J., C. B. Harris, and J. L. Reyna, 2019: Assessing the Potential to Reduce U.S. Building CO2 Emissions 80% by 2050. *Joule*, **3**(10), 2403–2424, doi:10.1016/J.JOULE.2019.07.013.
Lari, A., 2012: Telework/Workforce Flexibility to Reduce Congestion and Environmental Degradation? *Procedia - Soc. Behav. Sci.*, **48**, doi:10.1016/j.sbspro.2012.06.1049.
Lausselet, C., J. P. F. Urrego, E. Resch, and H. Brattebø, 2021: Temporal analysis of the material flows and embodied greenhouse gas emissions of a neighborhood building stock. *J. Ind. Ecol.*, **25**(2), 419–434, doi:https://doi.org/10.1111/jiec.13049.
Levesque, A. et al., 2018: How much energy will buildings consume in 2100? A global perspective within a scenario framework. *Energy*, , doi:10.1016/j.energy.2018.01.139.
Levesque, A., R. C. Pietzcker, and G. Luderer, 2019: Halving energy demand from buildings: The impact of low consumption practices. *Technol. Forecast. Soc. Change*, **146**, 253–266, doi:10.1016/j.techfore.2019.04.025.
Lin, T., Y. Yu, X. Bai, L. Feng, and J. Wang, 2013: Greenhouse Gas Emissions Accounting of Urban Residential Consumption: A Household Survey Based Approach. *PLoS One*, **8**(2), doi:10.1371/journal.pone.0055642.
Lindstad, H., B. E. Asbjørnslett, and A. H. Strømman, 2015: Opportunities for increased profit and reduced cost and emissions by service differentiation within container liner shipping. *Marit. Policy Manag.* , **43**(3), 280–294, doi:10.1080/03088839.2015.1038327.
Lindstad, H., R. M. Bright, and A. H. Strømman, 2016: Economic savings linked to future Arctic shipping trade are at odds with climate change mitigation. *Transp. Policy*, **45**, 24–30, doi:10.1016/J.TRANPOL.2015.09.002.
Liu, Z. et al., 2018: How does circular economy respond to greenhouse gas emissions reduction: An analysis of Chinese plastic recycling industries. *Renew. Sustain. Energy Rev.*, **91**, 1162–1169, doi:https://doi.org/10.1016/j.rser.2018.04.038.
Lohrey, S., and F. Creutzig, 2016: A 'sustainability window' of urban form. *Transp. Res. Part D Transp. Environ.*, **45**, 96–111, doi:10.1016/j.trd.2015.09.004.
Lu, M., M. Taiebat, M. Xu, and S.-C. Hsu, 2018: Multiagent Spatial Simulation of Autonomous Taxis for Urban Commute: Travel Economics and Environmental Impacts. *J. Urban Plan. Dev.*, **144**(4), 4018033, doi:10.1061/(ASCE)UP.1943-5444.0000469.
Lucon, O. et al., 2014: Buildings. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O. et al., (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., pp. 671–738.
Lutsey, N., 2015: Transition to a global zero-emission vehicle fleet: a collaborative agenda for governments.
Mahadevan, M., A. Francis, and A. Thomas, 2020: A simulation-based investigation of sustainability aspects of 3D printed structures. *J. Build. Eng.*, **32**, 101735, doi:https://doi.org/10.1016/j.jobe.2020.101735.
Maizlish, N., N. J. Linesch, and J. Woodcock, 2017: Health and greenhouse gas mitigation benefits of ambitious expansion of cycling, walking, and transit in California. *J. Transp. Heal.*, **6**, 490–500, doi:10.1016/j.jth.2017.04.011.

