AARHUS UNIVERSITY

Coversheet

This is the accepted manuscript (post-print version) of the article.

Contentwise, the post-print version is identical to the final published version, but there may be differences in typography and layout.

How to cite this publication

Please cite the final published version:

Moberg, K. R., Aall, C., Dorner, F., Reimerson, E., Ceron, J.-P., Sköld, B., . . . Piana, V. J. E. E. (2018). Mobility, food and housing: responsibility, individual consumption and demand-side policies in European deep decarbonisation pathways. doi:10.1007/s12053-018-9708-7

Publication metadata

Title:	Mobility, food and housing: responsibility, individual consumption and demand-side policies in European deep decarbonisation pathways
Author(s):	Moberg, K. R., Aall, C., Dorner, F., Reimerson, E., Ceron, J.-P., Sköld, B., . . . Piana, V. J. E. E.
Journal:	<i>Energy Efficiency</i>
DOI/Link:	10.1007/s12053-018-9708-7
Document version:	Accepted manuscript (post-print)

General Rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Mobility, food, and housing: Responsibility, individual consumption, and demand-side policies in European deep decarbonisation pathways

1. Introduction

There is now broad agreement that achieving international climate goals requires both drastic improvements in energy efficiency and profound lifestyle changes (Dietz et al. 2009; UNECE 2010; Huntington and Smith 2011; OECD 2011; IEA 2012; IPCC 2014: 140). Some have even gone so far as to call this ‘deep decarbonization’ (Geels et al. 2017) or ‘fast’ and ‘accelerated’ energy transitions (Sovacool 2016), and in particular stated that “The potential of household action deserves increased policy attention. Future analyses of this potential should incorporate behavioral as well as economic and engineering elements” (Dietz et al. 2009: 18452). The Paris Agreement recognises the important contribution of sustainable lifestyles and patterns of consumption in mitigating climate change to limit global average temperature increase to well below 2°C above pre-industrial levels, and pursue efforts to limit the temperature increase to 1.5°C (UN 2015: 2-3). The agreement underscores the need for using a full range of instruments to close the emission gap.

Current climate change mitigation policies and Nationally Determined Contributions (NDCs) under the Paris Agreement are neither consistent with a 1.5°C, nor a 2°C world (UNEP 2017). Near-term mitigation targets for the 2020-2030 period are also insufficient for reaching the temperature goal, and we urgently “need accelerated short-term action” if the Paris Agreement goals are to remain within reach since “[t]he gap between the reductions needed and the national pledges made in Paris is alarmingly high” (UNEP 2017: xiv; Schleussner et al. 2016). Pathways consistent with a 2°C world have already used most of the supply-side mitigation potential by 2050, and achieving the 1.5°C goal thus requires a scale-up of mitigation efforts on the demand-side, including a shorter timeline where comprehensive reductions are realised by 2030 (Millar et al. 2017; Rogelj et al. 2015). An increasing share of the additional mitigation effort should take place in Annex I (UNFCCC 2014) countries (Rogelj et al. 2015). Emission pathway scenarios with a 66% likelihood of limiting average temperature increase to 1.5°C assume large-scale rollout of negative emission technologies to remove carbon from the atmosphere in the second half of the century (Rogelj et al. 2015). Strong near-term emissions reductions would reduce the risk of missing the goal by hedging ‘against a high climate response or subsequent reduction rates proving economically, technically or politically unfeasible’ (Millar et al. 2017: 1; see also IEA 2017; Sanderson, O’Neill and Tebaldi 2016; Rogelj et al. 2015; Smith et al. 2015).

Changing household consumption has the potential to significantly reduce GHG emissions in some contexts (Dietz et al. 2009), especially in the areas mobility, housing, diet and waste (IPCC 2014: 66). In order to reach current climate goals, national climate mitigation policies need to systematically address consumption-related emissions. Policy efforts in this field tend to individualise responsibility for an issue that is difficult to address in the absence of coordinated collective action (Maniates 2001; Dauvergne 2010). Not only is it unclear what moral or ethical obligations climate change devolves upon individual actors (Sinnott-Armstrong 2005; Sovacool et al. 2016) and how appropriate such a policy focus is (Shove 2010), but it is also uncertain whether individual actors are willing or able to take on responsibility to substantial mitigation action (Berthou 2013; Asdal and Jacobsen 2009; Miller and Rose 1995; Howell 2009).

In this paper, we analyse climate change mitigation policies targeting or indirectly affecting household consumption-related GHG emissions in four household consumption categories (mobility, housing, food and other consumption) in four high-income countries (HICs) (France, Germany, Norway and Sweden). The paper draws on data gathered in the project ‘Household Preferences for reducing greenhouse gas Emissions in four European High Income Countries’ (HOPE). The project combines an extensive mapping of existing policies with a mapping of 309 households’ GHG emissions in four medium-sized cities (Communauté de Pays d’Aix, Mannheim, Bergen and Umeå), results from a GHG emission reduction simulation game, and results from in-depth interviews with selected households. We are particularly interested in exploring how climate change

mitigation policies in the four cases correspond with individuals' perceived space for action and what implications this may have for mitigation policies to be effective in achieving the 1.5°C goal. We address what policy strategies and mechanisms are currently used for governing household GHG emissions, and how these policies correspond with individuals' perceived space for climate change mitigation actions. We go on to discuss the implications of our findings for demand-side policies in line with the 1.5°C goal, and conclude the paper with suggestions for changes in current climate policies to realise more of existing demand-side mitigation potential. This includes extensively targeting consumption in the next update of NDCs due to occur after the 2018 facilitative dialogue at COP23. While existing NDCs include some demand-side measures such as electricity savings, other areas included in our analysis like food and air travel are left out of the NDCs.

2. Analytical Framework

2.1 Sustainable Consumption

Analysing the problems and prospects of changing household consumption patterns in order to achieve the 1.5°C goal can benefit from previous debates on sustainable consumption. Sustainable consumption and lifestyles have been recognised as a key dimension for tackling climate change and environmental issues since the beginning of the environmental crisis in the 1970s, before climate change was widely considered a decisive issue (Bäckstrand and Ingelstam 2006; Sachs et al. 1973; Sachs, Kapp and Iglesias 1972). The role assigned to consumption in environmental discourse has varied over time. Consumption change played an important role in the 1960s and 1970s discussions of limits to growth, criticism of the industrial and capitalist character of modern societies and ideas for alternative economic models (Ehrlich and Holdren 1971; Georgescu-Roegen 1971; Sachs, Kapp and Iglesias 1972; Daly 1968; Mishan 1977). In the 1980s, the emerging discourse of ecological modernisation attempted to reconcile economic, environmental and social development goals within a capitalist organisation of production and consumption, thus shifting focus from reducing consumption per se in HICs (Mol et al. 2009).

The United Nations (UN) World Commission on Environment and Development's report 'Our Common Future' (WCED 1987) argued that many people in HICs lead lifestyles incompatible with planetary boundaries. The 1994 UN Conference on Sustainable Consumption was however the first UN conference to seriously address the role of consumption in achieving sustainability goals (Aall 2001). Since then, numerous policy initiatives and research efforts have emerged on the issue of sustainable consumption, and three main strategies can be identified: efficiency, substitution, and reduction (Høyer 2008). Policy strategies of efficiency and substitution (focusing on improving technology and changing patterns of consumption, respectively) have attained premium attention within the discourse of ecological modernisation, while strategies of reduction (focusing on reducing levels of consumption) challenge 'business-as-usual' pathways and present radical suggestions for socio-ecological transformation articulated through, for example, discourses of degrowth (Jackson 2006; Demaria et al. 2013; Asara et al. 2015; Xue et al. 2016).

Reports from the Intergovernmental Panel on Climate Change (IPCC), reflecting the scientific status on climate change, have only to a limited degree picked up on the sustainable consumption debates. The fourth IPCC Assessment Report (AR4) (IPCC 2007) mostly disregarded the issue of consumption. However, the AR5 (IPCC 2014) examines consumption and lifestyles as drivers of emissions from production to a greater extent. This shift between the two most recent ARs is particularly evident in some sectoral chapters (e.g. industry chapter 10) (Dubois and Ceron 2015). Nevertheless, the IPCC mitigation discourse has, until now, been dominated by ecological modernisation, and the literature linking consumption to climate change has had limited presence.

2.2 A Governmentality Approach

While environmental policy problems concern 'natural' objects, the ways in which they are understood, articulated and addressed are effects of social constructions (Feindt and Oels 2005). Increasing demand-side mitigation efforts in the near-term could increase the likelihood of staying in line with emission trajectories

compatible with the 1.5°C goal (Millar et al. 2017; Rogelj et al. 2015). This would require significant shifts in policy. By turning our focus to the underlying rationales of consumption-oriented climate change mitigation policies through an approach based on the concept of *governmentality*, we are able to critically investigate the framing of suitable courses of action by de-neutralising existing regimes and practices (Oels 2005). A governmentality approach offers a way to problematize existing governing rationalities, thus making them amenable to reconstruction by government intervention (Rose and Miller 1992; Walters 2012).

