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Ecological Sufficiency in Climate Policy: Towards Policies for Recomposing Consumption

Tina Nyfors[1], Lassi Linnanen[2], Ari Nissinen[3], Jyri Seppälä[3], Merja Saarinen[4], Kristiina Regina[4], Tero Heinonen[3], Riku Viri[5], Heikki Liimatainen[5]

Affiliations: 1 University of Helsinki | 2 Lappeenranta-Lahti University of Technology LUT | 3 Finnish Environment Institute (SYKE) | 4 Natural Resources Institute Finland (aka Luke) | 5 Tampere University (TUNI)

Abstract

According to the Paris Agreement, global warming is to be limited to well below 2 degrees. The largely prevailing emission reduction approach has been to improve ecological efficiency in production. Despite remarkable improvements, total emissions have not decreased but resulted in a multitude of rebound effects. Ecological sufficiency has been brought up as a necessary complementary approach to reach the climate targets. This article clarifies the role of ecological sufficiency in consumption-based climate policy and discusses it in relation Gough's stages of decarbonisation: 1) ramping up eco-efficiency; 2) an intermediate stage of recomposing consumption; and 3) reducing consumption. A theoretical conceptualisation of the second stage, considered as a type of sufficiency, is described. Following previous studies, recomposing consumption entails systematically steering consumption away from identified carbon hotspots towards low-carbon options. The article identifies a number of policy measures to recompose consumption.

Keywords

Ecological sufficiency; eco-sufficiency; consumption; ecological efficiency; eco-efficiency; climate policy

Corresponding author contact details:
Tina Nyfors, tina.nyfors@helsinki.fi

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Introduction

Meeting the climate targets means reducing emissions at an unprecedented scale within a window of ten years. 'Deep emissions reductions in all sectors' are needed as outlined in the Intergovernmental Panel for Climate Change (IPCC 2018, 3) 1.5 degree special report. In the report, measures that address demand, i.e. consumption, are outlined as key elements. That is, the climate impact of household consumption is significant; for example in Finland, it accounted for 66% of consumption-based greenhouse gas (GHG) emissions in 2015 and in Sweden for 63% in 2014 (Nissinen et al. 2019, 50). However, there are considerable differences between households. In the European Union, carbon emissions are highly correlated with the income levels of individuals and national income, in other words, levels of consumption (Ivanova et al. 2017). Also, there are differences between regions and class (Ulvila and Wilén 2017). Many consumption patterns are intrinsically unsustainable. At a global level, the richest 10% of the people in the world are responsible for half of all GHG emissions through their individual consumption (Oxfam 2015; Fleurbaey et al. 2014). This places the spotlight on rich countries' and households' responsibility to act.

Rich countries' disproportionately large share of carbon emissions is made visible through consumption-based emissions accounting (CBA). Contrary to conventional territorial emissions accounting, CBA includes emissions from imported goods and services as well as emissions from international flying and shipping (and excludes exports). Many developed countries present decreasing emission trends when reporting territorial emissions to the UNFCCC. However, when calculating consumption-based emissions, there is often a much smaller or no decrease in the GHG-emissions of a country (Peters et al. 2012). Consumption-based emissions abroad is of growing concern globally since around a fourth of all emissions are connected to goods produced in a different country to that in which they are consumed (Moran 2018, Schmidt et al. 2019). Using consumption-based accounting

as a complement to territorial emissions accounting can make climate policy and mitigation efforts more effective (Moran 2018: 5; Grasso 2017: 93).

Traditionally, reducing emissions has been done through a focus on production, technical solutions in energy generation and improving energy efficiency. Despite remarkable increases in efficiency, total global GHG emissions have kept increasing (WMO 2020). A central idea of efficiency is decoupling economic growth from environmental impact (Parrique et al. 2019, 3). Prudence and the search for adequate measures (i.e. absolute, permanent and large enough emission reductions) in climate policy have led numerous scholars to study the concept of ecological sufficiency, hereafter referred to as sufficiency. The importance of sufficiency is that it directs attention to reducing consumption and addressing overconsumption in rich countries in order to stay within the limits of the earth's carrying capacity (Princen 2005; Spengler 2018; Heindl et al. 2016; Speck et al. 2015). When linking sufficiency with consumption-based emissions accounting, a question arises: Which of our individual emissions are really necessary, and which of them could be avoided? The definition of a sufficient level of consumption is not an easy task (and achieving that level is even harder) when most of our institutions are designed during an era when resource depletion and increased emissions were not a limiting factor.