Majumdar, D., and T. Jash, 2015: Merits and Challenges of E-Rickshaw as An Alternative form of Public Road Transport System: A Case Study in the State of West Bengal in India. *Energy Procedia*, **79**, 307–314, doi:10.1016/j.egypro.2015.11.492.
Makov, T., A. Shepon, J. Krones, C. Gupta, and M. Chertow, 2020: Social and environmental analysis of food waste abatement via the peer-to-peer sharing economy. *Nat Commun*, **11**(1156), doi:https://doi.org/10.1038/s41467-020-14899-5.
Markandya, A., X. Labandeira, and A. Ramos, 2015: Policy instruments to foster energy efficiency. *Green Energy Technol.*, **164**, 93–110, doi:10.1007/978-3-319-03632-8_4.
Markewitz, P., P. Hansen, W. Kuckshinrichs, and J. F. Hake, Strategies for a low carbon building stock in Germany.
Martínez-Jaramillo, J. E., S. Arango-Aramburo, K. C. Álvarez-Uribe, and P. Jaramillo-Álvarez, 2017: Assessing the impacts of transport policies through energy system simulation: The case of the Medellin Metropolitan Area, Colombia. *Energy Policy*, **101**, 101–108, doi:10.1016/j.enpol.2016.11.026.
Mastrucci, A., and N. D. Rao, 2017: Decent housing in the developing world: Reducing life-cycle energy requirements. *Energy Build.*, **152**, 629–642, doi:10.1016/j.enbuild.2017.07.072.
Mastrucci, A., and N. D. Rao, 2019: Bridging India's housing gap: lowering costs and CO2 emissions. *Build. Res. Inf.*, **47**(1), 8–23, doi:10.1080/09613218.2018.1483634.
Mastrucci, A., J. Min, A. Usubiaga-Liaño, and N. D. Rao, 2020: A Framework for Modelling Consumption-Based Energy Demand and Emission Pathways. *Environ. Sci. Technol.*, **54**(3), 1799–1807, doi:10.1021/ACS.EST.9B05968.
Mata et al., 2020: A map of roadmaps for zero and low energy and carbon buildings worldwide. *Environ. Res. Lett.*, **15**(11), 113003, doi 10.1088/1748-9326/abb69f.
Mata, É., A. S. Kalagasidis, and F. Johnsson, 2018: Contributions of building retrofitting in five member states to EU targets for energy savings. *Renew. Sustain. Energy Rev.*, **93**, 759–774, doi:10.1016/j.rser.2018.05.014.
Material Economics, and M. Economics, 2018: *The Circular Economy - a Powerful Force for Climate Mitigation*, Stockholm, Sweden, 176 pp. https://materialeconomics.com/publications/the-circular-economy-a-powerful-force-for-climate-mitigation-1.
Mbow, C. et al., 2019: Food Security. In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security and greenhouse gas fluxes in terrestrial ecosystems*, in press, p. pp. 437.
Milford, R. L., J. M. Allwood, and J. M. Cullen, 2011: Assessing the potential of yield improvements, through process scrap reduction, for energy and CO2 abatement in the steel and aluminium sectors. *Resour. Conserv. Recycl.*, **55**(12), 1185–1195, doi:10.1016/j.resconrec.2011.05.021.
Millward-Hopkins, J., J. K. Steinberger, N. D. Rao, and Y. Oswald, 2020: Providing decent living with minimum energy: A global scenario. *Glob. Environ. Chang.*, **65**, 102168, doi:10.1016/j.gloenvcha.2020.102168.
Monzon, A., Á. Garcia-Castro, and C. Valdes, 2017: Methodology to Assess the Effects of ICT-measures on Emissions. The Case Study of Madrid. *Procedia Eng.*, **178**, 13–23, doi:10.1016/j.proeng.2017.01.054.
Mrkajic, V., D. Vukelic, and A. Mihajlov, 2015: Reduction of CO2 emission and non-environmental co-benefits of bicycle infrastructure provision: the case of the University of Novi Sad, Serbia. *Renew. Sustain. Energy Rev.*, **49**, 232–242, doi:10.1016/j.rser.2015.04.100.
Muller, A. et al., 2017: Strategies for feeding the world more sustainably with organic agriculture. *Nat. Commun.*, **8**(1), doi:10.1038/s41467-017-01410-w.