Drawing on an understanding of governing as the structuring of possible fields of action, *governmentality* refers to the ways in which we think about governing. This includes the rationalities or moralities underlying it, and the techniques and procedures used for directing human behaviour (Dean 2010; Foucault 1991). Assumptions of how systems work, and what the appropriate tools for governing are, shape policy choices and pathways. In this way, organisational rationalities continuously shape the characteristics of new policy initiatives (Keskitalo et al. 2012; Feindt and Oels 2005). They also produce and steer the subjects of governing - the individuals and groups whose actions are framed and shaped by the tactics, arrangements and activities of governments and other governing bodies (Dean 2010; Foucault 1991).

Central dimensions of the governmentality concept are the *rationalities* and *technologies of Government*¹ (Miller and Rose 2008: 16). *Rationalities of Government* refers to particular forms of representation, thought and knowledge that provide accounts of the objects and subjects to be governed, thus rendering reality thinkable and governable (Higgins and Tamm Hallström 2007; Miller and Rose 2008). Rationalities of Government lay the basis for how a policy problem is constructed and understood, and what policy solutions are perceived appropriate or feasible. Analyses of political rationalities can contribute to an ‘understanding of the logics within a system that may come to steer choices of policy tools and mechanisms’ (Keskitalo et al. 2012: 437).

Rationalities of Government govern both the development of concrete policies and the choice of appropriate *technologies of Government* - the strategies, techniques and procedures used to implement policies or programmes - to operationalize them (Higgins and Tamm Hallström 2007; Miller and Rose 2008; Rose and Miller 1992). Identifying technologies of Government can serve as an analytical entry point, used to trace and identify specific rationalities of Government (Keskitalo et al. 2012; Rose and Miller 1992).

Rationalities of Government implicate *subjectification effects* that produce roles for agents subjected to Government - that is, they produce certain types of identities and behaviour (*subjectivities*) as appropriate, legitimate or effective (Villadsen 2010:15; Bacchi 2010). The different policy strategies for sustainable consumption discussed above are based on different rationalities, and they presume and prescribe different roles and responsibilities for consumers. The liberal and neoliberal rationalities commonly associated with the discourse of ecological modernisation are characterised by privatisation of public services and market mechanisms as governing strategy. This individualises responsibility for areas that traditionally have been up to public authorities to regulate. By contrast, bureaucratic rationalities entail more ‘social’ forms of governing – public government steering, emphasising rules and legislation, with state provision of public services and fewer ‘tasks’ left to the market (Keskitalo et al. 2012; Rose and Miller 1992).

The roles and responsibilities presumed and produced by predominant policy strategies shape the discretion and agency of governed subjects. If there is incoherence between these constructed subjectivities and the perceptions of the political subjects taking on these roles, governance strategies might fail (Berthou and Ebbesen 2016). Using the concepts of technologies and rationalities of Government to analyse demand-side climate mitigation policy opens for a discussion of the production of subjectivities and potential spaces for increasing the ambition of consumption-oriented climate policies. Noting existing approaches and tools in one policy area can open up for taking advantage of existing policy approaches and spaces by transferring them to other areas. This incremental policy change could be more politically feasible than radical alternatives, since ‘[r]adical alternatives are usually more politically difficult to achieve than more incremental change’ (Weimer and Vining 2016: 12).

¹ We use ‘Government’ to refer to the concept in the theoretical sense, and ‘government’ to refer to the governing institutions of states.

3. Method

This paper is based on three sources of household data: mapping of carbon footprints, the output from a climate mitigation simulation game, and in-depth interviews. In addition, we have mapped current household-related mitigation policy measures. The data collection and analysis is elaborated in Appendix 1.

4. Results

This part of the paper presents our results, organised according to three empirical sources: household emissions reduction priorities in the mitigation simulation game, demand-side mitigation policy approaches and reflections on individual mitigation action. The household data that support the findings of this study are available from the corresponding author upon reasonable request. The policy data is available in full as electronic supplementary material.

4.1. Household emission reduction priorities

The initial carbon footprint (CF) baseline assessments of households participating in the HOPE study found the mobility sector to be the most significant contributor to the median household's GHG (kg CO₂e²) emissions per year per consumption unit (CU)³ across all four country cases, making up 34% of the CF with a median value of 2.9 tonnes CO₂e per household member (Appendix 2). Within the mobility sector, plane and car were the highest contributing factors for GHG emission per household and year. Food was found to be the second largest emission sector making up 30% of total GHG emissions equivalent to 2.6 tonnes CO₂e. Here, meat and dairy consumption along with meals at restaurants and other food had the highest mitigation potential. Emissions related to the housing sector made up 21% of the initial CF, or roughly 1.8 tonnes CO₂e. Heating was the biggest contributing factor to emissions across all country cases within the housing sector, and thus an area with significant mitigation potential. The studied household sector with lowest mitigation potential was other consumption, making up 15%, or 1.3 tonnes CO₂e, of the median household CF (Appendix 2). Table 1 shows the share of emission reduction per consumption sector during the simulation game.

In the 'voluntary' scenario of the simulation game, households on average reduced their GHG emissions by 25% (Appendix 2), falling short of reaching the demand-side emission reduction target of 50%. The output of the 'forced' scenario where households selected actions until they had achieved close to 50% emission reduction shows that the largest share of chosen mitigation actions were from the mobility sector, making up 41% of total reductions (Table 1). This was achieved by primarily reducing emissions related to private car use and air travel. More than one third (34%) of the total reduction was made in the food sector, with the most significant contributions to reductions being increased share of local and ecological food and reduced meat consumption. These were followed by 21% of the total reduction in the housing sector where reducing emissions from heating made up the largest share of reductions. Actions chosen to reduce emissions from other consumption made up a modest share of 4% of total reductions (Table 1).

Table 1 Initial median carbon footprint (kg CO₂e per consumption unit per year) for each household sector, and observed median reductions between the initial CF and the 'forced' scenario.

Variable	Initial median CF	(%) Initial median CF	Observed median reduction	(%) Observed median reduction	Impact: Effect of reductions (% of initial CF)
Housing	1800	21%	880	21%	4%
Food	2600	30%	1430	34%	10%
Other	1300	15%	180	4%	<1%

² Defined in Herrmann et al (2017).

³ Consumption units are calculated based in the OECD equivalence scale to capture per capita emissions (OECD n.d.).

Mobility	2900	34%	1700	41%	14%
Total	8600	100%	4190	100%	

The simulation game results imply that the most important demand-side mitigation efforts consistent with 1.5°C can be found in the sectors mobility, food, and housing, concluded by comparing the initial CF levels with the observed reductions during the ‘forced’ round of the simulation game (Table 1). The effect of our observed reductions i.e. the impact of the simulation rounds show that reductions in the the sector ‘other consumption’ were of diminishing significance in comparison to the other consumption sectors in terms of observed mitigation. ‘Other consumption’ was of little significance in terms of reducing household CFs for two reasons: (1) the mitigation actions the participants chose during the simulation rounds, and (2) technical aspects of the simulation tool that influenced the number of mitigation actions it was possible to choose. The latter could thus not be affected by the households themselves but relies solely on the design of the tool used in this study. However, given the low share that ‘other consumption’ made up of the initial CF, the extent to which a more flexible simulation tool might have facilitated a higher share of reduction in that consumption sector, given the relative mitigation potential of the other three sectors. This decision is corroborated by previous research showing that the consumption sectors mobility, food and housing hold the most significant mitigation potential (see Aall and Hille 2010 for an overview of this literature). The remainder of this paper therefore limits its scope to these sectors with the highest mitigation potential: mobility, food and housing, paying particular attention to the actions that contributed most to emission reductions.

4.2. Demand-side policy approaches

The whole set of data from the HOPE project reveals not only patterns and dynamic trends about household emissions and reduction priorities; it also informs the possible design of new governance strategies. Table 2 offers an overview of the most important existing policy measures, grouped according to consumption areas for change. For a full presentation of the results from the policy mapping, see tables in Appendix 3. For the full list of the 250 identified policy measures, see supplementary material.

Table 2 Consumption areas for change and policy measures currently in place in one or more of the four investigated HICs.