A central concept in this study is Gough's (2017) three-stage strategy for decarbonisation, consisting of (1) ramping up eco-efficiency, (2) an intermediate stage of recomposing consumption and (3) reducing consumption absolutely. The two latter relate to sufficiency. The second stage, which is the focus of this study, is characterised by shifting the consumption from identified carbon-intensive options to low-carbon options in as many consumption areas as possible (Gough 2017). This study refers to carbon intensive 'hotspots' (Institute for Global Environmental Strategies et al. 2019, v), meaning that the use of commodities with high GHG intensity ought to be rapidly reduced while commodities with low GHG intensity are allowed to grow. Satisfying needs ought to have priority over 'wants' and surplus goods (Gough 2017). The third stage entails more radical sufficiency strategies for reducing consumption in absolute terms and includes degrowth, i.e. moving to a steady-state economy (Gough 2017). Focus is to a large extent on structural changes, which are outside the scope of this article.

This article uses a broad definition of sufficiency suggested by Spengler (2018), which includes the possibility of understanding sufficiency both as an intermediate stage of recomposing consumption from high-carbon options to low-carbon options, as well as reducing absolute levels of consumption. While an analytical distinction between sufficiency and efficiency is needed for the study, the boundary between the two is not clear-cut, partly because of the goal of decreasing emissions is shared. This article discusses a possible emission reduction pathway based on a three-stage strategy to ecological sufficiency in climate policy. Focus of the study is on the second stage: recomposing consumption. It focuses on individual choice and includes concrete suggestions of policy instruments. The rest of the text is organised as follows: after briefly describing the methodology, the two emission reduction strategies of ecological efficiency and ecological sufficiency are presented, including the notion of limits related to sufficiency. After this, sufficiency in policy-making is discussed. Finally, sufficiency policy instruments for recomposing consumption are presented, illustrated by some examples in the fields of mobility, housing, nutrition and goods and services.

Methodology

The study was conducted by first exploring different views of sufficiency and of sufficiency in policy making in previous research. Based on sufficiency theorising, sufficiency policy-making was then studied in the field of consumption. In the process of reviewing policy instruments, the identified policies for recomposing consumption were grouped according to the type of policy instrument (e.g. regulatory, economic, cooperation) and according to broader themes (e.g. bans, taxes, subsidies) in different fields of consumption. Then the policies were sorted according to whether they address individual choice or structural changes. Based on policy instruments addressing the former, Table 1 was created. The non-exhaustive literature review included relevant scientific articles related to sufficiency as well as reports and emission reduction strategies of different developed countries, in particular Finland and Sweden. The categorization process is outlined in more detail in Linnanen et al. 2020.

Efficiency as a strategy to reduce emissions

The relationship between human activities and environmental impact is commonly expressed as the equation I = PAT, where environmental impact (I) is determined by population (P), affluence (A) and technology (T) (Alcott 2008, 770). Strategies to decrease the population are rarely discussed. [i] Ecological efficiency, hereafter referred to as efficiency, that addresses the technology factor and primarily focuses on production has been the main approach in environmental policy over the last decades (Bonnedahl et al. 2018). Technology is central, for example, in ecological modernization (Spengler 2018). However, despite remarkable increases in efficiency it has not brought about a decrease in total energy use for example. A widely recognised side-effect of technological improvements is the rebound effect, or Jevon's paradox. In short, this signifies that gains in efficiency, which lead to lower prices, are offset by increased consumption, which in turn leads to increased overall emissions and resource use (Alcott 2005).

