

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

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Abstract The Brundtland Commission report ‘Our Common Future’ highlighted that residents in high-income countries lead lifestyles incompatible with planetary boundaries. Three decades later, consumption-related greenhouse gas (GHG) emissions have continued to increase. To achieve ‘well below 2°C’ and 1.5 °C goals, consumption-related emissions must be substantially reduced in the coming decades. This paper provides insights on how to pursue 1.5 °C pathways through changes in household consumption. It draws on original data gathered in the project ‘Household Preferences for reducing greenhouse gas Emissions in four European

High Income Countries’ (HOPE) to analyse policies targeting and affecting direct and indirect GHG emissions in three household consumption categories (mobility, housing and food) in four countries (France, Germany, Norway and Sweden) and four medium-sized cities. This paper demonstrates discrepancies and similarities between current governmental policy approaches in the four countries and household perceptions of consumption changes with respect to policy mechanisms, responsibilities and space for acting on mitigation. Current demand-side policy strategies rely heavily on instruments of self-governance and nudging behaviour. Whilst some of our

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data suggests that households broadly accept this, it also suggests that governments could more actively lead and steer demand-side mitigation via adjusting and supplementing a comprehensive list of 20 climate policy measures currently in place in one or more of the case countries. The paper concludes by suggesting areas for more effective policy change and household-level climate change mitigation to feed the next update of climate pledges under the Paris Agreement.

Keywords Household energy use · Behaviour · Climate change mitigation · Climate policy · Energy consumption · Governmentality

Introduction

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, p. 140). Drastic demand-side emission reductions are a required feature of ‘deep decarbonisation’ (Geels et al. 2017) or ‘fast’ and ‘accelerated’ energy transitions (Sovacool 2016). Dietz et al. (2009, p. 18,452) state in particular 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.” The Paris Agreement recognises the important contribution of changes in lifestyles and consumption patterns to limit global warming to 1.5 or 2 °C (UNFCCC 2015, pp. 2–3).

Current climate change mitigation policies and nationally determined contributions (NDCs) under the Paris Agreement are neither consistent with the 1.5 °C, nor the 2 °C goal (UNEP 2017). Near-term mitigation targets for the 2020–2030 period are also insufficient for reaching these goals 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, p. 14; Schleussner et al. 2016). Pathways consistent with the 2 °C goal have already used most of the supply-side mitigation potential by 2050. Achieving the 1.5 °C goal 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).

We maintain that an increasing share of the additional mitigation effort should take place in developed countries (Rogelj et al. 2015). Most emission scenarios limiting average temperature increase to 1.5 °C assume large-scale carbon dioxide removal (CDR) from the atmosphere in the second half of the century (Kriegler et al. 2018). Those that operate with none or a smaller scale of CDR require radical demand-side emission reductions near-term (Kriegler et al. 2018). This would reduce the risk of missing the 1.5 °C goal by hedging ‘against a high climate response or subsequent reduction rates proving economically, technically or politically unfeasible’ (Rogelj et al. 2018; Millar et al. 2017, p. 1; see also IEA 2017; Sanderson et al. 2016; Rogelj et al. 2015; Smith et al. 2015). The more near-term mitigation society is able to implement, the less CDR will eventually be needed: every tonne counts (Kriegler et al. 2018).

Therefore, changing household consumption has the potential to significantly reduce GHG emissions in some contexts (Dietz et al. 2009), particularly mobility, housing, diet and waste (IPCC 2014, p. 66). Stronger demand-side mitigation, especially in the transport and building sectors, is a central feature of 1.5 °C compatible scenarios (Rogelj et al. 2018). 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); it is also uncertain whether individual actors are willing or able to take responsibility for substantial mitigation action (Berthou 2013; Asdal and Jacobsen 2009; Miller and Rose 1995; Howell 2009).

This paper analyses 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 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 responses from in-depth interviews with selected households. We explore 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. Whilst 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.