Sector	Subsector	Policy measures(s)
Mobility	Aviation	Exemption from carbon tax for sustainable biofuel
		Passenger tax on air travel
	Private car	Taxes on vehicles, fuels and roads supplemented by subsidies for electric and hybrid vehicles
		Necessary charging infrastructure and differentiated tolls in city areas
		Emissions labels
Food	Public transport	Development of rail services or improving ageing rail infrastructure
	Bicycle	Funding and frameworks for bicycles
	Dietary change	Policies or incentives promoting vegetarian and/or less energy/carbon intensive diets
	Local food promotion	Promotion of locally grown food
	Organic food promotion	Promotion of organically certified food
Housing	Building design	Energy efficiency standards
		Energy labelling schemes
		Bans on certain heating sources
		Tax deductions, subsidies or beneficial loans for improving energy performance
	Energy supply	Carbon tax on heating fuels
	Energy use	Mandatory requirements, grant schemes, certificates, and feed-in tariffs to incentivise renewable energy sources
		Taxes on electricity consumption
		Informing consumers via teaching plans in schools, consultation services
	Household appliances	Informative energy billing
		Energy labelling and certification schemes

When framed as part of the literature on environmental regulation, energy policy, and climate policy, Table 2 underscores how policymakers should not rely upon a single policy instrument, e.g. carbon pricing which continues to face major political obstacles (Meckling et al. 2015). Instead, policymakers should mobilise a range of policies and change this over time, such as financial instruments (taxes, subsidies, grants, loans), regulatory instruments (standards, laws, performance targets) and processual instruments (demonstration projects, network management, public debates, consultations, foresight exercises, roadmaps) (Voß et al. 2007). The appropriate mix is likely to vary between countries and domains, depending on political cultures and stakeholder configurations (Rogge and Reichardt 2016). Nonetheless, a consistent theme within the policy studies and public policy literature has been the necessity of concerted sets of policies needed to spur low-carbon innovation and transitions, rather than isolated instruments (Loiter and Nornerg-Bohm 1999; Haas et al. 2004; Dietz et al. 2009; Mendonça et al. 2009; Sovacool 2009; Kivimaa and Kern 2016).

4.2.1 Mobility

As previously indicated, aviation and private car use hold the greatest mitigation potential and are thereby the two most important areas of GHG emissions from household consumption. When mapping existing policies, we divided measures targeting mobility into four categories: *aviation*, *private car*, *public transport* and *bicycle*.

We found only found three policies aimed at *aviation*, all of which were coded as ‘Economic Instruments’. Two policies were found in Norway: exemption from carbon tax for domestic aviation fuel when refuelling with a certain amount of biofuel, and a modest passenger tax on air travel. The latter also applies in Germany. *Private car* is the sub-sector most frequently addressed in policy across all four countries. A significant share of these measures were coded at ‘Economic Instruments’, ranging from taxes on vehicles, fuels and roads supplemented by subsidies for electric and hybrid vehicles and necessary charging infrastructure and differentiated tolls in city areas. Coded at ‘Regulatory Approaches’, all cases had fuel composition requirements and restricted parking and vehicle access to certain areas. Coded at ‘Information Policies’, we found that all four countries have introduced emission labels for cars. Several policies address alternatives to travelling by air and private car. All four countries target public transportation and cycling. The development of public transportation infrastructure is emphasised, which includes development of rail services or improving ageing rail infrastructure. Most of these policies are coded at ‘Regulatory Approaches’. We found several policies promoting bicycling, typically steered by national frameworks, often accompanied by specific funding mechanisms.

Policies not only exhibited heterogeneity in terms of sectors but also in terms of approach. For France and Germany, the dominant policy approach in the mobility sector was market-oriented made up by policy measures coded at ‘Economic Instruments’ and ‘Information Policies’ (76% for France and Germany). For Norway and Sweden, the dominant approach was found to be command-and-control, with respectively 54% of measures coded at ‘Regulatory Approaches’ and ‘Public Goods and Services’ in Norway, and 57% in Sweden. France and Norway distinguish themselves by applying a more technology oriented policy approach than the other two with respectively 65% and 54% of measures coded as ‘efficiency’, whereas the share for Germany and Sweden is 27% and 32% respectively. When summarising the share of measures coded as ‘efficiency’ and ‘substitution’, the differences between the countries almost vanished. On average, policies aimed at changing patterns, rather than volume, of consumption made up around 85%.

While command-and-control measures were found in all four countries, and more so in Norway and Sweden compared to France and Germany, market-based measures characterised an overwhelming share of the policies we mapped targeting private cars when looking at all four countries combined. For the case of aviation, the few measures we found were tax based, and very modest. In sum, the governance strategy concerning the two most important emission sources from household consumption, namely aviation and private car, is dominated by mechanisms of ‘efficiency’ and ‘substitution’. The market-oriented approach leaves the final decision on whether to engage in mitigation activities to the individual consumer.

4.2.2 Food

The HOPE simulation game showed that food was the second largest sector in terms of emissions and mitigation potential. Median households had to choose the following measures to meet the 50% reduction goal: increase

the share of fresh, local, organic and vegetarian foods. From here on we refer to these measures as ‘sustainable diet’.

The policies mapped for this sector were divided into the categories *dietary change*, *local food promotion* and *organic food promotion*. This sector had the smallest number of demand-side actions compared to the other three sectors, and showed little variation between countries. The policy approach is largely market-oriented across all four countries and food subsectors with 81% of the total number of identified measures coded at ‘Information Policies’ or ‘Economic Instruments’. The measures are largely information-based, such as information campaigns and labelling schemes on local and organic produce. A minor share of measures, exclusively concerning local and organic food promotion, were coded at ‘Regulatory Approaches’ and ‘Public Goods and Services’ (command-and-control strategy). *Organic food promotion* is the subsector receiving the most policy attention across all four countries. France and Norway were the only countries where we found any measures on *local food promotion*, and Norway and Sweden were the only countries with measures explicitly promoting *dietary change*.

Market-oriented policies dominate the demand-side in this sector. France and Norway are the only countries where we find a minor share of command-and-control measures. This consumption category stands out with respect to anticipated strategies for changing consumption in the sense that policies aimed at dietary change almost exclusively work by ‘substitution’. In sum, the governing strategy concerning food is predominantly market-based. This leaves responsibility to engage in mitigation to the individual citizen. Governments’ overwhelming neoliberal approach to the food area means their role is almost entirely limited to nudging citizens to self-govern.

4.2.3 Housing

The housing sector closely follows the food sector in terms of GHG emissions from household consumption and available mitigation potential. For this sector, heating was the biggest contributing factor to emissions across all country cases, thus representing an area with significant mitigation potential. To achieve the 50% emission reductions in the simulation game, median households had to choose actions that reduced the climate impact of heating systems. The policy measures in this sector were grouped into four categories: *building design*, *energy supply*, *energy use* and *household appliances*. The housing sector has a high number of policy measures targeting demand-side activity. The approach is largely market-oriented, with up to 70% of identified measures coded at ‘Information Policies’ or ‘Economic Instruments’. All in all, there were no striking differences in the housing sector between the four countries.

All subcategories in this consumption area, apart from *household appliances*, contain policies that affect GHG emissions from heating, and measures vary greatly between the four IPCC classifications. In *building design*, the most important policies affecting heating target the energy performance of buildings in addition to measures that, where they exist, determine source of heating. Such measures range from energy efficiency standards, energy labelling scheme, ban on certain heating sources and tax deductions, subsidies or beneficial loans for improving energy performance. All four countries have regulation standards on the energy performance of buildings. The subsector *building design* has a somewhat higher share of policies coded at ‘Regulatory Approaches’ and ‘Public Goods and Services’ than the other subsectors, with 45% of measures. In *energy supply*, the measures most related to heating are measures related to energy production. All four countries have implemented a carbon tax applied to fuels for heating, thus indirectly incentivising low carbon energy sources. This is supplemented by various measures depending on the country, ranging from mandatory requirements to subsidy and grant schemes, certificates and feed-in tariffs to incentivise renewable energy sources. More than half (63%) of measures found in this subcategory are market-oriented, of which an overwhelming majority was coded at ‘Economic Instruments’. Policies that affect emissions from heating in the subcategory *energy use* include Norway’s introduction of an electricity tax aiming to reduce consumption with a similar tax found in France and Germany. Policies aiming to inform consumers are numerous, ranging from teaching plans in school, consultation services and consumption information on energy bills. This subcategory has a high share of market-oriented measures, with 83% of policies coded at ‘Economic Instruments’ and ‘Information Policies’. In contrast to *energy supply*, we find almost equal shares of information-oriented and fiscal measures.

The housing sector largely applies a market-based policy strategy. However, in *building design* we find a relatively high share of command-and-control measures across all four countries (45%), even though market-based measures dominate. Norway is the only country where command-and-control strategies play a prominent role overall (43%). As with the mobility sector, current policies mostly target changing consumption patterns by means of improving efficiency in energy use, at least in France and Germany. Norway and Sweden differs somewhat with a higher share of ‘reduction’ measures (33% and 29% respectively) compared to Germany and France (8% and 4% respectively). In sum, the governing strategy concerning demand-side GHG emissions from the housing sector places responsibility for mitigation actions with the individual citizen.

4.3. Individual actions

In the in-depth interviews, households were asked whom they consider responsible for acting on climate change mitigation. Two preliminary themes emerged from the qualitative content analysis of their responses: roles of responsibility and systemic barriers to mitigation actions. A broad consensus was found among most of the interviewees across the four countries that mitigation is a shared responsibility between all societal actors including individuals. One German interviewee summed it up this way:

Everyone. Everyone for themselves.

(Germany 1)

However, changing habits beyond relatively simple measures such as recycling waste is difficult for the average person, as pointed out by an interviewee in Norway:

Even if it's to eat vegetarian food or change travel habits it was very/ One doesn't really want to do anything beyond perhaps recycling milk cartons. It's the biggest effort a normal person is willing to put in today [...]. The will to change is/ it's a long way to go do something. To change your habits.