In the efficiency and ecological modernisation approaches, there are also elements of sufficiency (which is the topic of the next chapter), such as the aim of absolutely decoupling of resource use from economic growth. In order to be effective, the required decoupling would have to cover both resource use and impacts – both dimensions being absolute, global and permanent – and it would also need to be rapidly executed in the private, public and third sectors of society (Bonnedahl et al. 2019). The hypothesis of decoupling has been challenged by, for example, Parrique et al., who claim that it is not backed up by systematic empirical evidence; that it is not taking place on 'anywhere near the scale needed to deal with environmental breakdown' and, perhaps more importantly, that 'such decoupling appears unlikely to happen in the future' (Parrique et al. 2019, 3).

In order to achieve the climate goals with efficiency measures, Stern has estimated that emissions per unit produced need to be decreased globally by seven to eight times by 2050 in the scenario where the population keeps growing and economic growth remains at current levels (Stern 2015). Other studies also have serious doubts about the role of technology (see e.g., Vadén et al. 2019; Nässén 2015) – taken together,

increasing efficiency is necessary but not sufficient in itself to reach the required decarbonisation (See, e.g. Gough 2017; Spengler 2018; BIOS 2019).

Sufficiency as a strategy to reduce emissions: different interpretations

While technology is connected to efficiency, the concept of sufficiency addresses the affluence factor in the I = PAT equation. Sufficiency focuses primarily on consumption including, for example, an absolute reduction of consumption, emissions and material use (Spengler 2018). Changes in consumption patterns and behaviour are increasingly highlighted as essential in order to reach environmental targets (Kartha et al. 2020). Key features of sufficiency include staying within environmental limits; including an absolute reduction of consumption, emissions and material use; avoiding overconsumption; and advocating changes in lifestyle (Princen 2005; Spengler 2018; Speck et al. 2015; O'Neill et al. 2018; Heindl et al. 2016). Furthermore, sufficiency is described as a class of principles like restraint, precautionary, polluter pays, zero onus, and reverse onus, all of which are sensitive to environmental risks (Princen 2005; 2003).[ii]

Sufficiency can also be described as a middle way between two radical visions. On the one extreme, technological advancements are assumed to solve everything, and on the other, the suggested solution is to go completely back to nature (Spengler 2018). Thereby sufficiency suggests that changes in consumption patterns, as well as technological advancement, are needed (ibid). For the individual, a sufficiency lifestyle has been connected to 'consuming less, or even virtually nothing' (Speck et al. 2015, 8). Examples of sufficiency actions include, for example, repairing, reusing, sharing, recycling and prolonging the lifespan of goods, as well as decreasing or stopping using goods and services with a high ecological impact (Speck et al. 2015).

The term sufficiency has its roots in Latin, roughly meaning 'to be enough' (Schneidewind et al. 2014, 13). Connected to environmental concerns, the term *sufficiency* was perhaps first used by Herman Daly in the discussion on economic growth in the late 1970s (Boulanger 2010) and in the early 1990s, Wolfgang Sachs introduced it in the German environmental discussion (Schneidewind et al. 2014). Overall, the discussion has mainly moved forward in academia and among environmental activists (Speck et al. 2015; Spengler 2018), and many meanings are

connected to the concept. In its narrow sense, the focus is on reducing individuals' resource use and GHG emissions (Linz 2002; 2004; Voget 2009). In its broad sense, the focus is on understanding welfare in a new way: rather than bringing up living standards, the focus is on life quality and changing the values of society (ibid).