Analytical framework

Sustainable consumption

Analysing the prospects of changing household consumption patterns 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, 1972). The role assigned to consumption in environmental discourses 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 et al. 1972; Daly 1968; Mishan 1977). In the 1980s, the 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 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. 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, whilst 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 to a limited degree noticed the sustainable consumption debates. The Fourth IPCC Assessment Report (AR4) (IPCC 2007) mostly disregarded the issue of consumption. Even though the AR5 (IPCC 2014) examines consumption and lifestyles to an extent (Dubois and Ceron 2015), the IPCC mitigation discourse remains dominated by ecological modernisation, and the literature linking consumption to climate change has had limited presence. The published outline of AR6 indicates that lifestyle change is gaining ground (IPCC 2017), but will depend on the extent that it can draw on timely and rigorous peer-reviewed literature.

A governmentality approach

Whilst 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 (Kriegler et al. 2018). 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 can

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, making them amenable to reconstruction by 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, p. 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 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, p. 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 operationalise them (Higgins and 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).

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

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, p.15; Bacchi 2010). The different policy strategies for sustainable consumption 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 enables 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 opens up the possibility to take 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, p. 12).

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. During the simulation game, households are asked to reduce their GHG emissions by 50% within 2030, representing the idea of near-term demand-side mitigation compatible with 1.5 °C pathways (Sanderson et al.

2016; Rogelj et al. 2015). The simulation was divided into a ‘voluntary’ round and a ‘forced’ round. In addition, we have mapped current household-related mitigation policy measures. For considerations of space, the data collection and analysis is elaborated in Appendix 1.

Data availability The household data that support the findings of this study are available from the corresponding author upon reasonable request. The full datasets will be made available after all confidential data of study participants is deleted. The datasets will be made available through the national funding agency where applicable and through Open Science Framework (OSF). The policy data is available in full as electronic supplementary material to this publication.

Results

We present 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 actions. The household data are available from the corresponding author upon reasonable request. The policy data is available as electronic supplementary material.

Household emission reduction priorities

The baseline carbon footprint (CF) 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 t CO₂e per household member (Appendix 2). Within the mobility sector, plane and car were the highest contributing factors for GHG emission per household per year. Food was the second largest emission sector making up 30% of total GHG emissions equivalent to 2.6 t CO₂e. Here, meat and dairy consumption along with restaurant meals and other food had the highest mitigation potential. Housing sector-related emissions made up 21% of the initial CF, or roughly 1.8 t CO₂e. Heating

was the biggest contributing factor to emissions across all country cases, and an area with significant mitigation potential. The household sector with lowest mitigation potential was other consumption, making up 15%, or 1.3 t 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 primarily by reducing emissions related to private car use and air travel. More than one third (34%) of the total reduction were 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).

The simulation 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, based on the comparison of 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, shows that reductions in the sector other consumption were of limited importance compared 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 restricted the number of selectable mitigation actions. The latter could not be affected by the households. 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 is debatable, given the relative mitigation potential of the other three sectors. Indeed, previous research has shown that

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.).

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 (percent of initial CF)
Housing	1800	21%	880	21%	4%
Food	2600	30%	1430	34%	10%
Other	1300	15%	180	4%	<1%
Mobility	2900	34%	1700	41%	14%
Total	8600	100%	4190	100%	

the consumption sector mobility, food and housing hold the most significant mitigation potential (see Aall and Hille 2010). The remainder of this paper therefore limits its scope to the sectors with the highest mitigation potential: mobility, food and housing, paying attention to the actions that contributed most to emission reductions.

Demand-side policy approaches

The whole set of data from the HOPE project not only reveals patterns and dynamic trends about household emissions and reduction priorities but 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 a presentation of the results from the policy mapping, see tables in Appendix 3. For the list of the 250 identified policy measures, see supplementary material.

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 them over time, such as financial instruments (taxes, subsidies, grants, loans), regulatory instruments (standards, laws, performance targets) and procedural 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 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 Norberg-Bohm 1999; Haas et al. 2004; Dietz et al. 2009; Mendonça et al. 2009; Sovacool 2009; Kivimaa and Kern 2016).

Mobility

As previously indicated, aviation and private car use hold the greatest mitigation potential for mobility and are the 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* (Appendix 3, Table 6).