Murakami, S. et al., 2009: Overview of energy consumption and GHG mitigation technologies in the building sector of Japan. *Energy Effic.*, **2**(2), 179–194, doi:10.1007/s12053-008-9040-8.
Namazu, M., and H. Dowlatabadi, 2015: Characterizing the GHG emission impacts of carsharing: A case of Vancouver. *Environ. Res. Lett.*, **10**(12), doi:10.1088/1748-9326/10/12/124017.
Namazu, M., D. MacKenzie, H. Zerriffi, and H. Dowlatabadi, 2018: Is carsharing for everyone? Understanding the diffusion of carsharing services. *Transp. Policy*, **63**, 189–199, doi:10.1016/j.tranpol.2017.12.012.
NégaWatt, 2011: Rapport technique du scénario négaWatt 2011-2050. *Assoc. négaWatt*,.
Negawatt, A., 2018: *négaWatt scenario 2017-2050: A blueprint for a succesful energy transition in France*. https://negawatt.org/IMG/pdf/181128_negawatt-scenario_eng_12p.pdf.
Neves, A., and C. Brand, 2019: Assessing the potential for carbon emissions savings from replacing short car trips with walking and cycling using a mixed GPS travel diary approach. *Transp. Res. Part A Policy Pract.*, **123** 130–146, doi:10.1016/j.tra.2018.08.022.
Niamir, L., 2019: Behavioural Climate Change Mitigation: from individual energy choices to demand-side potential. University of Twente, 267 pp.
Niamir, L., T. Filatova, A. Voinov, and H. Bressers, 2018: Transition to low-carbon economy: Assessing cumulative impacts of individual behavioral changes. *Energy Policy*, **118**, 325–345, doi:10.1016/j.enpol.2018.03.045.
Niamir, L., O. Ivanova, and T. Filatova, 2020a: Economy-wide impacts of behavioral climate change mitigation: Linking agent-based and computabl general equilibrium models. *Environ. Model. Softw.*, **134**, 104839, doi:10.1016/j.envsoft.2020.104839.
Niamir, L., O. Ivanova, T. Filatova A. Voinov, and H Bressers, 2020b: Demand-side solutions for climate mitigation: Bottom-up drivers of household energy behavior change in the Netherlands and Spain. *Energy Res Soc. Sci.*, **62**(101356), 101356, doi:10.1016/j.erss.2019.101356.
Niamir, L. et al., 2020c: Assessing the macroeconomic impacts of individual behavioral changes on carbon emissions *Clim. Change*, **158**, 141–160, doi:10.1007/s10584-019-02566-8.
Nimesh, V., D Sharma, V. M. Reddy, and A. K. Goswami, 2020: Implication viability assessment of shift to electric vehicles for present power generation scenario of India. *Energy*, **195**, 116976, doi:10.1016/j.energy.2020.116976.
Noussan M., and S. Tagliapietra, 2020: The effect of digitalization in the energy consumption of passenger transport: An analysis of future scenarios for Europe. *J. Clean. Prod.*, **258**, 120926, doi:10 1016/j.jclepro.2020.120926.
Novikova, A. et al. 2015: The typology of the residential building stock in Albania and the modelling of its low-carbon transformation. , 136.
O'Brien, W., and F. Yazdani Aliabadi, 2020: Does telecommuting save energy? A critical review of quantitative studies and their research methods. *Energy Build.*, **225**, 110298, doi:10.1016/j.enbuild.2020.110298.
O'Keefe, P., B. Caulfield, W. Brazil, and P. White, 2016: The impacts of telecommuting in Dublin. *Res. Transp. Econ.*, **57**, doi:10.1016/j.retrec.2016.06.010.
Oluleye, G., and R. Smith, 2016: A mixed integer linear programming model for integrating thermodynamic cycles for waste heat exploitation in process sites. *Appl. Energy*, **178**, 434–453, doi:10.1016/j.apenergy.2016.06.096.
Oluleye, G., J. Allison, N. Kelly, and A. Hawkes, 2018: A Multi-period Mixed Integer Linear Program for Assessing the Benefits of Power to Heat Storage in a Dwelling Energy

System. *Comput. Aided Chem. Eng.*, **43**(2012), 1451–1456, doi:10.1016/B978-0-444-64235-6.50253-9.

Onn, C. C. et al., 2018: Greenhouse gas emissions associated with electric vehicle charging: The impact of electricity generation mix in a developing country. *Transp. Res. Part D Transp. Environ.*, **64**, 15–22, doi:10.1016/j.trd.2017.06.018.

Parodi, A. et al., 2018: The potential of future foods for sustainable and healthy diets. *Nat. Sustain.*, **1**(12), 782–789, doi:10.1038/s41893-018-0189-7.