(Norway 1)

While there was broad consensus on the important role of individuals, many interviewees at the same time pointed out that climate mitigation is a collective responsibility where government and industry actors must take their share of the responsibility and steer the process more than they do. In many areas, interviewees found it difficult to change much on their own without more government support:

An average person doesn't have the capacity to stay updated on things and I think that with [...] how serious the situation is that you can't depend on an average constituent citizen to be so updated. And then the choices just aren't there. [...Governments] have to take much more responsibility.

(Norway 2)

Some respondents further argued that the supranational level of governance and transnational cooperation would have to play a bigger role to succeed with mitigation:

And countries among themselves, it is useless if only one country acts and the neighbour pollutes like crazy.

(Germany 2)

The other theme emerging was systemic barriers to mitigation action. This was brought up in all four countries. Some system level problems were explicitly pointed out. First, as long as air travel is an available and cheap option, it is difficult to consider the alternatives:

[...] there are limits to consumer power in this case at least it must be placed on everyone. And I think planes are a good example here. They have to take a bigger share of climate

costs. [...] [I]t will become more expensive for consumers but it might lead to different choices. At the same time we're flying so cheaply now [...] if it were to cost a little more, OK.
(Sweden 1)

Second, imported meat often comes with long mileage, yet is cheaper to purchase than 'locally' farmed meat:

[...] something is wrong when it's cheaper to sell food that has travelled around the world to get here than having farmers producing it here. Because that meat is coming from New Zealand and Australia and the likes. And Brazil. Those distances aren't short.
(Sweden 2)

Finally, one interviewee pointed to issues with our societal model and the problem with putting the responsibility on individuals, arguing that it is the task of political representatives and industry to change the system and provide alternatives. The interviewee further pointed to climate justice issues and the right to develop (and pollute) for poorer countries:

[I]ndustry and politicians. [...] They are responsible, not just to say 'consumption must stop, you've got to stop this and that'. [...] The societal model must be changed, or at least production. [...] [A]nd not at the expense of the poorest countries [...]. They wouldn't have the right to pollute? [...] We've been polluting 5 times longer than them!
(France 1)

In sum, most interviewees stated that they do believe everyone shares the responsibility to take mitigation action when asked in the in-depth interviews. Many of them also pointed out that there is an important role to be played by the state. This was even emphasised for two areas holding particularly high mitigation potential: air travel and short-travelled food. Here interviewees particularly emphasised the important role to be played by governing authorities since they found it difficult to make the necessary changes in these places without more support and intervention from government. The remainder of this paper discusses the implications for demand-side climate policy in line with the 1.5°C goal set in Paris.

5. Implications for demand-side climate policy

While addressing consumption related emissions has in the past been deemed politically 'impossible' - illustrated by the frequently cited statement made by former President Bush ahead of the 1992 Earth Summit that 'the American way of life is not up for negotiation' (The Economist 2003) - it is now increasingly considered an area holding significant mitigation potential (Stern et al. 2016). Hertwich and Peters' (2009) study found that 72% of global GHG emissions are related to household consumption activities, whereas a major US study concluded that "reasonably achievable emissions reduction (RAER) can be approximately 20% in the household sector within 10 years if the most effective non-regulatory interventions are used" (Dietz et al. 2009: 18452); thus a large potential for 'low-hanging' fruits. Increasing the ambition of demand-side mitigation by introducing strong near-term emissions reductions would reduce the risk of missing the 1.5°C goal by hedging against risks and uncertainties related to the scale of carbon removal needed in the latter part of the century (Millar et al. 2017; IEA 2017; Sanderson, O'Neill and Tebaldi 2016; Rogelj et al. 2015; Smith et al. 2015). The math is simple: the more we mitigate short-term, the less we rely on negative emission technologies working at the scale they operate at in current climate models (Riahi et al. 2015: 13).

Our study corroborates that existing climate policies targeting the demand-side are not sufficient for realising emission reductions in line with 1.5°C emission pathways. There are two main reasons for this. First, the 'voluntary' scenario is unlikely to suffice. The 'voluntary' scenario of the simulation on average reduced GHG emissions by 25%, thus falling short of realising the demand-side emission reductions in line with the 1.5°C goal. Only the 'forced' scenario, where respondents were pushed to cut emissions until reaching 50% brought about the necessary lifestyle changes.

Second, our results indicate a mismatch between the roles and responsibilities implied in a majority of the policies we mapped and the perceptions of the people we interviewed. The dominating market-based approach and thus neoliberal rationality of governance individualises responsibility for mitigation action, a responsibility interviewees broadly accept in principle. However, our respondents also pointed out significant systemic barriers that are difficult for them to overcome without government and industry action. This was particularly obvious for two large emission factors: aviation and sustainable diet. Characteristic for both are minimal policy attention, and almost entirely market-based policy approaches. These two factors illustrate how responsibility to take mitigation action to realise some of the available emission mitigation potential is entirely individualised with minimal government intervention. Household reflections on roles of responsibility, and most interestingly, capabilities to act on such responsibility, showed that it was difficult for the interviewees to take sufficient mitigation action without more government involvement.

In line with findings from other recent studies on demand-side mitigation in HICs (Tvinnereim et al. 2017; Wynes and Nicholas 2017; Howell 2009), we find that people generally embrace individual responsibility but call for government intervention to facilitate consumption changes since existing government policies do not sufficiently address big mitigation potential demand-side measures. If policies place an unfair burden on households to take responsibility for GHG emission reductions compared to others such as industry or government, such efforts were resisted (Sovacool et al. 2017; Chilvers and Longhurst 2016). Taking advantage of the mitigation potential in the demand-side of the economy might require us to challenge our notion and treatment of individuals as unregulated consumers (Maniates 2001: 31) since it is difficult for individuals to take necessary mitigation action without government intervention (Berthou and Ebbesen 2016).

We found that the dominant policy strategy in the consumption areas holding the most mitigation potential for demand-side mitigation relies heavily on market-oriented instruments (a total of 64%). Furthermore, the policies are predominantly aimed at changing patterns (82%) as opposed to levels of consumption, and do so by means of improving efficiency (43%) in consumption as opposed to that of promoting substitution to less GHG intensive means of consumption (39%). These findings are in line with previous studies on sustainable consumption (Jackson 2006). The focus on efficiency improvements opens up to negative impacts of rebound mechanisms, which could lead to less GHG emission reductions than anticipated (Santarius et al. 2016), which is leading some scholar to state that '[t]he time has come to design energy policies as a contributor to absolute reduction in energy demand' (Ruzzenenti and Bertoldi 2017). However, we also note that some countries and some consumption areas diverge from the dominating pattern. In Norway and Sweden, in the sectors of mobility and housing, reduction strategies - as opposed to substitution or efficiency - make up a higher share (20-30%) of the identified policy measures than in the other countries.

Market-based policies dominate most of the areas holding large emission mitigation potential: aviation, private car, sustainable diet, and energy use (France and Germany). In these areas of consumption, the individual citizen is the agent responsible for undertaking mitigation action since the final decision on whether to engage in the activity is left for them to take. The only area holding significant mitigation potential where a command-and-control approach dominated in all four countries, and where governing authorities stand as the responsible agent for mitigation action, is the case *building design*. Here we must add that in Norway and Sweden, a command-and-control approach (barely) dominates the subsector private car, thus leaving governing authorities with a significant role to be played in terms of taking responsibility for mitigation action. Comparing measures coded as 'command-and-control' with 'market' we find very little differences between changing patterns versus levels of consumption; both rate around 30% with respect to changing levels of consumption - but with a slight difference when it comes to that of aiming at efficiency improvements (93 and 78% respectively).

Our study shows that there is some flexibility in policy approaches as indicated by the presence of command-and-control measures, and thus bureaucratic rationalities of Government, offering policy space for increased demand-side mitigation. There are three main observations that support this argument. First, and perhaps counter to intuition, interviewees called for more government intervention to help them make good choices. While politicians often face pressure because of re-election, interviewees largely acknowledged that public authorities have the right and even duty to regulate activities related to household GHG emissions.

Second, we found bureaucratic rationalities of Government in two areas with high mitigation potential: car use and residence heating. Though neoliberal rationalities of Government were prevalent here, both had

significant shares of bureaucratic rationalities - and thus traditions of stronger government intervention. This shows that there is indeed available space and an opportunity for government to take a clear leading role.

Third, households specifically called for more government intervention in the areas with close-to-none bureaucratic rationalities: aviation and sustainable diet. Interviewees particularly emphasised the important role to be played by governing authorities in aviation and sustainable diet since interviewees found it difficult to make the necessary changes in these areas on their own.

The current NDCs of the four country cases do not contain any reference to demand-side mitigation (UNFCCC n.d.). Across all submitted NDCs, only four contain references to 'sustainable consumption' (Mauritius, Seychelles, Malaysia, and Bhutan) (UNFCCC n.d.). As countries need to find ways to increase the mitigation ambition for the update of NDCs, more emphasis should be put on demand-side mitigation as this area holds significant mitigation potential. Our analysis shows that while neoliberal rationalities of Government currently dominate the policy approach to demand-side mitigation in the four HICs investigated in our study, there is policy space for stronger government intervention in that bureaucratic rationalities of Government are already present in most of the relevant areas (apart from food). Governments already play a significant role in regulating consumption activities, and to increase the role of government in regulating consumer activities might be less politically controversial than often assumed.

