



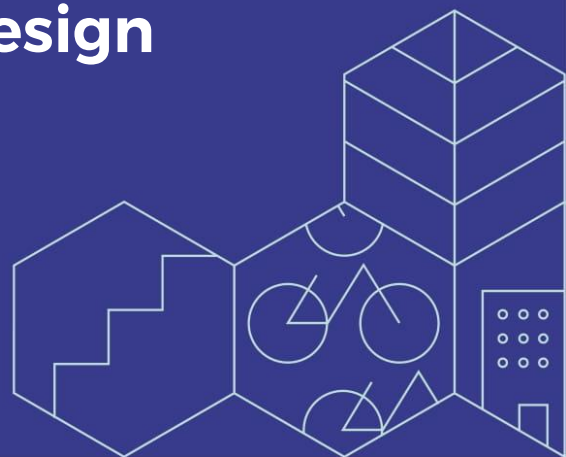
Fundamental decarbonisation
through sufficiency by lifestyle changes

Refinement of research design

FULFILL Deliverable D 2.3

Place: Karlsruhe, Paris

Status: Final



Fundamental decarbonisation through sufficiency by lifestyle changes

GA#: 101003656

Deliverable number (relative in WP)	D 2.3
Deliverable name:	Refinement of research design
WP / WP number:	N° 2
Delivery due date:	31.05.2022
Actual date of submission:	12.08.2022
Place	Karlsruhe, Paris
Status	Final
Dissemination level:	Public
Lead beneficiary:	Fh ISI
Authors:	Josephine Tröger, Edouard Toulouse, Abigail Alexander-Haw, Elisabeth Dütschke, Yves Mari-gnac, Sabine Preuß, Adrien Toledano
Contributor(s):	All partners
Internal reviewer(s):	Leon Leuser, Lorenzo Pagliano



FULFILL has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003656.

Project Partners

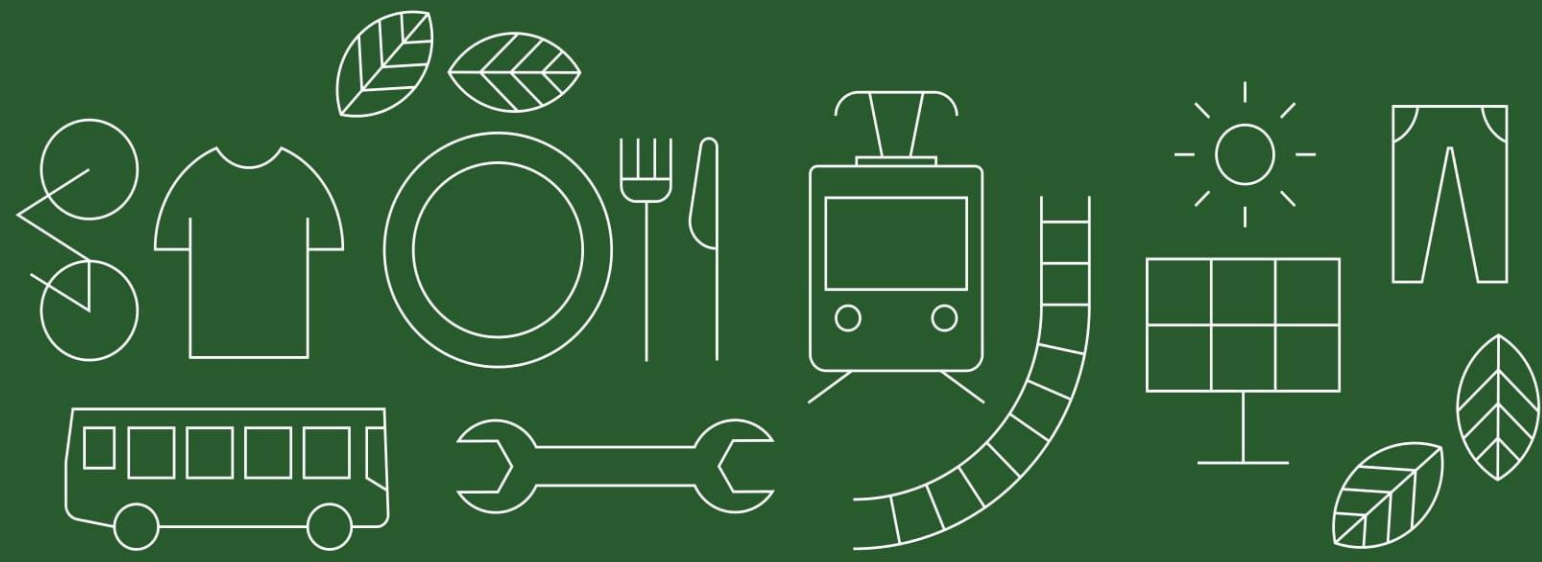
No	Participant name	Short Name	Country code	Partners' logos
1	Fraunhofer Institute for Systems and Innovation Research ISI	FH ISI	DE	 Fraunhofer
2	Wuppertal Institut für Klima, Umwelt, Energie GMBH	WI	DE	 Wuppertal Institut
3	Accademia Europea di Bolzano	EURAC	IT	eurac research
4	Notre Europe - Institut Jacques Delors	JDI	FR	 <small>Jacques Delors Institute Penser l'Europe • Thinking Europe • Europa denken</small>
5	Association négaWatt	NW	FR	 <small>ASSOCIATION négaWatt</small>
6	Politecnico di Milano	POLIMI	IT	 POLITECNICO MILANO 1863
7	International Network for Sustainable Energy-Europe	INFORSE	DK	 INFORSE-EUROPE <small>International Network for Sustainable Energy</small>
8	Zala Briviba Biedriba SA	ZB	LV	 Zaļā brīvība

Acknowledgement



FULFILL has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003656.