Pauliuk, S., and N. Heeren, 2021: Material efficiency and its contribution to climate change mitigation in Germany: A deep decarbonization scenario analysis until 2060. *J. Ind. Ecol.*, **25**(2), 479–493, doi:https://doi.org/10.1111/jiec.13091.

Pauliuk, S. et al., 2021: Global Scenarios of Resource and Emissions Savings from Systemic Material Efficiency in Buildings and Cars. *Nat. Commun.*, **12**, doi:10.1038/s41467-021-25300-4.

Peñaloza, D., M. Erlandsson, J. Berlin, M. Wålinder, and A. Falk, 2018: Future scenarios for climate mitigation of new construction in Sweden: Effects of different technological pathways. *J. Clean. Prod.*, **187**, 1025–1035, doi:10.1016/j.jclepro.2018.03 285.

Pendrill, F. et al., 2019: Agricultural and forestry trade drives large share of tropical deforestation emissions. *Glob. Environ. Chang.*, **56**(March), 1–10, doi:10.1016/j.gloenvcha.2019.03.002.

Peng, Y., and X. Bai, 2018: Experimenting towards a low carbon city: Policy evolution and nested structure of innovation. *J C ean. Prod.*, **174**, 201–212, doi:10.1016/j.jclepro.2017.10.116.

Peters, D. R., J. L. Schnell, P. L. Kinney, V. Naik, and D. E. Horton, 2020: Public Health and Climate Benefits and Tradeoffs of U S. Vehicle Electrification. *GeoHealth*, , doi:10.1029/2020GH000275.

Petersen, A. K., and B. Solberg, 2005: Environmental and economic impacts of substitution between wood products and alternative materials: a review of micro-level analyses from Norway and Sweden. *For. Policy Econ.*, **7**(3), 249–259, doi:https://doi.org/10.1016/S1389-9341(03)00063-7.

Plötz, P., S. A. Funke, P. Jochem, and M. Wietschel, 2017: CO2 Mitigation Potential of Plug-in Hybrid Electric Vehicles larger than expected. *Sci. Rep.*, **7**(1), 16493, doi:10.1038/s41598-017-16684-9.

Podgornik, A. B. Sucic, and B. Blaz c, 2016: Effects of customized consumption feedback on energy efficient behaviour in low-income households. *J. Clean. Prod.*, **130**, 25–34, doi:10.1016/j.jclepro 2016 02.009.

Pomponi, F. et al., 2021: A Novel Method for Estimating Emissions Reductions Caused by the Restriction of Mobility: The Case of the COVID-19 Pandemic | Environmental Science & Technology Letters. *Environ. Sci. Technol. Lett.*, **8**(1), 46–52, doi:10 1021/acs.estlett.0c00764.

Poore, J., and T. Nemecek, 2018: Reducing food's environmental impacts through producers and consumers. *Science*, **360**(6392), 987 LP – 992, doi:10.1126/science.aaq0216.

Psaraftis, H. N., and C. A. Kontovas, 2013: Speed models for energy-efficient maritime transportation: A taxonomy and survey. *Transp. Res. Part C Emerg. Technol.*, **26**, 331–351, doi:10.1016/J.TRC.2012.09.012.

Purohit, P., and L. Höglund-Isaksson, 2017: Global emissions of fluorinated greenhouse gases 2005-2050 with abatement potentials and costs. *Atmos. Chem. Phys.*, **17**(4), 2795–2816, doi:10.5194/acp-17-2795-2017.

Purohit, P., I. Bertok, V. Chaturvedi, and M. Sharma, 2016: Scenario Analysis for HFC Emissions in India : Mitigation potential and costs. (September).

Puzzolo, E., and D. Pope, 2017: Clean Fuels for Cooking in Developing Countries. In:

Encyclopedia of Sustainable Technologies, Elsevier, pp. 289–297.
Rafsanjani, H., C. Ahn, and M. Alahmad, 2015: A Review of Approaches for Sensing, Understanding, and Improving Occupancy-Related Energy-Use Behaviors in Commercial Buildings. *Energies*, **8**(10), 10996–11029.
Rai, V., and A. D. Henry, 2016: Agent-based modelling of consumer energy choices. *Nat. Clim. Chang.*, **6**(6), 556–562, doi:10.1038/nclimate2967.
Rajper, S. Z., and J. Albrecht, 2020: Prospects of Electric Vehicles in the Developing Countries: A Literature Review. *Sustainability*, **12**(5), 1906, doi:10.3390/su12051906.
Rakib, M. I., R. Saidur, E. N. Mohamad, and A. M. Afifi, 2017: Waste-heat utilization – The sustainable technologies to minimize energy consumption in Bangladesh textile sector. *J. Clean. Prod.*, **142**, 1867–1876, doi:https://doi.org/10.1016/j.jclepro.2016.11.098.
Raman, S., 2010: Designing a liveable compact city physical forms of city and social life in urban neighbourhoods. *Built Environ.*, **36**(1), 63–80, doi:10.2148/benv.36.1.63.
Rao, N. D., and J. Min, 2018: Decent Living Standards: Material Prerequisites for Human Wellbeing. *Soc. Indic. Res.*, **138**(1), 225–244, doi:10.1007/s11205-017-1650 0.
Rao, N. D., J. Min, and A. Mastrucci, 2019a: Energy for decent living. *Nat. Energy*,.
Rao, N. D., J. Min, and A. Mastrucci, 2019b: Energy requirements for decent living in India, Brazil and South Africa. *Nat. Energy*, **4**(12), 1025–1032, doi:10.1038/s41560-019-0497-9.
Reis, D. C. et al., 2021: Potential CO2 reduction and uptake due to industrialization and efficient cement use in Brazil by 2050. *J. Ind. Ecol.*, **25**(2), 344–358, doi:https://doi.org/10.1111/jiec.13130.
Riggs, W., 2020: *Telework and Sustainable Travel During the COVID-19 Era*. Elsevier BV, 58 pp.
Rodriguez, A. S., T. de Santana, I. MacGill, N. J. Ekins-Daukes, and A. Reinders, 2020: A feasibility study of solar PV-powered electric cars using an interdisciplinary modeling approach for the electricity balance, CO2 emissions, and economic aspects: The cases of The Netherlands, Norway, Brazi , and Australia. *Prog. Photovoltaics Res. Appl.*, **28**(6), 517–532.
Roth, K. W., T. Rhodes and R Ponoum, 2008: The energy and greenhouse gas emission impacts of telecommuting in the U.S. *IEEE International Symposium on Electronics and the Environment*
Ruparathna, R., K. Hewage, and R. Sadiq, 2016: Improving the energy efficiency of the existing building stock: A critical review of commercial and institutional buildings. *Renew. Sustain. Energy Rev* , **53**, 1032–1045, doi:10.1016/j.rser.2015.09.084.
Ryen, E. G., C. W. Babbitt, and E. Williams, 2015: Consumption-Weighted Life Cycle Assessment of a Consumer Electronic Product Community. *Environ. Sci. Technol.*, **49**(4), 2549–2559, doi: 0 1021/es505121p.
Samaras, Z. et al., 2016: Quantification of the Effect of ITS on CO2 Emissions from Road Transportation. *Transp. Res. Procedia*, **14**, 3139–3148, doi:10.1016/j.trpro.2016.05.254.
Sato, T., and M Saijo, 2016: How Can We Facilitate the Diffusion of Electric Vehicles in Japan? - Consumer Characteristics and Perceived Innovation Attributes. *8th International Conference on Knowledge Management and Information Sharing*, 70–81 https://www.scitepress.org/Link.aspx?doi=10.5220/0006068200700081.
Schäfer, A. W. et al., 2019: Technological, economic and environmental prospects of all-electric aircraft. *Nat. Energy*, **4**(2), 160–166, doi:10.1038/s41560-018-0294-x.
Schanes, K., K. Dobernig, and B. Gözet, 2018: Food waste matters - A systematic review of household food waste practices and their policy implications. *J. Clean. Prod.*, **182**, 978–991.
Senbel, M., W. Giratalla, K. Zhang, M. Kissinger, and W. G. - Maged Senbel Kevin Zhang, Meidad Kissinger, 2014: Compact Development without Transit: Life-Cycle GHG