6. Conclusions

While one should be careful to generalise from comparative case study analysis such as this, the findings could be relevant for analysis of other HICs. Three main findings from our analysis should be emphasised: *First*, we found that current climate policies targeting the demand-side appears to be insufficient for realising emission reductions in line with 1.5°C emission pathways. There is a mismatch between current climate policy objectives and actual patterns of living and practices of consumption, in which households specifically call for stronger government intervention in high mitigation potential areas that are now receiving minor policy focus. *Second*, current climate policies are largely market-based, aiming at changing patterns - and not levels - of consumption. *Third*, there appears to be policy space for increased demand-side mitigation efforts by means of more frequently applying command-and-control measures aimed at high emission consumption areas since a mix of instruments is most likely to deliver the desired outcomes.

In conclusion, these findings indicate that the door for stronger government intervention is already 'half-open'. Government already intervenes with command-and-control measures in several high mitigation potential areas, so one may assume this means there is already public acceptance for such intervention; an assumption corroborated by our study. Respondents specifically call for stronger government intervention in the high mitigation potential areas as of yet receiving minor policy focus.

If we are to reach the 1.5°C goal set in Paris, taking advantage of the near-term demand-side mitigation potential in HICs is one important way to reduce our reliance on large-scale rollout of negative emission technologies in the second half of the century. However, taking advantage of the significant demand-side mitigation potential requires stronger government intervention. We have indicated existing policy spaces for stronger government intervention; adjustments and supplements to the presented list of 20 climate policy measures currently in place in one or more of the four investigated countries. These are spaces for realising household decarbonisation rather than merely discussing it.

Bibliography

- Aall, C. (2001). Local Agenda 21 as means of interpreting and introducing the new policy issue of sustainable production and consumption – experiences from seven Norwegian municipalities. In W. Lafferty (Ed.), *Sustainable Communities in Europe* (82-100). London: Earthscan Publishers.
- Aall, C., Hille, J. (2010). Consumption – a missing dimension in climate policy. In R. Bhaskar, C. Frank, K.G. Høyer, P. Naess and J. Parker (Eds.), *Interdisciplinarity and Climate Change: Transforming Knowledge and Practice for Our Global Future* (85-100). London: Routledge.
- Adua, L. (2010). To Cool a Sweltering Earth: Does Energy Efficiency Improvement Offset the Climate Impacts of Lifestyle? *Energy Policy*, 38(10), 5719-5732.
- Asara, V., Otero, I., Demaria, F., Corbera, E. (2015). Socially sustainable degrowth as a social-ecological transformation: repoliticizing sustainability. *Sustainability Science*, 10(3), 375-384.
- Asdal, K., Jacobsen, E. (2009). *Forbrukerens ansvar*. Oslo: Cappelen Damm Akademisk.
- Bacchi, C. L. (2009). *Analyzing Policy: What's the Problem Represented to be?* Frenchs Forest NSW: Pearson.
- (2010). Foucault, Policy and Rule: Challenging the Problem-Solving Paradigm. Aalborg: Institut for Historie, Internationale Studier og Samfundsforhold, Aalborg Universitet. FREIA's tekstserie, No. 74, doi:10.5278/freia.33190049
- Bäckstrand, G., Ingelstam, L. (2006). Enough! Global challenges and responsible lifestyles. *Development Dialogue*, 47, 97-147.
- Berthou, S. K. G. (2013). The Everyday Challenges of pro-Environmental Practices. *The Journal of Transdisciplinary Environmental Studies*, 12(1), 53-68.
- Berthou, S. K. G., Ebbesen, B. V. (2016). Local Governing of Climate Change in Denmark: Recasting Citizens as Consumers. *Journal of Environmental Planning and Management*, 59(3), 501-17.
- Bryman, A. (2012). *Social Research Methods* (4th Ed.). Oxford: Oxford University Press.
- Chilvers, J., Longhurst, N. (2016). Participation in Transition(s): Reconceiving Public Engagements in Energy Transitions as Co-Produced, Emergent and Diverse. *Journal of Environmental Policy & Planning*, 18(5), 585-607.
- Daly, H. E. (1968). On economics as a life science. *Journal of Political Economy*, 76(3), 392-406.
- Dauvergne, P. (2010). The Problem of Consumption. *Global Environmental Politics*, 10(2), 1-10.
- Dean, M. (2010). *Governmentality: power and rule in modern society*. Thousand Oaks, CA: SAGE Publications.
- Demaria, F., Schneider, F., Sekulova, F., Martinez-Alier, J. (2013). What is degrowth? From an activist slogan to a social movement. *Environmental Values*, 22 (2), 191-215.
- Dietz, T., Gardner, G. T., Gilligan, J., Stern, P. C., Vandenberghe, M. P. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *PNAS*, 106(44), 18452–18456.
- Dubois, G., Ceron, J. P. (2015). Consommation et modes de vie: Une autre perspective sur les politiques d'atténuation du changement climatique. *Natures Sciences Sociétés*, 23(supplément), S76-S90.
- Feindt, P. H., Oels, A. (2005). Does Discourse Matter? Discourse Analysis in Environmental Policy Making. *Journal of Environmental Policy & Planning*, 7(3), 161-73.
- Foucault, M. (1991). Governmentality. In G. Burchell, C. Gordon and P. Miller (Eds.), *The Foucault effect: studies in governmentality: with two lectures by and an interview with Michel Foucault* (87-104). Chicago: University of Chicago Press.
- Geels, F. W., Sovacool, B. K., Schwanen, T., Sorrell, S. (2017). Sociotechnical transitions for deep decarbonisation. *Science*, 357(6357), 1242-1244.
- Georgescu-Roegen, N. (1971). *Energy and economic myths*. New York: Pergannon Press.
- Haas, R., W. Eichhammer, C., Huber, O., Langniss, A., Lorenzoni, R., Madlener, P., Menanteau, et al. (2004). How to Promote Renewable Energy Systems Successfully and Effectively. *Energy Policy*, 32(6): 833-39.
- Herrmann, A., Fischer, H., Amelung, D., Litvine, D., Aall, C., Andersson, C., et al. (2017). Household preferences for reducing greenhouse gas emissions in four European high-income countries: Does health information matter? A mixed-methods study protocol. *BMC Public Health*, 18(1), doi: <http://doi.org/10.1186/s12889-017-4604-1>
- Hertwich, E. G., Peters G. P. (2009). Carbon footprint of nations: A global, trade-linked analysis. *Environmental*

- Science & Technology, 43(16), 6414–6420.
- Higgins, W. and Hallström, K. T. (2007). Standardization, Globalization and Rationalities of Government. *Organization*, 14(5): 685-704.
- Hood, C. C. (1983). *The Tools of Government*. London: Macmillan.
- Howell, R. (2009). The experience of carbon rationing action groups: implications for a personal carbon allowances policy. UK Energy Research Centre, Demand Reduction Theme. University of Oxford. <http://www.eci.ox.ac.uk/research/energy/archive-carbon-rationing.html>. Accessed 28 October 2017.
- Huntington, H., Smith, E. (2011). Mitigating Climate Change Through Energy Efficiency: An Introduction and Overview. *The Energy Journal*, 32(1), 1-6.
- Høyer, K. G. (2008). Sustainable Development. In: D. Brune, D. Chapman, M.O. Gwynne and J.M. Pacyna (Eds.), *The Global Environment: Science, Technology and Management (1185-1205)*. Weinheim: VCH Publishers.
- IPCC (2014). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J. C. Minx (eds.)]. Cambridge: University Press.
- (2007). *Climate change 2007: Mitigation. Contribution of working group III to the fourth assessment report of the intergovernmental panel on climate change* [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds.)]. Cambridge: Cambridge University Press.
- Jackson, T. (2006). *The Earthscan Reader in Sustainable Consumption*. London: Earthscan.
- Keskitalo, E. Sirkku Juhola, C. H., Westerhoff, L. (2012). Climate Change as Governmentality: Technologies of Government for Adaptation in Three European Countries. *Journal of Environmental Planning and Management*, 55(4), 435-52.
- Kivimaa, P. and Kern, F. (2016). Creative Destruction or Mere Niche Support? Innovation Policy Mixes for Sustainability Transitions. *Research Policy*, 45(1): 205-17.
- Knill, C., Tosun, J. (2012). *Public Policy: A New Introduction*. Houndmills: Palgrave Macmillan.
- Lodge, M. (2007). Comparative Public Policy. In F. Fischer, G. J. Miller, M. S. Sidney (Eds.), *Handbook of Public Policy Analysis (273-288)*. Boca Raton, FL: Taylor & Francis.
- Loiter, J. M. and Norberg-Bohm, V. (1999). Technology Policy and Renewable Energy: Public Roles in the Development of New Energy Technologies. *Energy Policy*, 27(2): 85-97. [https://doi.org/10.1016/S0301-4215\(99\)00013-0](https://doi.org/10.1016/S0301-4215(99)00013-0).
- Maniates, M. F. (2001). Individualization: Plant a Tree, Buy a Bike, Save the World? *Global Environmental Politics*, 1(3), 31-52.
- Meckling, J., Kelsey, N., Biber, E., and Zysman, J. (2015). Winning coalitions for climate policy. *Science* 349, 1170-1171.
- Mendonça, M., Jacobs, D. and Sovacool, B. K. (2010). *Powering the Green Economy: The Feed-in Tariff Handbook*. London; Sterling, VA: Earthscan.
- Millar, R., Fuglestedt, J., Friedlingstein, P., Rogelj, J., Grubb, M., Matthews, H. D., Skeie, R. B., Forster, P. M., Frame, D. J., Allen, M. R. (2017). Emission budgets and pathways consistent with limiting warming to 1.5°C. *Nature Geoscience*, doi:10.1038/ngeo3031
- Miller, P., Rose, N. S. (2008). *Governing the Present: Administering Economic, Social and Personal Life*. Reprinted. Cambridge: Polity Press.
- (1995). Production, Identity, and Democracy. *Theory and Society*, 23(3), 427-467.
- Mishan, E. J. (1977). *The economic growth debate: An assessment*. London: G. Allen & Unwin.
- Mol, A. P. J., Spaargaren, G., Sonnenfeld, D.A. (2009). Ecological modernisation: Three decades of policy, practice and theoretical reflection. In A. P. J. Mol, D. A. Sonnenfeld, G. Spaargaren (Eds.), *The Ecological Modernisation Reader: Environmental Reform in Theory and Practice (3-14)*. London: Routledge.
- IEA (2017). *Energy Technology Perspectives 2017: Catalysing Energy Technology Transformations*. OECD/IEA. Paris: International Energy Agency.
- IEA (2012). *World Energy Outlook 2012*. OECD/IEA Paris: International Energy Agency.
- OECD (2011). *Climate change and tourism policies in OECD countries*. OECD, UNEP. Paris: OECD, UNEP.