This document reflects only the author's view and the Agency is not responsible for any use that may be made of the information it contains.



Inhalt

Abstract / Summary	7
Introduction: Research Design for FULFILL	8
1. Key Concepts	10
1.1. Sufficiency	10
1.2. Lifestyles	16
2. Existing sufficiency-based pathways from prospective studies	19
2.1. Climate neutrality scenarios	19
2.2. Scope and ambition	20
2.3. Areas and extent of sufficiency	21
2.4. Sufficiency levers	22
2.5. Sources and justifications of the sufficiency assumptions	23
2.6. Other inspiring studies	24
3. Measuring sufficiency-oriented lifestyles	27
3.1. Carbon footprint	28
3.2. Minimum well-being level	31
4. Methodologies for the assessment of the potentials of sufficiency lifestyle changes	35
4.1. Integrating lifestyle change in forecasting studies	35
4.2. Methods for building assumptions	36
4.3. Limits and methodological recommendations	38
4.4. The contribution of human and social sciences to model sufficiency lifestyles	39
5. Concluding thoughts	41
5.1. Key areas for sufficiency lifestyles	41
5.2. Gender dimension in FULFILL's research design	42
5.3. Sufficiency principle in upcoming work packages	44
References	46



List of Abbreviations

CO_{2eq}	Carbon Dioxide Equivalent
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas
SDG	Sustainable Development Goals
SSH	Social Sciences and Humanities
WHO	World Health Organisation

List of Tables

Table 1 List of the 16 climate neutrality scenarios	20
Table 2 List of the most frequent sufficiency levers per sector (ranked by the number of occurrences in the 16 scenarios) and examples of related drivers	22
Table 3 Domains and facets of quality of life measurement	33
Table 4 Typology of sufficiency assumptions according to their scopes, sources, natures, and framings	37

List of Figures

Figure 1 Conceptual and methodological approach of the FULFILL project	8
Figure 2 Methodological approach for the development of the research design	9
Figure 3 Spread of sustainable lifestyles according to Transition theory.	17
Figure 4 Overarching framework for lifestyle analyses on societal different levels	18
Figure 5 Carbon Footprint Sectors Overview.....	29
Figure 6 Nine dimensions that constitute the definition of quality of life in the definition by European Commission / EUROSTAT	32



Abstract / Summary

This deliverable presents core concepts targeted within the FULFILL project. It outlines methodological approaches and concerns to research sufficiency-oriented lifestyles on the micro, meso and levels of society. We take an interdisciplinary perspective combining social science and humanity perspectives with techno-economic perspectives throughout the whole project and also in this deliverable (see introduction).

We introduce sufficiency as key concept (chapter 1.1.) and discuss the multidimensionality and diversity of the concept. Based on the variety of approaches towards sufficiency we derive the projects' two-folded perspective: On the one hand, **sufficiency serves as a principle that enables sufficiency-oriented lifestyles** (through creating social, infrastructural, regulatory conditions) that **reduce energy demand and greenhouse gas emissions** and **contributes to individual and societal well-being** to stay within the planetary boundaries. On the other hand, we analyse sufficiency as already **performed by individuals** in order to **understand various levers on the micro, meso and macro levels of society (i.e., infrastructures and societal frameworks) towards sufficiency-oriented lifestyles**. This approach helps to elaborate what (future) sufficiency lifestyles would actually look like.

We also introduce lifestyle as a key concept and research frame that is used throughout the project (chapter 1.2.). Afterwards, we widen the scope from the micro level perspective to the meso and macro levels perspectives: We present an overview of current sufficiency-based scenarios and evaluate their contributions in order to identify the most important levers for sufficiency and the potential contribution to remain below 1.5°C (chapter 2.). Based on this macro level perspective, key areas for research on sufficiency-oriented lifestyles and important levers for sufficiency are outlined.

A core part of the deliverable approaches how to **measure and evaluate sufficiency-oriented lifestyles** based on our definition. Therefore, we outline how sufficiency-oriented lifestyles and well-being could be defined and measured on the micro level (chapter 3.) and also on a macro level (chapter 4.). In particular, sufficiency-oriented lifestyles from the macro level perspective reveal potentials and challenges with regard to future integration of sufficiency measures into energy and climate models, which are discussed as well.

Finally, we summarize the key areas for sufficiency lifestyles (chapter 5.1.), highlight how the gender dimension will be considered in the whole project (chapter 5.2.) and give a brief outlook on upcoming work packages (chapter 5.3.) and briefly describe how they will include the key areas identified for sufficiency-oriented lifestyles in their work, consider gender dimensions accordingly and the interconnectedness between micro and macro levels in the project.