Emissions from Four Variations of Residential Density in Vancouver. *Environ. Plan. A Econ. Sp.*, **46**(5), 1226–1243, doi:10.1068/a46203.
Seto, K. C. et al., 2021: From Low- to Net-Zero Carbon Cities: The Next Global Agenda. *Annu. Rev. Environ. Resour.*, **46**(1), null, doi:10.1146/annurev-environ-050120-113117.
Shabanpour, R., N. Golshani, M. Tayarani, J. Auld, and A. (Kouros) Mohammadian, 2018: Analysis of telecommuting behavior and impacts on travel demand and the environment. *Transp. Res. Part D Transp. Environ.*, **62**, 563–576, doi:10.1016/j.trd.2018.04.003.
Shanks, W. et al., 2019: How much cement can we do without? Lessons from cement material flows in the UK. *Resour. Conserv. Recycl.*, **141**, 441–454, doi:10.1016/J.RESCONREC.2018.11.002.
Sharma, M., V. Chaturvedi, and P. Purohit, 2017: Long-term carbon dioxide and hydrofluorocarbon emissions from commercial space cooling and refrigeration in India: a detailed analysis within an integrated assessment modelling framework. *Clim. Change*, **143**(3–4), 503–517, doi:10.1007/s10584-017-2002-4.
Sharmina, M. et al., 2021: Decarbonising the critical sectors of aviation, shipping road freight and industry to limit warming to 1.5–2°C. *Clim. Policy*, **21**(4), 455–474, doi:10.1080/14693062.2020.1831430.
Sheppard, C. J. R., A. T. Jenn, J. B. Greenblatt, G. S. Bauer, and B. F. Gerke, 2021: Private versus Shared, Automated Electric Vehicles for U.S Personal Mobility: Energy Use, Greenhouse Gas Emissions, Grid Integration, and Cost Impacts. *Environ. Sci. Technol.*, **55**(5), 3229–3239, doi:10.1021/acs.est.0c06655.
Shi, S., H. Zhang, W. Yang, Q. Zhang, and X. Wang, 2019: A life-cycle assessment of battery electric and internal combustion engine vehicles: A case in Hebei Province, China. *J. Clean. Prod.*, **228**, 606–618, doi:10.1016/j jclepro 2019.04.301.
Simpson, J. M., R. E. Dunlap, and A. S. Fullerton, 2019: The Treadmill of InformationDevelopment of the Information Society and Carbon Dioxide Emissions. *Sociol. Dev.*, **5**(4), 381–409, doi:10.1525/sod.2019.5.4.381.
Sims, R. et al., 2014: Transport. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O. et al., (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 559–670.
Skrúcaný, T. et al., 2019: Impact of the Electric Mobility Implementation on the Greenhouse Gases Production in Central European Countries. *Sustainability*, **11**(18), 4948, doi:10.3390/su11184948
Smith, P. et al 2007: Agriculture. In: *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Metz, B., O.R. Davidson, P.R. Bosch, R. Dave, and L.A. Meyer, (eds.)], Cambridge University Press, Cambridge, UK, pp. 497–540.
Smith, P. et al., 2013: How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals? *Glob. Chang. Biol.*, **19**(8), 2285–2302, doi:10.1111/gcb.12160.
Springmann, M. et al., 2016: Global and regional health effects of future food production under climate change: A modelling study. *Lancet*, **387**(10031), 1937–1946, doi:10.1016/S0140-6736(15)01156-3.
Springmann, M. et al., 2018a: Options for keeping the food system within environmental limits. *Nature*, **562**(7728), 519–525, doi:10.1038/s41586-018-0594-0.
Springmann, M. et al., 2018b: Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *Lancet Planet. Heal.*, **2**(10), e451–e461, doi:10.1016/S2542-5196(18)30206-7.

Strategies, I. for G. E., 2019: *1.5-Degree Lifestyles: Targets and Options for Reducing Lifestyle Carbon Footprints*. Institute for Global Environmental Strategies, Hayama, Japan, 49 pp. https://www.iges.or.jp/en/publication_documents/pub/technicalreport/en/6719/15_Degree_Lifestyles_MainReport.pdf.

Sun, K., and T. Hong, 2017: A simulation approach to estimate energy savings potential of occupant behavior measures. *Energy Build.*, **136**, 43–62, doi:10.1016/j.enbuild.2016.12.010.