- (n.d.). What are equivalence scales? OECD Project on Income Distribution and Poverty.
<http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf>. Accessed 27. October 2017.
- Oels, A. (2005). Rendering Climate Change Governable: From Biopower to Advanced Liberal Government? *Journal of Environmental Policy & Planning*, 7(3), 185-207.
- Riahi, K., Kriegler, E., Johnson, N., Bertram, C., den Elzen, M., Eom, J., et al. (2015). Locked into Copenhagen Pledges? Implications of Short-Term Emission Targets for the Cost and Feasibility of Long-Term Climate Goals. *Technological Forecasting and Social Change*, 90, 8-23.
- Rogelj, J., Luderer, G., Pietzcker, R. C., Kriegler, E., Schaeffer, M., Krey, V., Riahi, K. (2015). Energy System Transformations for Limiting End-of-Century Warming to below 1.5 °C. *Nature Climate Change*, 5(6), 519-27.
- Rogge, K. S. and Reichardt, K. (2016). Policy mixes for sustainability transitions: An extended concept and framework for analysis. *Research Policy*, 45, 1620-1635.
- Rose, N. S. (1999). *Powers of Freedom: Reframing Political Thought*. Cambridge: Cambridge University Press.
- Rose, N. S., Miller, P. (1992). Political Power Beyond the State: Problematics of Government. *The British Journal of Sociology*, 43(2), 173-205.
- Ruzzenenti, F., Bertoldi, P. (2017). Energy Conservation Policies in the Light of the Energetics of Evolution. In N. Labanca (Ed.), *Complex Systems and Social Practices in Energy Transitions - Framing Energy Sustainability in the Time of Renewables (147-170)*. Switzerland: Springer Nature.
- Sachs, I., Ceron, J. P., Godard, O., Hourcade, J. C., Théry, D., Vallet, G., Vinaver, K. (1973). *Suggestions pour un programme environnement/développement, étude effectuée pour le programme des nations unies pour l'environnement*. Paris: CIRED.
- Sachs, I., Kapp, K. W., Iglesias, E. V. (1972). Development and environment: Report and working papers of a panel of experts, Founex, Switzerland, June 4-12, 1971. Paris: Mouton.
- Sanderson, B. M., O'Neill, B. C., Tebaldi, C. (2016). What would it take to achieve the Paris temperature targets? *Geophysical Research Letters*, 43, 7133-7142.
- Schleussner, C. F., Rogelj, J., Schaeffer, M., Lissner, T., Licker, R., Fischer, E. M., et al. (2016). Science and Policy Characteristics of the Paris Agreement Temperature Goal. *Nature Climate Change*, 6(9), 827-835.
- Shove, E. (2010). Beyond the ABC: Climate Change Policy and Theories of Social Change. *Environment and Planning A*, 42(6), 1273-1285.
- Sinnott-Armstrong, W. (2005). It's Not My Fault: Global Warming and Individual Moral Obligations. *Advances in the Economics of Environmental Resources*, 5, 285-307.
- Smith, P., Davis, S. J., Creutzig, F., Fuss, S., Minx, J., Gabrielle, B., et al. (2015). Biophysical and Economic Limits to Negative CO₂ Emissions. *Nature Climate Change*, 6(1), 42-50.
- Sovacool, B. K. (2016). How Long Will it Take? Conceptualizing the Temporal Dynamics of Energy Transitions. *Energy Research & Social Science*, 13, 202-215.
- (2009). The Importance of Comprehensiveness in Renewable Electricity and Energy-Efficiency Policy. *Energy Policy*, 37(4): 1529-41. <https://doi.org/10.1016/j.enpol.2008.12.016>.
- Sovacool, B. K., Heffron, R. J., McCauley, D., Goldthau, A. (2016). Energy decisions reframed as justice and ethical concerns. *Nature Energy*, 16024, 1-6.
- Sovacool, B. K., Kivimaa, P., Hielscher, S., Jenkins, K. (2017). Vulnerability and resistance in the United Kingdom's smart meter transition. *Energy Policy*, 109, 767-781.
- Stern, P. C. et al. Janda, K. B., Brown, M. A., Steg, L., Vine, E. L., Lutzenhiser, L. (2016). Opportunities and insights for reducing fossil fuel consumption by households and organizations. *Nature Energy*, doi: <http://dx.doi.org/10.1038/nenergy.2016.43>.
- The Economist (2003). A greener Bush. 13 February 2003, The Economist.
<http://www.economist.com/node/1576767>. Accessed 27 October 2017.
- Treib, O., Bähr, H., Falkner, G. (2007). Modes of governance: towards a conceptual clarification. *Journal of European Public Policy*, 14(1), 1-20.
- Tvinnereim, E., Fløttum, K., Gjerstad, Ø., Johannesson, M. P., Norbø, Å. D. (2017). Citizens' preferences for tackling climate change. Quantitative and qualitative analyses of their freely formulated solutions. *Global Environmental Change*, 46, 34-41.
- UN (2015). Paris Agreement. United Nations.

- http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf>.
Accessed 25 October 2017.
- UNCED (1992). Agenda 21: Programme of Action for Sustainable Development. United Nations Conference on Environment and Development. New York: United Nations.
- UNECE (2010). Catalysing change: The UNECE response to the climate countdown. United Nations (UN). Belley: Imprimerie Nouvelle Gonnet.
- UNEP (2017). The Emissions Gap Report 2017. United Nations Environment Programme (UNEP), Nairobi.
- UNFCCC (2014). List of Annex I Parties to the Convention. United Nations Framework Convention on Climate Change (UNFCCC). http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php. Accessed 20 October 2017.
- UNFCCC (n.d.). NDC Registry (interim). United Nations Framework Convention on Climate Change (UNFCCC). <http://www4.unfccc.int/ndcregistry/Pages/Home.aspx>. Accessed 19 October 2017.
- Utenriksdepartementet (2012). Utenfor og innenfor: Norges avtaler med EU (NOU 2012:2). Oslo: Utenriksdepartementet.
- Villadsen, K. 2010. Forord til den danske udgave. In M. Dean (Ed.), Governmentality. Magt og styring i det moderne samfund. Frederiksberg: Forlaget Sociologi.
- Voß, J. -P., Newig, J., Kastens, B., Monstadt, J. and Nölting, B. (2007). Steering for Sustainable Development: A Typology of Problems and Strategies with Respect to Ambivalence, Uncertainty and Distributed Power. *Journal of Environmental Policy & Planning*, 9 (3–4), 193-212.
- Walters, W. (2012). Governmentality: critical encounters. London: Routledge.
- Weimer, D. L., Vining, A. R. (2016). Policy Analysis (5th ed). Abingdon: Routledge.
- WCED (1987). Our Common Future, World Commission on Environment and Development. Oxford: Oxford University Press.
- Wynes, S., Nicholas, K. A. (2017). The climate mitigation gap: education and government recommendations miss the most effective individual actions. *Environmental Research Letters*, 12, 1-9.
- Xue, J., Walnum, H.J., Aall, C., Næss, P. (2016). Two Contrasting Scenarios for a Zero-Emission Future in a High-Consumption Society. *Sustainability*, doi:10.3390/su9010020.