One area where interpretations of sufficiency differ is on the axis voluntary versus non-voluntary (Heindl et al. 2016; Spengler 2018). For a long time, the focus around sufficiency was on the voluntary approach for the individual. Advocates of this view emphasised the importance of freedom of choice and its compatibility with 'standard' environmental policies and liberal society. The critics claim that voluntary changes in lifestyle by affluent people are not enough and emphasise the importance of political initiatives in order to achieve greater ecological effects (see e.g. Princen 2005; Gough 2017; Alcott 2008; Spengler 2018). However, this would mean interference in people's private life touching sensitive issues, such as identity and questions like 'what is a good life?' (Heindl et al. 2016). In industrialised countries, the notion of an absolute reduction in material use faces strong resistance and is a rather unpopular political topic (Speck et al. 2015; Spengler 2018). On the other hand, policy already targets consumption, for example, related to the use of tobacco, alcohol, medicines, firearms and chemicals (Spengler 2018; Nissinen et al. 2015; Ahvenharju 2020).

The option of political initiatives for limiting consumption also gives rise to some controversial discussions related to the prevailing growth-based economic system, which is dependent on and encourages consumption. Sufficiency is closely connected to the view that fundamental changes in the economy are needed, a topic brought up by, for example, the degrowth movement (Heindl et al. 2016.).

Sufficiency action has been defined as only being applicable to people who live in affluence, have purchasing power and thereby have the *choice* to decrease their consumption (Alcott 2008; Heindl et al. 2016; Spengler 2018). From this it follows that sufficiency cannot be applied to persons who involuntarily live in poverty, nor can their lifestyle serve as a benchmark when defining a sufficient life even though their consumption would be within ecological limits. It is, however, worth noting that affluence is not synonymous with 'the North', or 'Western' or 'developed countries';

there are also rich people in poor countries and poor people in rich countries (Gough 2017). The rich people can be referred to as *affluent communities* (Myers 1997).

Sufficiency and the notion of limits

The notion of limits are central in the concept of sufficiency. Sufficiency raises the question about how much is 'enough' (Princen 2003, 46) and what is an 'appropriate level of consumption' (Allievi et al. 2015, 144). 'Enough' can refer to both an upper and a lower limit. The focus is often on the upper threshold since most authors address rich countries where the majority of people are considered to have lifestyles where needs are satisfied well beyond a minimum level (Spengler 2018). Raworth's (2017, 44) 'doughnut' model visualises both, including a lower limit, the social foundation, that no one should fall below and an upper ecological limit that should not be crossed. These two boundaries define the space which is socially just and ecologically sustainable, a 'consumption corridor' (Giulio et al. 2014, 184).

This in turn raises questions about which products and services are necessary and which consumption can be classified as unnecessary, luxury or overconsumption. A theory of human need can be useful for addressing this question, being based on that there are universal basic needs that are shared by all individuals in the world now and in the future (Gough 2017). The ways of fulfilling the needs are, however, different across cultures and times (ibid). Needs are closely connected to justice and equity; from this it follows that when needs and wants conflict, then needs are to be prioritised (ibid). Examples of negotiable consumption include air travel, meat, large houses and large cars (Alcott 2008). Regarding the climate impact of different types of consumption, necessities – such as domestic energy and food – tend to have higher emissions than luxuries or non-necessities when considered as emissions per monetary value (e.g. $kgCO_2e$/euro consumed) (Gough 2017).

What would limits mean in terms of per capita carbon footprints? To be in line with the 1.5 degree emission scenario, Institute for Global Environmental Strategies et al. (2019) proposed the following targets: 2.5 tCO_2e/person/year in 2030, 1.4 tCO_2e/person/year by 2040 and 0.7 tCO_2e/person/year by 2050. Taking Finland, where the current per capita emission level is more than 10 tCO_2e/year, as an example, this would mean reducing per capita emissions to at the least a fourth in ten

years. Other estimations in line with a 2 degree climate target projects per capita emission targets of 1.61 tCO_2/year (O'Neill et al. 2018) and 2.1 tCO_2e/year in 2050 (Girod et al. 2014). Despite the differing numbers, the magnitude is the same.