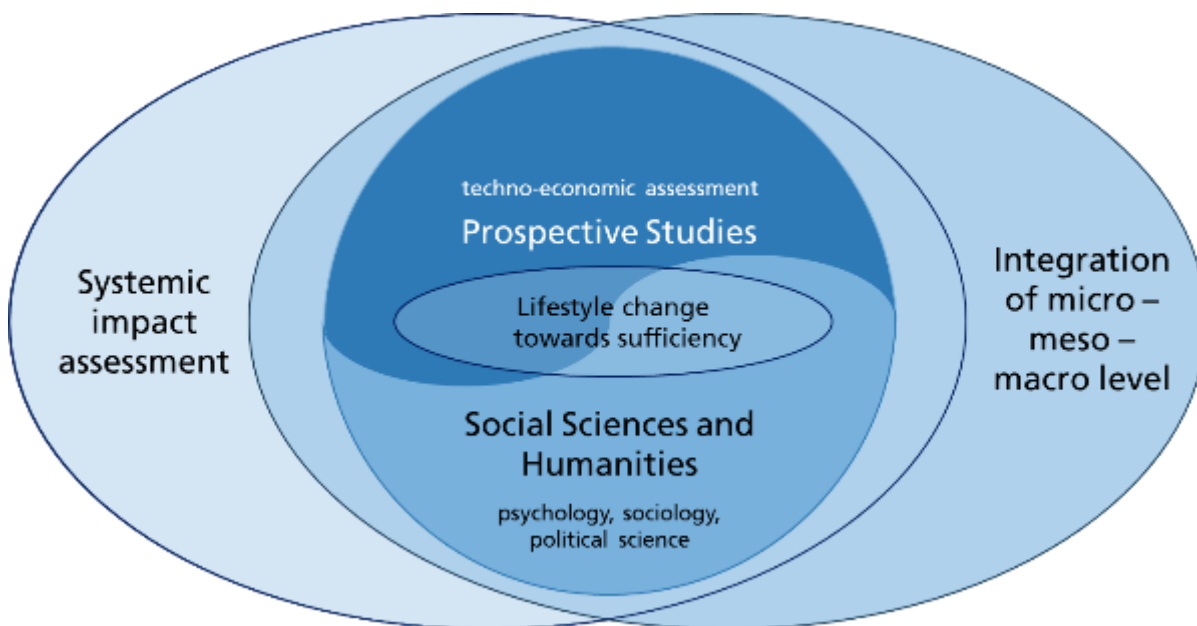


Introduction: Research Design for FULFILL

This deliverable documents the outcomes of task 2.3 in the project. This task consists of refining the research design, building on the earlier tasks of this WP. Based on the outputs of T2.2, it selects the key areas for further analysis in the project. This will inform the empirical work of WP3 to WP5 and provide a framework for a research design in the project.

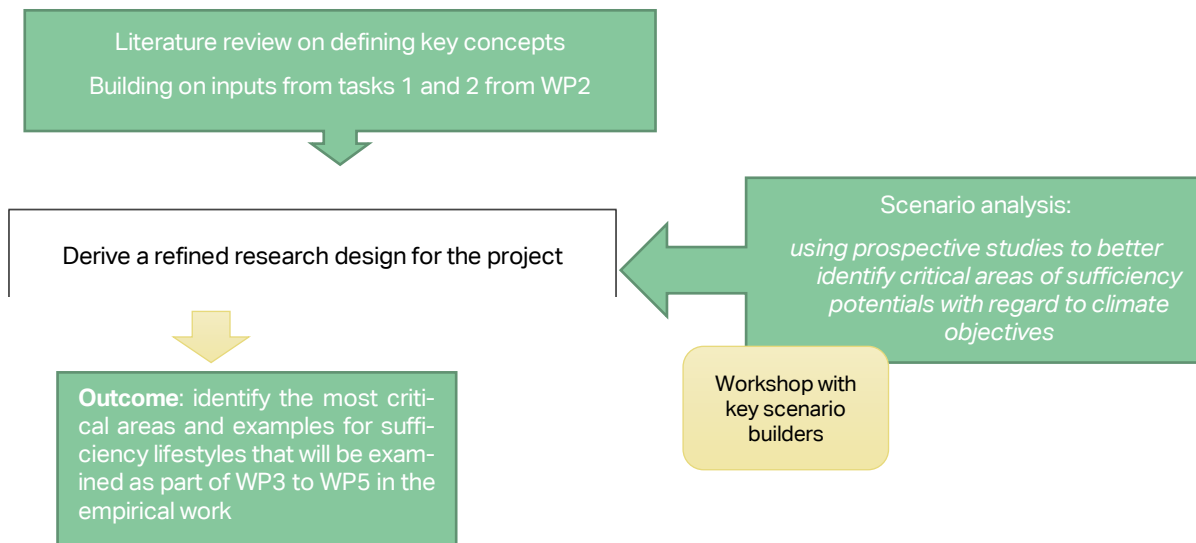
The methodological approach of FULFILL is to engage in an interdisciplinary dialogue between, on the one hand, Social Sciences and Humanities (SSH) and, on the other hand, Prospective Studies, techno-economic energy and climate research, regarding the role and implementation of lifestyle changes towards sufficiency in decarbonisation strategies (Figure 1). Consequently, it connects recent knowledge to study lifestyles changes (from SSH) with the identification of the most promising lifestyle changes that significantly contribute to decarbonisation (from Prospective Studies) and links also back to Prospective Studies by the including a macro level assessment of the impacts of sufficiency lifestyles. The rationale of taking such an interdisciplinary approach is that SSH and Prospective Studies can inform one another to generate new insights and support the design of effective policies and actions towards sustainable lifestyle changes. This can be understood as a **polycentric multi-level approach** that also allows integrating the **micro-meso-macro levels** in its investigation into lifestyles and to combine it with a systemic assessment regarding impacts e.g., with aspects of well-being and life-satisfaction, including health-related and justice- or power-related concerns (e.g., gender equality). This finally leads to soundly based and potentially highly effective recommendations for governance approaches for pathways towards sufficiency lifestyles and for a better integration of sufficiency approaches in decarbonisation strategies.