APPENDIX 1

This paper does not make any attempts to give quantified estimates of the GHG reduction impact of existing demand-side climate policies, nor make assumptions about the impact policies have on climate mitigation in terms of quantified GHG-emission reductions as this would be beyond the scope of our research. Neither existing mitigation policies nor the NDCs would keep emissions on track with an emission pathway compatible with the 1.5°C goal (Millar et al. 2017; Rogelj et al. 2015; Schleussner et al. 2016; UNEP 2017: xiv). The full potential of demand-side mitigation is not being taken advantage of. This is made apparent by several factors: 1) the current emission gap; 2) research demonstrating that increased demand-side mitigation is necessary to close the emission gap (Dietz et al. 2009); and 3) the uncertainty about voluntary mitigation occurring without stronger political interference (Berthou 2013; Asdal and Jacobsen 2009; Miller and Rose 1995; Howell 2009). Our research has therefore focused on identifying existing space in demand-side mitigation policies as this provides an opportunity for policy makers to put in place incremental policy changes that can take advantage of the mitigation potential in targeting household consumption. To this end, it is necessary to consider whether there is a match between the roles of responsibility implicit in the policies and the readiness of the policy target (in our case, households) to take on such responsibility for mitigation action. By focusing on the implicit or explicit role of responsibility inherent in each policy approach, we are then able to highlight the subjectification effect of consumption-oriented policies for the discretion and agency of governed subjects (households), as outlined above.

The research method used for household data collection in the HOPE project has been elaborated elsewhere (Herrmann et al. 2017), but a few key attributes deserve more explicit mentioning. We have three sources of household data: mapping of household related carbon footprints, the output from a household simulation game, and interviews with households. In addition, we have mapped current household-related climate policy measures.

309 households in four mid-sized European cities - Communauté du Aix-en-Provence, France; Mannheim, Germany; Bergen, Norway; and Umeå, Sweden - participated in the study. Three *Interactions* provided information on household behaviour in the following areas: food, housing, mobility, and other consumption. *Interaction 1* calculated households' carbon footprints (Herrmann et al. 2017: 3-4). *Interaction 2* was a simulation game with the goal to reduce household GHG emissions by 50% until 2030, in order to represent the idea of ambitious near-term demand-side mitigation compatible with 1.5°C pathways (Sanderson, O'Neill and Tebaldi 2016; Rogelj et al. 2015). Households were first asked to reduce their GHG emissions voluntarily by 50%. If they failed to reduce sufficiently in the 'voluntary' scenario, households were asked to imagine they were 'forced' to reduce their emissions by 50%. For *Interaction 3*, in-depth interviews were conducted with a subsample of households using an interview guide (Herrmann et al. 2017: 7). This paper uses a small part of the interview data, analysing interviewees' answers to the following question 'Who do you consider responsible for climate mitigation?' The interviews were audio recorded, transcribed verbatim and subjected to a qualitative content analysis where emerging themes were identified in the data (Bryman 2012). 50 statements relating to this question were analysed. The results are presented along with quotes illustrating the themes resulting from the qualitative content analysis.

The results from the household study were contrasted with results from a policy mapping. For this paper, 'policy' includes only the tangible output of political processes (Knill and Tosun 2012; Treib et al. 2007), such as strategy documents and legislative acts by public bodies, thus excluding voluntary initiatives by private entities or persons. The policy mapping identified any policy that affects household GHG emissions either directly or indirectly. The scope of our analysis is limited to 'demand-side' policies, including policies that might directly affect demand for goods or services. We have excluded supply-side policies (i.e. regulations to reduce GHG emissions from production) unless they fall into a grey-area (i.e. city planning for mobility or fuel mix regulations). Policy data was gathered through the Odyssee-Mure database, official reports to international organisations and government databases from the national, regional and local levels of government. EU policies were assumed implemented at subsidiary levels of government and therefore not mapped separately.⁴

⁴ Norway is obliged to adhere to EU directives and regulations through its membership in the European Economic Area (Utenriksdepartementet, 2012).

Our database includes 250 policies. They were coded along the dimensions shown in Table 1 and every policy was summarised in a separate policy sheet.

Table 1 Policy coding scheme

Policy area	Housing Mobility Food Other Consumption	
Anticipated policy mechanism	Improve efficiency (e.g. install more effective light bulbs, etc.) Substitute consumption (e.g. support public transportation for it to substitute private car). Reduce consumption (e.g. ban on cars in city centres)	
Policy categories	Information Policies	Information campaigns, research requests, suasion
	Regulatory Approaches	Prohibitions, standards
	Economic Instruments	Credits, grants, taxes, tax deductions
	Public Goods and Services	Planning, public company, infrastructure

Appendix 3 offers a breakdown of the policies for analytical purposes and to create an overview of the consumption categories addressed by policies as well as the logic these policies use. The ‘technologies of Government’ were identified and coded in the categories ‘policy instrument’. The objective of the coding was to identify the strategies and practices employed to achieve a stated policy objective. Keeping in line with the IPCC’s policy categories, policies were coded according to the policy categories used in the Fifth Assessment Report (IPCC 2014: p. 1155-56)⁵: Economic Instruments, Information Policies, Public Goods and Services, and Regulatory Approaches. International agreements or agreements between local governing bodies were counted if they resulted in tangible policies that affect private households as defined above. Policies that combine for example regulations and subsidies were counted twice, once per policy category.

After coding the policies, a generalised typology of rationalities was used to assess and analyse the logics and rationalities of Government across the four country cases and between the different consumption sectors (outlined in Table 2). The IPCC’s policy categories can be integrated with the rationalities of Government (Table 2). We would expect that market-oriented governance largely operates through policy instruments belonging to ‘Information Policies’ or ‘Economic Instruments’, and command-and-control governance generally uses either ‘Regulatory Approaches’ or ‘Public Goods and Services’. We summarised the policy results in tables in Appendix 3 by adding the number of policy measures in each category and showing the relative distribution of these across the policy categories. These figures must be used with great caution since individual policies have varying impact on GHG reductions, and they are for our purposes only meant to serve as indications of the broader policy approach.

Table 2 Governmentality framework

Policy category	Policy approach	Rationalities of Government	Technologies of Government
------------------------	------------------------	------------------------------------	-----------------------------------

⁵ This decision was made with the awareness that other, more abstract, typologies exist, e.g. Hood’s NATO scheme (see for example Knill and Tosun 2012: 22-25; Lodge 2007: 280-282).

Economic Instruments, Information Policies	Market-oriented	Liberal	<ul style="list-style-type: none"> - Audit processes - Enforced self-regulation - Regulated participation bodies - Competition focus
		Neo-liberal	<ul style="list-style-type: none"> - Marketisation and privatisation of public services - Personal responsibility to act - Self-surveillance measures - Standardisation, benchmarking, best practice schemes, performance indicators
Regulatory Approaches, Public Goods and Services	Command-and-control	Bureaucratic	<ul style="list-style-type: none"> - Legislative and regulative measures - Responsibility to act within bureaucratic apparatuses - Public services provided by the state

Source: Based on Rose and Miller (1992); Keskitalo *et al.* (2012); Asdal and Jacobsen (2009); Knill and Tosun (2012)

APPENDIX 2

Table 1 Median carbon footprint before, during and after the simulation game measured in kg CO₂e per year and *CU* by sector. The third column describes the CO₂e share of the Total, the fifth column shows the within-sector reduction in relation to the initial carbon footprint value, and the sixth column shows the reduction in percentage between the 'voluntary' and the 'forced' scenarios. The numbers presented are median values of pooled country data.