Then how does a current level of minimum consumption relate to the ecological limits above? There are two options; either the social minimum consumption results in an ecological impact that is within the ecological limits or it exceeds the limits. One way of estimating emissions from minimum consumption is to calculate the GHG emissions of national reference budgets, which has been done by Linnanen et al. (2020). In the case of Finland, the carbon footprint of a decent minimum level of consumption is around 5 tCO_2e/person/year, about half (49–58%) of that of an average Finn, depending on the household type. Despite the considerable emission reductions that a decent level of consumption entails, there is a need to reduce GHG emissions further in order to reach emission reduction targets. In relation to a global per capita carbon footprint target of 2.5 tCO_2e/year in 2030 (Institute for Global Environmental Strategies et al. 2019), the emissions of what is perceived as a minimum level of consumption in Finland are twice as high.

These results are in line with an earlier study on the material footprint of 18 minimum income receivers in Finland (Hirvilammi et al. 2013). The material footprint was a bit less than half of the footprint of an average Finn, 18 versus 40 tons per person per year (ibid). A sustainable level of resource use is estimated to be 6-8 tons per person per year (Lettenmeier et al. 2012). Similar findings were made in a UK study about the GHG emissions of a social minimum consumption level by Druckman and Jackson (2010). According to them, the emissions of the household type with lowest emissions were 37 per cent smaller than the consumption-based GHG emissions of an average British person in 2004. However, the emissions were still three times too big considering a 2030 target level of 2.5 tonnes CO_2e/person/year (ibid).

The fact that even individuals living on what is perceived to be a social minimum seem to exceed the ecological maximum level illustrates the magnitude of the emission reduction challenges and points towards the need of coordinated political initiatives.

Sufficiency in policy-making

In this article, sufficiency in policy is addressed with a focus on the individual. Another premise is that changes in both consumption patterns as well as in technology are needed – sufficiency serves as a necessary strategy to complement efficiency measures. The importance of addressing structural changes from a sufficiency perspective is crucial, but is outside the scope of this article.

In many countries, there are already policies in place that address the climate impact of consumption. In Finland, policies have already decreased emissions, for example, through the reduced energy consumption of products and new buildings (Nissinen et al. 2015). Policies address, in particular, personal transport and housing, even though they are often based on health or other motivations rather than climate motivations (ibid). A characteristic of sufficiency policy is that it constrains certain practices and enables others (Spengler 2018), hereby steering demand to low-carbon options for them to become routinized. It entails to 'recognise boundaries to a social order and to make normative judgements: so much consumption is enough; so much is too much' (Darby 2007, 118). Where the numerical boundaries are drawn is central (ibid). The instruments for sufficiency policy can be but are not always new ones; often it means applying existing environmental policies more consistently (Heindl et al. 2016; Speck et al. 2015; Spengler 2018). At the same time, sufficiency policy might differ more than first expected from conventional policy that is focused on efficiency. Rather than focusing on a specific product, the starting point can be certain needs (Thomas et al. 2015). Furthermore, efficiency and sufficiency policies should not be regarded as mutually exclusive; some of the measures are found in both approaches, for example, energy taxation and cap-and-trade schemes (Spengler 2018; Gough 2017).

In the literature reviewed, few sources presented clear definitions of sufficiency policy. Perhaps the most fitting definition for the present study was developed by Spengler (2018, 234), who defines sufficiency policy broadly, as

> policies that aim to decrease the demand or use of goods and services with high environmental impacts in order to achieve per-capita consumption levels that

ensure emissions and resource use to stay within the environmental carrying capacity.

Having a definition of sufficiency in policy still leaves many questions related to how to implement it at a large scale in society. Reducing consumption and its consequences for the economy currently seem politically very difficult. To address this challenge, this article refers to Gough's (2017) strategy where the process of decarbonisation is divided into three stages. To bridge the gap between the ongoing stage of ramping up eco-efficiency and the stage of reducing consumption absolutely, Gough suggests an intermediate stage of recomposing consumption, which is the focus of this article. A theoretical conceptualisation was developed with Finland as a case, identifying carbon intensive hotspots that are to be rapidly reduced as well as low-carbon options that can grow. Hotspots were identified in different consumption areas based on the following references: Institute for Global Environmental Strategies et al 2019; Salo et al. 2016; Saarinen et al. 2019). Hotspots in mobility included flying and private car use; in nutrition hotspots consisted of a diet rich in meat and dairy as well as food waste; in housing hotspots were heating per square metre, including the continuous increase in the average square meters per capita as well as warm water consumption and electricity use; in goods and services hotspots included high-emission goods and services and a high-consumption lifestyle – noting that the cumulative emissions determine; they can consist of many smaller or a few big emission sources (for details on this conceptualization, please see Linnanen et al. 2020).