We found only 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. The latter also applies in Germany. *Private car* is the subsector most frequently addressed in policy across all four countries. A significant share of these measures was coded as ‘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 as ‘Regulatory Approaches’, all cases had fuel composition requirements and restricted parking and vehicle access to certain areas. Coded as ‘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 as ‘Regulatory Approaches’. We found several policies promoting

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	
	Public transport	Development of rail services or improving ageing rail infrastructure	
	Bicycle	Funding and frameworks for bicycles	
Food	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 Mandatory requirements, grant schemes, certificates and feed-in tariffs to incentivise renewable energy sources
		Energy use	Taxes on electricity consumption Informing consumers via teaching plans in schools, consultation services Informative energy billing
		Household appliances	Energy labelling and certification schemes

bicycling, typically steered by national frameworks accompanied by specific funding mechanisms.

Policies exhibited heterogeneity not only 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, based on policy measures coded as ‘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 as ‘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, (Appendix 3, Table 8). When summarising the share of measures coded as ‘efficiency’ and ‘substitution’, the country differences almost vanished. Generally, policies aimed at changing patterns, rather than volume, of consumption. This was also the case when looking specifically at policies targeting mobility across the four countries (Appendix 3, Table 9).

Whilst 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. The case of private car is dominated by mechanisms of ‘efficiency’ and ‘substitution’, whereas aviation is dominated by ‘reduction’ mechanisms. However, the few measures we found targeting the latter were tax based and very modest. The market-oriented approach leaves the final decision on whether to engage in mitigation activities to the individual consumer.

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*. It 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 the countries and food subsectors with 81% of the total number of identified measures coded as ‘Information Policies’ or ‘Economic Instruments’ (Appendix 3, Table 10). Most measures are 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 as ‘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. 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.

Housing

The housing sector closely follows the food sector in terms of GHG emissions from household consumption and available mitigation potential. Here, heating was the largest 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 69% of identified measures coded as ‘Information Policies’ or ‘Economic Instruments’ (Appendix 3, Table 10). 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*, policies affecting heating mostly 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 schemes, bans on certain heating sources and tax deductions, to subsidies or beneficial loans for improving energy performance. All four countries have regulation standards for the energy performance of buildings. The subsector *building design* has a somewhat higher share of policies coded as ‘Regulatory Approaches’ and ‘Public Goods and Services’ (47%) than the other subsectors. In *energy supply*, the measures most related to heating target energy production. All four countries have implemented a carbon tax on fuels for heating, 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 as ‘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 86% of policies coded as ‘Economic Instruments’ and ‘Information Policies’.

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 (47%), even though market-based measures dominate. Norway is the only country where command-and-control strategies play a prominent role overall (43%) (Appendix 3, Table 6). 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 differ somewhat with a higher share of

‘reduction’ measures (33 and 29%, respectively) compared to Germany and France (8 and 4%, respectively) (Appendix 3, Table 8). In sum, the governing strategy concerning the housing sector places responsibility for mitigation actions with the individual citizen.

Individual actions

During in-depth interviews, households were asked whom they consider responsible for 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 amongst most of the interviewees across the four countries that mitigation is a shared responsibility between all societal actors including individuals. One German interviewee aptly 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)*

Whilst 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 currently 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 for successful 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. This was brought up in all four countries. Some system-level problems were explicitly pointed out. First, as long as air travel is available and a 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 that 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. Interviewees particularly emphasised the 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.

Implications for demand-side climate policy

In the past, addressing consumption-related emissions has been deemed politically ‘impossible’—illustrated by President Bush’s statement ahead of the 1992 Earth Summit, ‘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, and 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, p. 18,452). There is a large potential for ‘low-hanging’ fruits. Strengthening demand-side mitigation drastically by introducing strong near-term emission reductions is not only a necessary part of 1.5 °C pathways; it would also reduce the risk of missing the goal by reducing the size of carbon budget overshoot (Kriegler et al. 2018). The math is simple: the more we mitigate short-term, the less we rely on CDR working at the scales indicated in most climate models (Riahi et al. 2015, p. 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 goal. 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%, 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 by 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 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 consumption areas 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 interestingly, capabilities to act on such responsibility, showed that it was difficult for the interviewees to take sufficient mitigation action without more government involvement due to few feasible alternatives. For market-based policies to achieve desired behavioural change, they must be designed carefully and preferably provide feasible alternatives since higher costs and pure provision of information do not proportionately induce higher responses (Bager and Mundaca 2017; Faruqi and Sergici 2010). In cases such as aviation, where few feasible technological and operational alternatives exist, the only solution near-term is demand management, often seen as controversial and unpopular (Bows-Larkin 2015).