Figure 1 Conceptual and methodological approach of the FULFILL project



In the following we discuss and define the key concepts of this project, namely sufficiency and lifestyles, based on current research. The methodological approach to develop the research design is summarised in Figure 2.

Figure 2 Methodological approach for the development of the research design



1. Key Concepts

1.1. Sufficiency

For a few years, *sufficiency* (Latin “sufficere”, which means “to suffice” or more commonly translated in terms of “enough” or “enoughness”) has been an increasingly discussed term within the sustainability and socio-ecological transformation discourse (IPCC, 2022; Jungell-Michelsson & Heikkurinen, 2022). Sufficiency can be argued to be one part of a strategic bundle to reach sustainability (Fischer & Grieshammer, 2013; Zell-Ziegler et al., 2021). Together with efficiency (optimisation of input-output ratios in production and usage) and consistency (establishing circular processes in production and consumption, engaging in recycling processes and using nature as a role model) these strategies aim to guide societies towards a sustainable future. A well-known example according to the consistency sustainability strategy is the increased use of renewables as source of energy. An example for efficiency would be the change from conventional vehicles to electric vehicles making a more efficient use of energy. Whilst efficiency and consistency often focus on technological improvements, sufficiency focuses on behavioural as also value-based mental shifts in regard to consumption on individual (micro) and collective (meso and macro) levels (Zell-Ziegler et al., 2021). The goal of sufficiency as sustainability strategy is an absolute reduction of resource consumption (Alcott, 2008; Princen, 2003, 2005) in order to tackle overshooting of planetary boundaries and guarantee well-being for current and future generations (O’Neill et al., 2018; Rockström et al., 2009). In order to reach this, fundamental changes in the relationship between resource usage, production and consumption are needed (Princen, 2005). All of these elements are based on human decision making, more or less consciously made by people. Thus, addressing behaviour and consumption patterns on several levels of society whilst reflecting on the meso and macro levels’ influence on the performance of certain behaviours serves as a key within the sufficiency approach. Above this, a core part of the sufficiency strategy attempts to understand the interrelations between need satisfaction and consumption (Tröger et al., 2021; Vita, Hertwich, et al., 2019). Given by the constantly ongoing overshoot of planetary boundaries and, thus, increasing risks for societies and species all over the globe, sufficiency aims at bringing together psychological need-satisfaction and well-being on the one hand with moderated consumption and behaviours that help to stay within the planetary boundaries on the other hand.

Sometimes, the impetus of less overall consumption and potential restrictions of individual consumption is perceived to be in contradiction with growth-oriented economies and common values such as individualism, financial success and status or material acquisition (Hickel & Kallis, 2020; Kasser, 2016; Krausmann et al., 2009). In line with Spangenberg and Lorek (2019, p. 1071) sufficiency constitutes the “antithesis to the ‘faster, further, more’ orientation within society”, which may reflect the tendency of Western consumerist cultures to support extrinsic value orientation and to less likely relate to ecological responsible behaviour and well-being alike (Brown & Kasser, 2005; Kasser, 2016). What this in detail means for the micro and meso levels and how sufficiency-oriented lifestyles may already constitute a part of an “antithesis” to current ways of life are being explored in detail throughout the project.

Rationales, roots and multi-faceted approaches towards sufficiency

Several roots and strands of argumentation for sufficiency can be identified in the current literature: First, there is the major critique against a mere reliance on efficiency measures to limit climate change and approach the Paris agreement goals over the past decades (Jungell-Michelsson & Heikkurinen, 2022). Because the previous and commonly used sustainability strategies, which were mainly based on efficiency approaches, also lead to considerable rebound effects in the past (Hertwich, 2005) technological improvements alone are argued not to suffice to reach sustainability goals but need to be flanked by a stronger focus on sufficiency strategies and stricter demand reductions as well (Dufournet et al., 2019; IPCC, 2022; Toulouse et al., 2017).



Thus, the focus on absolute reductions (instead of input-output ratio changes), behavioural changes and the role of need satisfaction through changes in patterns of consumption gained importance over the past years (Darby & Fawcett, 2018; Figge et al., 2014; Fischer & Grieshammer, 2013).