Consumption sector	Median CF	% of total	Simulation game scenario	Reduction of initial CF	Reduction of 'voluntary' scenario
Housing	1770	21%	Initial footprint		
	1264	20%	'Voluntary'	29%	
	895	21%	'Forced'	49%	29%
Food	2564	30%	Initial footprint		
	1704	27%	'Voluntary'	34%	
	1131	26%	'Forced'	56%	34%
Other consumption	1291	15%	Initial footprint		
	1193	19%	'Voluntary'	8%	
	1109	26%	'Forced'	14%	7%
Mobility	2926	34%	Initial footprint		
	2162	34%	'Voluntary'	26%	
	1208	28%	'Forced'	59%	44%
Total	9507		Initial footprint		
	7112		'Voluntary'	25%	
	4915		'Forced'	48%	31%

APPENDIX 3

Table 1 IPCC-policy category breakdown by consumption category for each country

		Policy Categories and Instruments	Count	Percentage per country
Food	Total Food		22	
	France	Economic Instruments	3	43%
		Grants	3	
		Information Policies	2	29%
		Information campaign	2	
		Public Goods and Services	-	-
		Regulatory Approaches	2	29%
		Standards	2	
	Germany	Economic Instruments	2	50%
		Grants	2	
		Information Policies	2	50%
		Information campaign	2	
		Public Goods and Services	-	-
		Regulatory Approaches	-	-
	Norway	Information Policies	4	50%
		Information campaign	3	
		Suasion	1	
		Regulatory Approaches	1	13%
		Standards	1	
		Economic Instruments	2	25%
		Grants	2	
		Public Goods and Services	1	13%
		Planning	1	
	Sweden	Economic Instruments	1	33%
		Grants	1	
		Information Policies	2	67%
		Information campaign	2	
		Public Goods and Services	-	-
		Regulatory Approaches	-	-
Housing	Total Housing		85	
	France	Economic Instruments	14	45%
		Credit	1	
		Grants	9	
		Tax	1	
		Tax deductions	3	
		Information Policies	10	32%
		Information campaign	8	
		Suasion	2	
		Public Goods and Services	1	3%
		Planning	1	
		Regulatory Approaches	6	19%

	Germany	Standards	6	
		Economic Instruments	10	40%
		Credit	1	
		Grants	8	
		Tax	1	
		Information Policies	6	24%
		Information campaign	4	
		Suasion	2	
		Public Goods and Services	4	16%
		Infrastructure	1	
		Planning	1	
		Public company	2	
		Regulatory Approaches	5	20%
		Standards	5	
	Norway	Economic Instruments	6	43%
		Credit	1	
		Grants	3	
		Tax	2	
		Information Policies	4	14%
		Information campaign	4	
		Public Goods and Services	-	-
		Regulatory Approaches	6	43%
		Prohibitions	1	
		Standards	5	
	Sweden	Economic Instruments	5	33%
		Grants	3	
		Tax	1	
		Tax deductions	1	
		Information Policies	6	40%
		Information campaign	3	
		Suasion	3	
		Public Goods and Services	2	13%
		Infrastructure	2	
		Regulatory Approaches	2	13%
		Standards	2	
Mobility	Total Mobility		86	
	France	Economic Instruments	6	35%
		Grants	3	
		Tax	3	
		Information Policies	7	41%
		Information campaign	2	
		Research inquiries	4	
		Suasion	1	
		Public Goods and Services	3	18%

		Infrastructure	2	
		Planning	1	
		Regulatory Approaches	1	6%
		Standards	1	
	Germany	Economic Instruments	9	52%
		Grants	7	
		Tax	2	
		Information Policies	4	24%
		Information campaign	4	
		Public Goods and Services	1	6%
		Planning	1	
		Regulatory Approaches	3	18%
		Prohibitions	1	
		Standards	2	
	Norway	Economic Instruments	10	42%
		Grants	3	
		Tax	3	
		Tax deductions	3	
		User charges	1	
		Information Policies	1	4%
		Information campaign	1	
		Public Goods and Services	8	33%
		Infrastructure	8	
		Regulatory Approaches	5	21%
		Prohibitions	3	
		Standards	2	
	Sweden	Economic Instruments	9	32%
		Grants	4	
		Tax	3	
		Tax deductions	2	
		Information Policies	3	11%
		Information campaign	3	
		Public Goods and Services	14	50%
		Infrastructure	9	
		Planning	5	
		Regulatory Approaches	2	7%
		Prohibitions	1	
		Standards	1	
Other Consumption	Total Other Consumption		57	
	France	Economic Instruments	2	18%
		Public procurement	1	
		Use charges	1	
		Information Policies	4	36%
		Information campaign	3	

		Suasion	1	
		Public Goods and Services	-	-
		Regulatory Approaches	5	45%
		Prohibitions	1	
		Standards	4	
	Germany	Economic Instruments	-	-
		Information Policies	9	53%
		Information campaign	7	
		Research inquiries	1	
		Suasion	1	
		Public Goods and Services	4	24%
		Planning	2	
		Public company	2	
		Regulatory Approaches	4	24%
		Prohibitions	2	
		Standards	2	
	Norway	Economic Instruments	7	47%
		Grants	5	
		User charges	2	
		Information Policies	4	27%
		Information campaign	2	
		Suasion	2	
		Public Goods and Services	1	7%
		Infrastructure	1	
		Regulatory Approaches	3	20%
		Standards	3	
	Sweden	Economic Instruments	2	14%
		Tax deductions	1	
		Use charges	1	
		Information Policies	7	50%
		Information campaign	6	
		Suasion	1	
		Public Goods and Services	-	-
		Regulatory Approaches	5	36%
		Standards	5	
Grand total			250	

Note: The total count at the end of the table is the sum of all policy categories, which are in turn based on the sum of the policy instruments that constitute them. Policy instruments are provided for more details. Percentages given are calculated per consumption category for each country, resulting in 100% (except for rounding errors) for all policies per consumption category for each country.

Source: Based on the policy data, list of policies and coding is included in the supplementary material.

Table 2 Consumption subsector breakdown of policies per consumption category for each country

	France	Germany	Norway	Sweden	Total
Food	7	4	8	3	22
Diet change	-	-	1	2	3
	-	-	13%	67%	14%
Promote local food	3	-	3	-	6
	43%	-	38%	-	27%
Promote organic food	4	4	4	1	13
	57%	100%	50%	33%	59%
Housing	31	25	14	15	85
Building design	16	7	4	5	32
	52%	28%	29%	33%	38%
Household appliances	2	-	-	1	3
	6%	-	-	7%	4%
Energy supply	2	6	4	4	16
	6%	24%	29%	27%	19%
Energy use	11	12	6	5	34
	35%	48%	43%	33%	40%
Mobility	17	17	24	28	86
Air traffic	-	1	2	-	3
	-	6%	8%	-	3%
Cars	12	6	12	19	49
	68%	35%	58%	43%	50%
Cycling	2	5	1	3	11
	16%	29%	4%	21%	18%
Public transport	3	5	9	6	23
	16%	29%	29%	36%	30%
Other Consumption	11	17	15	14	57
Consumables	2	-	-	-	2
	18%	-	-	-	4%
Diverse	7	13	2	6	28
	64%	76%	13%	43%	49%
Durable goods	-	-	4	1	5
	-	-	27%	7%	9%
Waste	2	4	9	7	22
	18%	24%	60%	50%	39%
Total	66	63	61	60	250

Note: The percentages in every other row are based on the count of policies per country broken down for each consumption category. The last column includes the percentage breakdown per consumption category for the total number of policies in that consumption category.

Table 3 Targeted household behaviour change per country (efficiency, reduction, substitution)

	Efficiency	Reduction	Substitution
% of Food	-	-	100.00%
France	-	-	100.00%
Germany	-	-	100.00%
Norway	-	-	100.00%
Sweden	-	-	100.00%
% of Housing	59%	15%	26%
France	72%	4%	24%
Germany	68%	8%	24%
Norway	33%	33%	33%
Sweden	42%	29%	29%
% of Mobility	45%	14%	41%
France	65%	6%	29%
Germany	29%	6%	65%
Norway	54%	17%	29%
Sweden	32%	21%	46%
% of Other Consumption	35%	37%	28%
France	18%	36%	46%
Germany	29%	29%	42%
Norway	47%	40%	13%
Sweden	43%	43%	14%
Overall %	44%	18%	38%

Note: Percentages calculated per row. They add up to 100% from left to right in each column.

Table 4 Targeted household behaviour change per consumption subsector (efficiency, reduction, substitution)

	Efficiency	Reduction	Substitution
% of Food	-	-	100%
Diet change	-	-	100%
Promote local food	-	-	100%
Promote organic food	-	-	100%
% of Housing	59%	15%	26%
Building design	81%	13%	6%
Energy supply	6%	6%	88%
Energy use	62%	21%	18%
Household appliances	100%	-	-
% of Mobility	45%	14%	41%
Air traffic	67%	33%	-
Cars	49%	14%	37%
Cycling	36%	9%	55%
Public transport	39%	13%	48%
% of Other Consumption	35%	37%	28%
Consumables	-	50%	50%
Diverse	25%	29%	46%
Durable goods	-	100%	-
Waste	59%	32%	9%
Overall %	44%	18%	38%

Note: Percentages calculated per row. They add up to 100% from left to right in each column.

Table 5 IPCC policy categories broken down for each consumption subsector

	Information Policies	Regulatory Approaches	Economic Instruments	Public Goods and Services
% of Food	45%	14%	36%	5%
Diet change	-	100%	-	-
Promote local food	33%	33%	-	33.33%
Promote organic food	8%	38%	8%	46.15%
% of Housing	28%	22%	41%	8%
Building design	19%	38%	34%	9%
Energy supply	13%	25%	50%	13%
Energy use	41%	9%	44%	6%
Household appliances	67%	-	33%	-
% of Mobility	17%	13%	40%	30%
Air traffic	-	-	-	100%
Cars	16%	16%	22%	45%
Cycling	-	27%	55%	18%
Public transport	13%	17%	39%	30%
% of Other Consumption	42%	30%	19%	9%
Consumables	100%	-	-	-
Diverse	11%	71 %	14%	4%
Durable goods	-	-	-	100 %
Waste	55%	18%	5%	23%
Overall %	29%	20%	35%	16%

Note: Percentages calculated per row. They add up to 100% from left to right in each column.