Sufficiency policy instruments

Based on Spengler's definition of sufficiency policy and Gough's three stages of decarbonisation, policy instruments of different fields of consumption were identified in the literature listed in the footnote below and categorized as: regulatory, economic, nudging, cooperation and information instruments[iii].

In the categorization process, the most common policy category was ramping up eco-efficiency, hardly surprising, since efficiency is the prevailing approach for decreasing emissions. It was fairly easy to find policy instruments categorized as

recomposing consumption. The category with the fewest policy instruments, which were also most challenging to find, was reducing consumption absolutely. This is perhaps not surprising, since it is connected to a degrowth scenario which runs contrary to the logic of growth-based economies. In cases where policy instruments could be categorized as both recomposing and reducing consumption, the former was chosen. Among the recomposing consumption policy instruments, most were economic in nature, followed by regulatory instruments and nudging. Sufficiency policy examples regarding mobility, housing, nutrition and goods and services are dealt with in more detail in Linnanen et al. (2020).

The purpose of listing policy examples from literature is to provide some concrete options rather than to rate them in relation to each other, evaluate their feasibility or consider administrative aspects. An analysis of policy instruments, their synergies and other relations would require a more specific approach, for example, analysing policy instrument packages (Nissinen et al. 2015).

Table 1 presents an overview of types of instruments for recomposing consumption.

Regulatory instruments include the categories of banning or regulating high-carbon options; an obligation to provide low-carbon options; and regulating advertising. Banning the sales of cars that use fossil fuels has been proposed in several countries and cities internationally. In urban areas, certain zones can be made accessible only with low-emission vehicles, the use of private car can be prohibited on certain days and the number of parking lots in city centres can be considerably reduced. Carbon intensive products such as outdoor heaters can be banned. At a general level, the establishment of malls can be restricted and the opening hours of shops can be shortened. Furthermore, labels and brand names that are misleading can be banned. The second type of regulatory instruments is connected to an obligation to provide low-carbon options, like laws on the imperative to provide renewable fuels, such as biogas. The third type of regulating advertising can concern certain status goods or advertising directed at children. Advertisements can be banned or restricted for specific products or services with a high climate impact such as luxury cars, flights, meat, snacks and sweets. Restrictions can be placed on certain channels, for example,

advertising in public spaces or on television. Also, there can be restrictions on utilising information technologies for profiling individuals for commercial purposes.

Economic instruments include carbon taxes and fees on high-carbon options; subsidies and tax exemptions for low-carbon options; removal of subsidies and tax exemptions for high-carbon options and personal carbon rationing. Carbon taxes and fees on high-carbon options can be applied to all areas of consumption and there is a plethora of suggestions on how it can be done. General suggestions include value added tax according to climate impact. For example, a high tax (40–70%) (Ahvenharju 2018, 7) could be placed on specific products or services, such as meat and flights.

The other side of the coin is to support low-carbon options through subsidies, lower tax, tax exemptions and bonuses. There can, for example, be a lower value-added tax for low-carbon goods and services, including repair services. Second-hand products can be exempt from VAT. Economic incentives can be put in place to advance the consumption of vegetables in workplace and school canteens. Sharing can be supported through less taxation on leasing cars, machines and electronics. There can be financial incentives for discarding old appliances under the condition that no new ones are bought. In order to decrease the carbon emission of hobbies, subsidies for organisations can be connected to using an environmental management scheme. Furthermore, economic instruments include removing subsidies and tax exemption for high-carbon options. Examples include removing tax exemptions for air travel, as well as subsidies for measures that support increased transportation, such as commuter subsidies, company cars, free parking, compensation per kilometre, which is bigger than the cost of driving. Overall, this category includes removing subsidies that support the increased consumption of high-carbon options.