In line with findings from 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 industry or government actors, such efforts were resisted (Sovacool et al. 2017; Chilvers and Longhurst 2016). Current energy and climate policies tend to hold unrealistic assumptions about behaviour (see Bager and Mundaca 2017). Taking advantage of the demand-side mitigation might require challenging our notion and treatment of individuals as unregulated consumers (Maniates 2001, p. 31) since it is difficult for individuals to take necessary mitigation action without carefully designed government intervention (Berthou

and Ebbesen 2016). These findings are important since behavioural interventions have trended towards measures for voluntary behaviour change, rather than changing the context of behaviour (Abrahamse et al. 2005), especially since peoples' preferences often depend on context and presentation of choice (Pichert and Katsikopoulos 2008).

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%) (Appendix 3, Table 10). Our findings are consistent with global empirical trends where market-based measures dominate policy portfolios for low-carbon energy technology (Mundaca and Markandya 2016). We find that policies are predominantly aimed at changing patterns (82%) as opposed to volume of consumption, and do so by means of improving efficiency (44%) in consumption and by promoting substitution to less GHG intensive means of consumption (38%) (Appendix 3, Table 8). 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), with some arguing 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 found 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 (Appendix 3, Table 10). 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 up to them. 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 *building design*. Here, we must add that in Norway and Sweden, a command-and-control approach (barely) dominates the subsector private car, leaving governing authorities with a significant role in terms of taking responsibility for mitigation action.

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. Whilst politicians often face pressure because of reelection, 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, both subsectors 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-no 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. Other studies have also pointed out the need for improving individuals' decisions under risk and uncertainty by linking choice architecture measures with other incentives to regulate consumption (Kunreuther and Weber 2014).

The current NDCs of the four country cases do not refer to demand-side mitigation (UNFCCC n.d.). Across all submitted NDCs, only four contain references to 'sustainable consumption' (Mauritius, Seychelles, Malaysia and Bhutan). As countries need to find ways to increase the mitigation ambition for the update of NDCs, more emphasis should be put on stringent demand-side mitigation. Our analysis shows that whilst neoliberal rationalities of government currently dominate the policy approach to demand-side mitigation in the four HICs investigated, 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 controversial than often assumed.

Conclusions

Whilst one should be careful to generalise from our cases, the findings could be relevant for analysing other HICs. Three main findings can be emphasised. First, we found that current climate policies targeting the demand-side are 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. If a market-based policy approach is to deliver on emission reductions, it must present more scope for people to respond (e.g. more choices in transport modes or price unwanted behaviour high enough to discourage it). 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’. Governments already intervene with command-and-control measures in several high mitigation potential areas, so one may assume that 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, or anything close to it, taking advantage of the near-term demand-side mitigation potential in HICs is one important way to reduce our reliance on large-scale carbon dioxide removal from the atmosphere 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 this; adjustments and supplements to the presented list of 20 climate policy measures currently in place in one or more of case countries. These are spaces for realising household decarbonisation rather than merely discussing it.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval and consent to participate All participants were given written information about the study objectives and modalities (points of assessment, length of questionnaires), data preparation and pseudonymised data storage, the expected amount of commitment, the voluntary nature of participation and their right to withdraw at any time. Furthermore, participants were informed verbally about the study purpose and procedures and were given the chance to ask questions. All participants provided written informed consent. All countries assure that data processing and storage is done in line with European and national data protection rules. Where necessary, the study procedures were approved by an ethical committee. In Norway, the Norwegian Center for Research Data approved the study (44003). In Germany, the Institutional Review Board of the Medical Faculty by the University of Heidelberg approved the study (S-611/2015). In Sweden, the study was approved by the Regional Ethical Review Board in Umeå (2015/357-31Ö). In France, the project needed to fulfill the obligations of the CNIL (Commission Nationale Informatique et Libertés), no specific ethical approval was necessary.

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, p. 14). 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 policymakers 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.

Three-hundred-nine 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, pp. 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 et al. 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, p. 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 verbatim⁴ and subjected to a qualitative content analysis where emerging themes were identified in the data (Bryman 2012). Fifty 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 and minimum energy efficiency standards as these target the producer, and not the consumer) 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.⁵

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 3).