Taniguchi, A. et al., 2016: Estimation of the contribution of the residential sector to summer peak demand reduction in Japan using an energy end-use simulation model. *Energy Build.*, **112**, 80–92, doi:10.1016/j.enbuild.2015.11.064.

Tarulescu, S., R. Tarulescu, A. Soica, and C. I. Leahu, 2017: Smart Transportation CO2 Emission Reduction Strategies. *IOP Conf. Ser. Mater. Sci. Eng.*, **252**, 12051, doi:10.1088/1757-899X/252/1/012051.

Te, Q., and C. Lianghua, 2020: Carsharing: mitigation strategy for transport-related carbon footprint. *Mitig. Adapt. Strateg. Glob. Chang.*, **25**(5), 791–818, doi:10.1007/s11027 019-09893-2.

Tillig, F., W. Mao, and J. W. Ringsberg, 2015: Systems modelling for energy-efficient shipping.

Timilsina, G., A. Sikharulidze, E. Karapoghosya, and S. Shatvoryan, 2016: How Do We Prioritize the GHG Mitigation Options ? Development of a Marginal Abatement Cost Curve for the Building Sector in Armenia and Georgia. (June).

Timperley, J., 2019: Eight charts show how "aggressive" railway expansion could cut emissions . *CarbonBrief*.

Underwood, A., and A. Fremstad, 2018: Does sharing backfire? A decomposition of household and urban economies in CO2 emissions. *Energy Policy*, **123**, 404–413, doi:10.1016/J.ENPOL.2018.09 012.

UNEP, 2017: *Resource Efficiency: Potential and Economic Implications. A report of the International Resource Pane*. 167 pp. https://www.resourcepanel.org/sites/default/files/documents/document/media/resource_efficiency_report_march 2017_web_res.pdf.

UNFCCC, 2015: *Paris Agreement*. , Paris, https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement pdf (Accessed December 4, 2020).

Ürge-Vorsatz, D., S. T. Herrero, N. K. Dubash, and F. Lecocq, 2014: Measuring the co-benefits of climate change mitigation. *Annu. Rev. Environ. Resour.*, **39**, 549–582, doi 10.1146/annurev-environ-031312-125456.

Ürge-Vorsatz, D. et al., 2018: Locking in positive climate responses in cities. *Nat. Clim. Chang.*, **8**(3), 174 177, doi:10.1038/s41558-018-0100-6.

Van Den Wymelenberg, K., 2012: Patterns of occupant interaction with window blinds: A literature review. *Energy Build.*, **51**(2012), 165–176, doi:10.1016/j.enbuild.2012.05.008.

van der Grijp, N. et al., 2019: Demonstration projects of Nearly Zero Energy Buildings: Lessons from end-user experiences in Amsterdam, Helsingborg, and Lyon. *Energy Res. Soc. Sci.*, **49**(January 2018), 10–15, doi:10.1016/j.erss.2018.10.006.

Virage-énergie Nord-Pas de Calais, 2016: *Mieux vivre en Nord-Pas de Calais*. , Lille, 294 pp. http://www.virage-energie.org/wp-content/uploads/2016/01/Virage-énergie-NPdC_Rapport-complet-étude-mieux-vivre_mars2016-1.pdf.

Volochovic, A., Z. Simanaviciene, and D. Streimikiene, 2012: Šiltnamio Efektą Sukeliančių Dujų Emisijų Mažinimas Dėl Elgsenos Pokyčių Lietuvos Namų Ūkiuose. *Eng. Econ.*, **23**(3), 242–249, doi:10.5755/j01.ee.23.3.1936.

Wang, H., J. Faber, D. Nelissen, B. Russell, and D. St Amand, 2010: *Reduction of GHG* *emissions from ships. Marginal Abatement Costs and Cost Effectiveness of Energy-Efficiency Measures*. , London,.

Wang, X., A. Khattak, and Y. Zhang, 2013: Is Smart Growth Associated with Reductions in Carbon Dioxide Emissions? *Transp. Res. Rec.*, **2375**(1), 62–70, doi:10.3141/2375-08.

Wei, Y.-M., L.-C. Liu, Y. Fan, and G. Wu, 2007: The impact of lifestyle on energy use and CO 2 emission: an empirical analysis of China's residents. *Energy Policy*, **35**(1), 247–257.

Willett, W., and E. al., 2018: Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. , doi:10.1016/S0140.