Second, current recent scientific findings argue decoupling, i.e. decreasing absolute resource usage from ecological burdens while still raising Gross Domestic Product (GDP) will be unlikely and is not to be expected in the near future (Haberl et al., 2020; Vadén et al., 2020; Ward et al., 2016). However, given the risks caused by transgressing planetary boundaries, absolute decoupling will be necessary to guarantee societal well-being for all in the short and long term (Fanning et al., 2022; O'Neill et al., 2018; Rockström et al., 2009). Currently, many societies are dependent on economic growth and measure societal progress only with GDP. This is a major challenge for transition towards more ecological, just and sufficiency-oriented societies also because it manifests mental models of infinite growth (Tröger & Reese, 2021). One way to stimulate transformative processes in regard to stricter ecological measures, less material consumption and increased well-being would be to integrate alternative measures of societal well-being and incentivise activities that increase societal well-being while respecting planetary boundaries (Giannetti et al., 2015). Sufficiency argues to widen the scope on measures of global and societal well-being instead of further relying on efficiency gains and welfare measures rooted in neoclassical economics. This is where sufficiency connects to even more transformative concepts and is linked to the international degrowth or post growth debate (Alexander & Gleeson, 2022; Eversberg & Schmelzer, 2018; Hickel, 2021; Kallis et al., 2018; Petschow et al., 2021; Sekulova et al., 2013).

Third, there is a strong argumentative root in concerns on global and social justice: In order to guarantee a good, healthy and just life for all both upper and lower boundaries of consumption are needed (Jungell-Michelsson & Heikkurinen, 2022; O'Neill et al., 2018; Spengler, 2016; Zell-Ziegler et al., 2021). Upper boundaries are essential as overconsumption is not only at the cost of the environment but also at the cost of people in the Global South, poor and the unprivileged people all over the world. Overconsumption causes injustice now and in the future (Spengler, 2016). Lower boundaries are important as basic needs should be satisfied in order to live well now and in the future (ibid.). Whereas current strategies of decarbonisation often perpetuate global injustices and colonial disparities (Hickel et al. 2022), sufficiency aims on political and societal change that addresses these inequalities more overtly (Fanning et al., 2022; Hickel & Slamersak, 2022). It also integrates the notion to take responsibility by the polluters (Hayden, 2019; Tröger & Reese, 2021). Nevertheless, this raises the question how to set just and need-satisfying limits of consumption, or distribute goods and services between individuals and nations in a democratic way. Thus, some authors in the sufficiency debate also argue on reorganizing political institutions and economies in an increased participatory manner as core part of aiming societal sufficiency (Spangenberg & Lorek, 2019; Tröger & Reese, 2021).

Fourth, reorienting lifestyles and living with less is at least partly an opposition to individual and societal values that are a major cause of current overconsumption (see for instance Kasser et al., 2004). Sufficiency entails a shift to non-material values which is argued to enhance both individual and societal well-being (Isham et al., 2022; Kasser, 2016) – and this should simultaneously support a more just distribution of the (scarce) resources provided by the Earth as already argued above (Fanning et al., 2022; O'Neill et al., 2018). People who pursue intrinsic values (i.e. personal growth, sense of community and importance of social relationships, valuing things that intrinsically lead to well-being) instead of extrinsic values (i.e. striving for monetary rewards or status gain, valuing things that can only indirectly lead to well-being) consume less and have more satisfying relationships (Kasser, 2016). The resulting satisfaction can, in turn, be the cause of environmentally friendly behaviour (ibid.) and sufficiency orientation (Tröger et al., 2021; Tröger & Wullenkord, 2022; Wullenkord, 2020). At the individual level, less materialism and consumption is associated with psychological well-being and environmental protection behaviours (Dittmar et al., 2014; Hook et al., 2021; Kasser et al., 2014; Kasser, 2016). Also on macro levels well-being and happiness no longer increase with growing material stuff or income after a certain set point (Fanning & O'Neill, 2019) and decrease with social inequality (Stelzner, 2022).



The notion of 'consuming less' from an individual and micro level perspective already shares commonalities with former concepts such as **frugality**, **voluntary simplicity**, and **minimalism**, which will be briefly outlined in the green box below. Furthermore, defining limits or boundaries of consumption on meso and macro levels is embedded in approaches such as **consumption corridors** (Di Giulio & Fuchs, 2014) or **demand-side options** (Creutzig et al., 2022) sharing the common goal of creating a liveable and just future for all.

Recognising the **variety and openness of concepts that contain a sufficiency component**, one "common denominator" can be outlined in many approaches that capture the idea of enoughness, namely that it constitutes **"both a means and an end"** (Jungell-Michelsson & Heikkurinen, 2022, p. 4). Furthermore, a core value of the sufficiency discourse is also, that it seeks to build bridges **from theory to practise** and thus, aims to contribute not only knowledge but also develop and circumscribe practices how to limit and deal with global socio-ecological crises on the many levels of society (Sandberg, 2021; Spangenberg & Lorek, 2019).

This aligns with the sufficiency conceptualisation in FULFILL as we argue that **sufficiency can be seen as twofold** (a) by **providing both a principle of creating conditions** for decarbonisation and absolute downsizing of ecological footprints (=sufficiency as a means) and also (b) by **constituting a goal in itself** in terms of reaching a society lower ecological footprints (i.e., less waste, less resource consumption, etc.) as well as with **people living a good and healthy life** (= sufficiency as an end). Based on these considerations it gets clearer that sufficiency-oriented lifestyles need corresponding infrastructures and sufficiency policies (i.e., societal frameworks) that help to transform systems in such a way that people actually act in a sufficiency-oriented manner (Erba & Pagliano, 2021; Schneidewind & Zahrnt, 2014; Thomas et al., 2015; Zell-Ziegler et al., 2021) breaking up locked-in structures that still prevent from absolute emission reductions.