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, pp. 239–241)⁶: Economic Instruments, Information Policies, Public

⁴ The interview recording has not been modified when put in writing. It is typical for speech situations that a sentence is abandoned before completing to start a new sentence. The '/' after a sentence marks this kind of pause in speech behaviour.

⁵ Norway is obliged to adhere to EU directives and regulations through its membership in the European Economic Area (Utenriksdepartementet 2012).

⁶ 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, pp. 22–25; Lodge 2007, pp. 280–282).

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 3 Policy coding scheme

Policy area	Housing	
	Mobility	
	Food	
	Other consumption	
Anticipated policy mechanism	<p>Improve efficiency (e.g. install more effective light bulbs)</p> <p>Substitute consumption (e.g. support public transportation for it to substitute private car)</p> <p>Reduce consumption (e.g. ban on cars in city centres)</p>	
IPCC categories and policy instruments	Economic instruments	Credits, grants, taxes, tax deductions
	Information policies	Information campaigns, research requests, suasion
	Public goods and services	Planning, public company, infrastructure
	Regulatory approaches	Prohibitions, standards

Table 4 Governmentality framework

Policy category	Policy approach	Rationalities of government	Technologies of government
Economic instruments and information policies	Market-oriented	Liberal	- Audit processes - Enforced self-regulation - Regulated participation bodies - Competition focus
		Neo-liberal	- Marketisation and privatisation of public services - Personal responsibility to act - Self-surveillance measures - Standardisation, benchmarking, best practice schemes, performance indicators
Regulatory approaches and public goods and services	Command-and-control	Bureaucratic	- 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) and Knill and Tosun (2012)

Appendix 2

Table 5 Median carbon footprint before, during and after the simulation game measured in kg CO₂e per year and CU by sector

Consumption sector	Median CF	Percent 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%

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

Appendix 3

Table 6 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	

Table 6 (continued)

	Policy categories and instruments	Count	Percentage per country
	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%
	Standards	6	
	Germany		
	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%
		3	

Table 6 (continued)

	Policy categories and instruments	Count	Percentage per country
	Information campaign		
	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%

Table 6 (continued)

	Policy categories and instruments	Count	Percentage per country	
	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	Total other consumption	57		
Consumption	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%

Table 6 (continued)

	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	

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

Table 7 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

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

	Efficiency	Reduction	Substitution
Percent of food	–	–	100.00%
France	–	–	100.00%
Germany	–	–	100.00%
Norway	–	–	100.00%
Sweden	–	–	100.00%
Percent of housing	59%	15%	26%
France	72%	4%	24%
Germany	68%	8%	24%
Norway	33%	33%	33%
Sweden	42%	29%	29%
Percent of mobility	45%	14%	41%
France	65%	6%	29%
Germany	29%	6%	65%
Norway	54%	17%	29%
Sweden	32%	21%	46%
Percent of other consumption	35%	37%	28%
France	18%	36%	46%
Germany	29%	29%	42%
Norway	47%	40%	13%
Sweden	43%	43%	14%
Overall percent	44%	18%	38%

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

Table 9 Targeted household behaviour change per consumption subsector (efficiency, reduction, substitution)

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

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

Table 10 IPCC policy categories broken down for each consumption subsector

	Economic instruments	Information policies	Public goods and services	Regulatory approaches
Percent of food	36%	45%	5%	14%
Diet change	–	100%	–	–
Promote local food	33%	33%	–	33%
Promote organic food	46%	38%	8%	8%
Percent of housing	41%	28%	8%	22%
Building design	34%	19%	9%	38%
Energy supply	50%	13%	13%	25%
Energy use	44%	41%	6%	9%
Household appliances	33%	67%	–	–
Percent of mobility	40%	17%	30%	13%
Air traffic	100%	–	–	–
Cars	45%	16%	22%	16%
Cycling	18%	27%	55%	–
Public transport	30%	17%	39%	13%
Percent of other consumption	19%	42%	9%	30%
Consumables	–	–	–	100%
Diverse	4%	71%	14%	11%
Durable goods	100%	–	–	–
Waste	23%	18%	5%	55%
Overall percent	35%	29%	16%	20%

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

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