There are also suggestions regarding personal carbon rationing, which has been described as, in principle, the ideal policy instrument for realising sufficiency. Cap-and-trade schemes are pointed out to work better than taxes for reaching a specific emission reduction target (Spengler 2018). Combining caps and price regulation – setting a cap for maximum consumption and taxing carbon-intensive products (Gough 2017) – can be an effective option; reductions are shared and a certain level of

reductions are reached at the same time. Gough (2017) suggests testing personal carbon rationing in phase two and implementing it at a large scale in phase three.

Nudging includes making low-carbon choices more easily accessible or default; framing; consumption monitoring; social comparison; and personalised sufficiency advice. Making low-carbon choices more easily accessible or default includes, for instance, placing high-carbon products in unfavourable positions on the shelves in a store. Regarding energy contracts for households, it can be made mandatory to present eco-energy as the default option. In the context of nutrition, canteens can offer vegetarian dishes as default with the possibility of ordering meat.

Framing – choosing from what perspective an issue is viewed – can be applied, for example, when selling cars. The total costs of car ownership and usage over, for example, five years can be the mandatory way of communicating the price instead of just paying the initial cost of purchasing the car. Applying consumption monitoring and individual metering is another type of nudging; in housing it can include the mandatory installation of smart energy meters and water meters to record use of hot water, with monthly readings or real-time readings, as well as statistics to show trends. Social comparison and providing information on the low-carbon behaviour of others can be done, for example, in connection to the utility bill, showing residents their own energy or water use compared to that of others in in the apartment block. Personalised sufficiency advice can be provided, for example, in connection to energy use.

Cooperation includes focusing on collective goods and services; and widening social consumption, for example through community-based wind power initiatives. Cooperation includes widening social consumption; referring to increased community ownership of, for example, wind power facilities. The category of collective goods and services include leasing and renting services or setting up facilities for sharing or swapping. In for example mobility, the sharing economy can be strongly advanced through car-pooling and the like. Furthermore, shared cars could receive parking benefits and be allowed to drive in bus lanes. In housing, the shared use of living space could be increased through housing regulation. Another way of increasing collective goods and services is to stimulate public consumption at the expense of

private consumption. It is also central to support existing public institutions like libraries and adult education centres, as well as to establish new institutions that promote the practices of sharing, renting, reusing repairing and other social innovations.

Information is about communicating the idea of sufficiency broadly in society, in particular related to the background and benefits of the policy measures above and in relation to national per capita emission targets. Examples of sufficiency need to be given in the various consumption sectors (i.e. related to different products and services) as well as communicating 'best practice' sufficiency examples to specific target groups. Information can also be used to increase awareness of the standards of luxury that we have attained and to increase awareness of the legacy of values and the mechanisms that stimulate consumption. Furthermore, the information can take the form of warnings similar to the ones on cigarette packages. These could be placed on high-carbon products, such as red meat, flights and fossil fuels.

Policy Instruments for Recomposing Consumption	
Category	**Examples of instruments**
Regulatory	Banning or regulating high-carbon options
	The obligation to provide low-carbon options
	Regulating advertising
Economic	Carbon taxes, fees on high-carbon options
	Subsidies, tax exemptions for low-carbon options
	Removal of subsidies and tax exemptions for high-carbon options
	Personal carbon rationing
Nudging	Making low-carbon choices more easily accessible or default options
	Framing – choosing from what perspective an issue is viewed
	Consumption monitoring, individual metering
	Social comparison: providing information on the low-carbon behaviour of others
	Personalised sufficiency advice
Cooperation	Widening social consumption
	Focusing on collective goods and services
Information	Communicating sufficiency to specific target groups

Table 1. An overview of sufficiency policy instruments for recomposing consumption based on the literature review (Linnanen et al. 2020).