Lastovicka et al. (1999, p. 88) define **frugality** as "unidimensional consumer lifestyle trait characterised by the degree to which consumers are both restrained in acquiring and in resourcefully using economic goods and services to achieve longer-term goals". In line with sufficiency, people restrict themselves to acquire possessions and strive for using resources in a conscious and voluntary manner. Furthermore, frugal people reuse and repair their possessions, partially grounded in a motivation of feeling "independent" from consuming and turning away from the norm to do so constantly (Goldsmith et al., 2014). Hence, sufficiency orientation and frugality share a high degree in non-materialistic thinking and overlap conceptually (see for instance Alexander & Gleeson, 2022; Bouckaert et al., 2011; Sandberg, 2018). However, individual motivations behind both or associated with them might differ. Frugality implies a consumption reduction not primarily because of eco-centred values, but because of subjectively held personal goals and value orientation. This, of course, might also cause sustainable behaviours, as re-usage and repairing of goods save money and are beneficial to the environment at the same time. However, individually held goals and the purpose of the restrictive consumption behaviours are different: frugal people tend to do these activities because of later personal need fulfilment (whatever this may imply in relation to consumption) and ego-centred concerns whilst sufficiency-oriented people would carry out such a behaviour also because of their eco-centred concerns (e.g., lowering personal ecological impact, saving ecosystems, climate protection now for a better future for all). Whilst frugality seeks to be non-normative, sufficiency's reasoning and purpose has a stronger emphasis on the outcomes regarding environmental impact. Empirical findings indicate that frugalism does not directly correspond to eco-centrism and motivation to save the planet (Fujii, 2006) but would have side effects on energy and material savings that would go in line with emission reductions. However, one study found that frugality seems not to be associated with reduced ecological impact (Kropfeld et al., 2018) and also has unintended side-effects on lowering green consumption through the intent to save money (Wang et al. 2021). Thus, the concept may include a focus on buying (vs. not buying) without having the ecological trade-offs in mind. This is partially opposing to the idea of sufficiency or sufficiency orientation as a prerequisite of acting towards sufficiency as a goal (Tröger et al., 2021). However,

recent research highlights the link of frugalism to sustainable and ethical consumption (Albert, 2019), showing that the distinction between both concepts remain empirically unclear.

Voluntary simplicity describes a lifestyle which includes “freely reduced consumption involving a conscious effort to live a simple life” (McDonald et al., 2006; Rich et al., 2017 as cited in Rebouças & Soares, 2021, S. 304). Such a simplified life also includes ethical and justice principles, environmental consciousness as also an argumentation for the reduction of working hours (Alexander & Ussher, 2012). First introduced by Gregg (1936) “The Value of Voluntary Simplicity” and inspired by spiritual and religious thoughts (see for instance Huneke, 2005) the concept raised interest in the 70's when Elgin and Mitchell (1977) gave a narrower scope to it. They described a voluntary simplistic lifestyle as maintaining material simplicity, leading a self-determined life, pursuing ecological awareness, and aiming on personal (instead of material) growth. Huneke (2005) empirically examined important facets of a voluntary simplistic lifestyle, i.e., a) ecological and social responsibility, b) the care for the community, and c) maintaining a spiritual life. During the last decade, voluntary simplicity became increasingly prominent as a movement with people seeking to treat material acquisition differently than accustomed, not by force and default infrastructures or consumerist norms but by individual decisions. Given these characterisations, sufficiency seems very closely related to voluntary simplicity. Both integrate a belief system that opposes consumerism (see Etzioni, 1999 on voluntary simplicity), aiming to achieve a simplified and less material lifestyle driven by concerns for society and the environment (Cherrier et al., 2011; Craig-Lees & Hill, 2002). Voluntary simplicity can contribute to understand actual consumption reduction and impact reduction (Kropfeld et al., 2018). However, the term did not enter successfully into the wider debate on sustainability or transformation yet. Furthermore, marketing has an interest in how to nevertheless reach people who describe themselves as voluntary simplifiers and instigate consumption which, in the end, might backfire the idea of sufficiency (Oates et al., 2008).

Consequently, voluntary simplicity and sufficiency orientation overlap in contents, targets and psychological facets. However, it can be argued that voluntary simplicity is a more self-centred approach not equally driven by the moral motivation to restore environmental justice as sufficiency incorporates (Shaw & Newholm, 2002). Some authors argue that voluntary simplicity lacks a transformative power as it excludes political dimensions and important socio-structural changes: “The essential reasoning here is that legal, political and economic structures will never reflect a post-growth ethics of macro-economic sufficiency until a post-consumerist ethics of micro-economic sufficiency is embraced and main-streamed at the cultural level” (Alexander, 2013, p. 289).