Willett, W. et al., 2019: Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *Lancet*, **393**(10170), 447–492, doi:10.1016/S0140-6736(18)31788-4.

Wilson, C., L. Kerr, F. Sprei, E. Vrain, and M. Wilson, 2020: Potential Climate Benefits of Digital Consumer Innovations. *Annu. Rev. Environ. Resour.*, **45**(1), 113 144, doi:10.1146/annurev-environ-012320-082424.

Wittchen, K. B., J. Kragh, and A. Søren, 2016: *Potential heat savings during ongoing renovations of buildings until 2050*. 76 pp.

Wolfram, P., Q. Tu, N. Heeren, S. Pauliuk, and E. G. Hertwich, 2021: Material efficiency and climate change mitigation of passenger vehicles. *J Ind. Ecol.*, **25**(2), 494–510, doi:10.1111/JIEC.13067.

Wu, T., Q. Shen, M. Xu, T. Peng, and X. Ou, 2018: Development and application of an energy use and CO2 emissions reduction evaluation model for Ch na's online car hailing services. *Energy*, **154**, 298–307, doi:10.1016/j.energy.2018.04.130.

Wynes, S., and K. A. Nicholas, 2017: The climate mitiga ion gap: Education and government recommendations miss the most effective individual actions. *Environ. Res. Lett.*, **12**(7), doi:10.1088/1748-9326/aa7541

Xu, L., H. Ü. Yilmaz, Z. Wang W. R. Poganietz, and P. Jochem, 2020: Greenhouse gas emissions of electric vehicles in Europe considering different charging strategies. *Transp. Res. Part D Transp. Environ* , **87**, 102534, doi:10.1016/j.trd.2020.102534.

Xu, X. et al., 2021: Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. *Nat. Food*, **2**(9), 724–732, doi:10.1038/s43016-021-00358-x.

Yi, W., and J. Yan, 2020: Energy consumption and emission influences from shared mobility in China: A national level annual data analysis. *Appl. Energy*, **277**, 115549, doi:10.1016/j apenergy.2020.115549.

Yin, B., L. Liu, N. Coulombel, and V. Viguié, 2018: Appraising the environmental benefits of ride-sharing: The Paris region case study. *J. Clean. Prod.*, **177**, 888–898, doi:10.1016/j.jclepro.2017.12.186.

Zahabi, S. A. H., A. Chang, L. F. Miranda-Moreno, and Z. Patterson, 2016: Exploring the link between the neighborhood typologies, bicycle infrastructure and commuting cycling over time and the potential impact on commuter GHG emissions. *Transp. Res. Part D Transp. Environ.*, **47**, 89–103, doi:10.1016/j.trd.2016.05.008.

Zeinali, M., Rutherford. D., I. Kwan, and A. Kharina, 2013: *U.S. domestic airline fuel efficiency ranking, 2010*. , Washington DC, 44 pp. https://theicct.org/publications/us-domestic-airline-fuel-efficiency-ranking-2010 (Accessed November 8, 2021).

Zhang, H. et al., 2020: Solar photovoltaic interventions have reduced rural poverty in China. *Nat. Commun.*, **11**(1), doi:10.1038/s41467-020-15826-4.

Zhang, R., S. Fujimori, and T. Hanaoka, 2018: The contribution of transport policies to the mitigation potential and cost of 2 °c and 1.5 °c goals. *Environ. Res. Lett.*, **13**(5), doi:10.1088/1748-9326/aabb0d.

Zhang, Y., D. Lin, and Z. Mi, 2019: Electric fence planning for dockless bike-sharing services.

J. Clean. Prod., **206**, 383–393, doi:10.1016/j.jclepro.2018.09.215.
Zhu, P., and S. G. Mason, 2014: The impact of telecommuting on personal vehicle usage and environmental sustainability. *Int. J. Environ. Sci. Technol.*, **11**(8), 2185–2200, doi:10.1007/s13762-014-0556-5.
Zhuge, C., B. Wei, C. Dong, C. Shao, and Y. Shan, 2019: Exploring the future electric vehicle market and its impacts with an agent-based spatial integrated framework: A case study of Beijing, China. *J. Clean. Prod.*, **221**, 710–737, doi:10.1016/j.jclepro.2019.02.262.