Discussion and conclusion

The conventional way of addressing environmental problems has been to focus on technological solutions for increasing ecological efficiency in production, in other words, producing goods and services more efficiently (Bonnedahl and Heikkurinen 2019). Efficiency importantly reduces resource input and emissions per unit, but it does not address overall problem with the over-use of resources, and consequent emissions. It appears to have limited capacity to bring about a reduction on a global scale, such as a reduction in global carbon emissions. There is a growing body of literature indicating that the current policy regime, driven by efficiency improvements and technocratic governance, is an inadequate sole strategy for solving the climate crisis.

This article discussed ecological sufficiency in climate policy, linking it with consumption-based emissions accounting. Spengler's definition of sufficiency was combined with Gough's decarbonisation in three phases. From the sufficiency perspective, policy efforts should next be targeted at recomposing consumption patterns. This means systematically steering consumption away from identified carbon hotspots towards low-carbon options. This broad definition of sufficiency means that approaches can also conceptually cover partial or qualitative reductions, or the direct downscaling of production and consumption in those sectors where reductions are needed most.

In order to enable policies to be more compatible with increasingly ambitious emission reduction targets, the article identified a number of policy measures to recompose consumption. These instruments were described as regulatory, economic, nudging, cooperation and information instruments. In future research, sufficiency could be approached, for instance, by using the three key distinctions of the virtue of moral restraint (Heindl et al. 2016) in relation the environmental limits, as well as their linkages to a fair distribution of consumption opportunities.

The article brought attention to the notion of limits. In industrialized countries, the notion of an absolute reduction of consumption faces strong resistance and is a rather unpopular political topic. The article also brought attention to the challenges related to

defining a sufficient lifestyle when studies indicate that even minimum income receivers exceed the ecological limits in industrialized countries. This underlines the need of coordinated political initiatives to meet the emission reduction challenges. Within the limited scope of this article it was not possible to address to what extent emissions can be reduced by policy measures focusing on individual choice and to what extent emission reductions depend on structural change.

Sufficiency in policy-making is a novel field and finding related literature was rather difficult. This may relate to that sufficiency touches on issues that are sensitive in liberal societies: freedom of choice versus political steering, as well as possible effects of reduced consumption on economic growth. Still, the need to reduce emissions remains. This article suggests that sufficiency policy and a focus on consumption hotspots may offer some invaluable contribution to the climate policy discussion in the search for a way forward.

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[i] Addressing the population factor is perceived as a sensitive issue. Sufficiency is often viewed as a strategy for rich countries only, which often do not have growing populations. This article will not deal with population policy.

[ii] *Zero principle* = extends the precautionary principle by stating that compromise solutions – a "balance" between jobs and the environment for instance – are unacceptable when such compromises serve only to postpone a real solution. Put differently, with critical threats, in the long term the only solution is to halt the environmental degradation. *Reverse onus principle* = the burden of proof is on those who would intervene in critical life support systems.

[iii] Modified version of Spengler's (2017) categorization that built on Jänicke's (2003) categorization of environmental policy instruments. The list of policy instruments in Table 1 is developed based on the following sources: Ahvenharju 2018, Bocken & Short 2016, Brand & Anable 2019, Buch-Hansen & Koch 2019, City of Lahti 2019, Darby 2007, Gough 2017, Hennlock et al. 2015, Hohle 2014, Larsson et al. 2015, Lorek & Fuchs 2013, Ministry of Agriculture, Food and Consumer Affairs Sweden 2005, Ministry of the Environment 2017, Ministry of Transport and Communications 2018, Naturskyddsföreningen 2017, Naturvårdsverket 2018, Niemistö et al. 2019, Nissinen et al. 2015 and 2017, OECD 2017, Saarinen et al. 2019, Schneidewind & Zahrnt 2014, Seppälä et al. 2017, Speck & Hasselkuss 2015, Spengler 2018, Tamminen et al. 2019, Thomas 2015, Welch 2019, as well as discussions held within the project working group. Explained in more detail in Linnanen et al. 2020.