A third term that is mentioned in the area of reducing material acquisitions is **minimalism**, which originated in the art and culture scene of the US in the 1960s and describes the reduction to the essential and the simple in pieces of arts (i.e., clear lines and structures, simplicity and beauty as a sign of aesthetics). The original idea was to force the viewer of minimalist art pieces to contemplate how the physical objects influenced their reactions by reflecting on principles like weight, light, and height for instance exemplified. Since then, others adopted the idea of minimalism and the idea entered into music, furniture, clothing, etc. Currently, the term is used by bloggers and prevalent in non-academic literature (Kang et al., 2021). Until now, there is no wider discussion in sustainability or psychological science about minimalism but it is precisely in the context of sufficiency that the associated attitude to life seems to be capable of being connected (see for a reflection on both concepts Tröger & Wullenkord, 2022). Minimalism is not only about an aesthetic approach to the world, but also about a different way of satisfying needs through selected and less material things. The goals of a minimalist lifestyle reclaims time for oneself, reducing distractions through less material stuff, in-creasing health for body, mind and spirit, freedom and independence, and also freeing oneself from objects that prevent people from living a healthy and satisfying life (Hook et al., 2021). In Japan, for example, minimalism has taken on a special meaning, inspired by the organizing expert Marie Kondo (2014) arguing that rooms and working spaces that are “decluttered” and furnished in terms of minimalistic principles help people to better concentrate, thus positively influencing subjective well-being and productivity (see Kang et al., 2021). This, however, has also been criticised to fuel neoliberal capitalist thinking as there is an ingrained tendency towards self-opti-

misation without really arguing for any system shifts (Khamis, 2019). However, and similarly to frugalism, ecological concerns are not a/the core motivation but a potential, maybe even unintended output of living minimalistic. Furthermore, and in contrast to sufficiency, minimalism has already been capitalised as brands and companies adopted the idea and try to sell the lifestyle to people (Pangarkar et al., 2021; Sandlin & Wallin, 2022). This, contrasts sufficiency as a goal, which would mean to lower impact by absolutely less consumption of (newly produced and growingly sold) products. Recently, marketing strategies were investigated in order to be compatible with sufficiency (by increasing sharing practices, for instance, see Gossen & Kropfeld, 2022).

In the future, however, it will be relevant to draw connections to look at the social dynamics and power of this minimalist movement regarding societal change given that (similar to voluntary simplicity) transformative power remains unclear (Meissner, 2019; Rodriguez, 2018). One important facet of minimalism is that it touches the discussion of time-affluence and potential time use effects on certain environmentally relevant behaviours. Possessions require time – but spending less time on material consumption may result in better concentration or the prioritisation of the most important things to do throughout the day. Minimalism implies a distance from consumer culture and also its negative aspects on peoples' psychological and physiological health. However, it is not empirically clear, if it really contributes to less stress, better concentration and emotional well-being as argued in theory.

Integrating multidimensionality into a FULFILL project definition

Given that the reduction of energy consumption and greenhouse gas (GHG) emissions stays in the foreground of sufficiency as a goal (Sandberg, 2021), there are many possibilities regarding the actors and causes of such a relative reduction: focusing on the micro-level, it would be relevant to assess **variance within or between individuals**; i.e., **individuals that reduced their personal footprint** or energy demand; or that are relatively frugal compared to others. Sufficiency in terms of an end-state could also be argued in absolute measures, i.e., **individuals with an environmental impact that does no longer lead to a collective overshooting** of the planetary limits. This translates, for instance, for climate change in a carbon footprint that would not exceed 1 to 2 annual tons of emissions per capita and year. The Institute for Global Environmental Strategies has forwarded global targets for carbon footprints per capita of 2.5 tons of carbon dioxide equivalent (CO_{2eq}) per year by 2030 and 0.7 t CO_{2eq} per capita and per year by 2050 (IGES et al., 2019, as cited in Sandberg, 2021, p. 2).

As already highlighted, a common notion within sufficiency is the role of individual and collective well-being as both driver towards sufficiency and consequence through satisfied basic psychological needs. If peoples' psychological needs are satisfied, people perceive a higher sense of well-being. In turn, they do not need to strive for material acquisition and status consumption anymore, which is good for a healthy and liveable planet (Fanning & O'Neill, 2019; Kasser, 2016). This process should be supported by shifting people's and societies' perspectives regarding consumption from "what people want" to "ensuring people's needs" (Di Giulio & Defila, 2021; Vita, Hertwich, et al., 2019). In consequence, sufficiency on the broader levels (meso and macro levels) needs to **provide supportive infrastructures**. This would **(1) ensure that people are healthy and functional** in order to be confronted with huge societal challenges such as climate change (i.e., fulfilment of basic material and psychological needs alike, Wullenkord, 2020) and **(2) may support individuals to have or develop sufficiency lifestyles** (e.g., through well designed bike lanes and networks). Material and immaterial (or physical and non-physical) infrastructures need to make sure that people also have the possibility for political and social participation, and are empowered to contribute to transformations towards societal sufficiency as a goal (citizen involvement, prosumer-perspective, see, for instance, Tröger & Reese, 2021).

FULLFILL catches up with these elements of comprehensive and innovative definitions towards sufficiency by capturing this interconnectivity between infrastructures and people's behaviours: On the one hand **FULFILL understands the sufficiency principle as creating the social, infrastruc-**



tural, and regulatory conditions for changing individual and collective lifestyles in a way that reduces energy demand and greenhouse gas emissions to an extent that they are **within planetary boundaries**, and simultaneously **contributes to societal well-being**.

Additionally, this project takes an output-oriented perspective on sufficiency. Hence, we focus on **measuring and understanding lifestyles that potentially lead to a reduction** in carbon emissions and the protection of ecosystems (i.e., to stay within the planetary boundaries) while sustaining or increasing quality of life. This means that **sufficiency is about living well within limits through 're-thinking and redesigning individual and collective practices to favour activities, services, and consumption patterns that are intrinsically low on energy use'** (Toulouse et al., 2017 as cited in Brizga et al., 2022, p. 3).

This two-fold approach – addressing infrastructural boundaries and necessities that help to to perform sufficiency-oriented lifestyles whilst understanding how these lifestyles in practice really look like – contributes to closing a knowledge gap on how to engender sufficiency-oriented lifestyle changes in particular and also to evaluate their (potential) impacts on well-being, health, emissions, gender effects and many more variables systematically on both meso and micro levels.

Pioneering work in regard to modelling the impact of sufficiency and demand reduction on the meso and macro levels has been developed by NégaWatt (Association négaWatt, 2021). Several projects have studied sustainable lifestyles but sufficiency is still in its infancy due to the scarcity of empirical work clearly focusing on the topic (Jungell-Michelsson & Heikkurinen, 2022; Sandberg, 2018). There is a strong need for further empirical research to improve assumptions, refine impact assessments, and better envisage how to scale up more sufficient lifestyles.

According to our definition of sufficiency in the project (see also deliverable 2.1) **sufficiency is an overarching principle which enables (structural) change but also needs enabling structures**. On the individual level, this should partially be visible in individual reduction-oriented behaviours (e.g., very low or no private car usage and higher usage of public transport), a low level of overall carbon footprint but also in people's values and attitudes (e.g., a high willingness to reduce consumption). On the meso and macro levels, this should be visible through the provision of infrastructures, that enable individuals to choose public transport for instance, reach destinations nearby (i.e., accessibility) or the organisation of local communities that enable people to participate in community gardening projects. Also legislation and policies (i.e., eco-efficiency standards for the building sector, or also the provision of energy from renewables) are highly relevant in order to let people live more sufficiency-oriented.

Given these definitions, we assume that structures should enable sufficiency and a 'decent life' in line with basic need satisfaction. To differentiate these multi-layered components, we refer back to definitions from task 2.1 (see also deliverable 2.1) using the terms of sufficiency habits, sufficiency infrastructures and sufficiency societal framework which will be analysed in detail during the course of FULFILL:

- **Sufficiency habits** = Sufficiency measures taken by individuals due to permanent lifestyle changes
- **Sufficiency infrastructures** = Physical and non-physical infrastructures enabling sufficiency habits
- **Sufficiency societal framework** = Institutions, legislation, norms enabling sufficiency habits and sufficiency infrastructural change

These three 'components' are highly interconnected and represent micro level (**habits**), meso and macro level (**infrastructures, societal framework**) perspectives on sufficiency. Habitual behaviour is always embedded in infrastructures (both mental/non-physical and physical ones) that provide indications as to when, where and how people engage in certain habitual behaviours. Infrastructures, especially changes in infrastructures, enable new habits to develop or reinforce (or prevent) sufficiency-oriented habits. Besides the infrastructures, the societal framework matters a lot: Societal context provide a wider framework, which options are available or not; and thus, they can

empower people to test new options, or force them to switch to new modes of behaviour – which in turn can potentially create new habits.

In order to understand the interconnectivity of sufficiency habits, infrastructures and societal frameworks in detail, we decided to build on the concept and research framework of 'lifestyles' which will be introduced in the following.

1.2. Lifestyles

The transfer of the concept of lifestyle to issues of sustainability and environmental justice has a long history. Lifestyle was quickly linked to consumption issues, which in turn are central to sustainability (see for instance Gram-Hanssen, 2012). Understanding the performance of sufficiency-oriented lifestyles and corresponding infrastructures or societal frameworks that support them, some general notes on lifestyle as concept and research frame are made in the following.

The term *lifestyle* has roots in sociological research and is used to integrate both differences in resource (e.g., income) levels and differences in values, attitudes and behaviour (van Acker, 2017; Veal, 1993). Thus, it connects these levels and dimensions to explain social differences (see for an overview of origins in sociological concepts Cockerham et al., 1997). According to Veal (1993, p. 247), lifestyle can be defined as a "distinctive pattern of personal and social behaviour characteristic of an individual or a group." In turn, lifestyles are determined by prototypical and distinctive configurations of behaviours and habits. However, behaviours are always performed in dependency of context and thus embedded in people's social lives. They are produced and reproduced by socio-structural configurations of the respective individuals and groups of people. Van Acker (2017) outlines two major perspectives existing in lifestyle research (1) "a mechanistic lifestyle approach considering a behavioural typology of activity and time use patterns", and (2) "a socio-graphic lifestyle approach focusing on behavioural orientations – values, attitudes and preferences – and a latent factor motivating behaviour patterns." Independently of the perspective taken, lifestyles are always a strong 'amalgamation' of various intra- and interpersonal systems but also external systems, such as infrastructures. These interrelations have a formative effect on individuals and groups in different ways and can thus form different configurations of behaviours that can be captured at different levels and in different areas of life. However, the degree of coherence and recognisability or even social interaction may vary to a greater or lesser extent and are always involved in a "process of wide or limited choice" (Veal, 1993, p. 248). On the one hand, lifestyle seems to be something stable, as it describes patterns of behaviour that are continuously shown to the outside world and that transcend situations. On the other hand, building and performing a lifestyle is a dynamic process with numerous influences and feedback loops leading to a continuous reflexivity and flexibility of these behavioural patterns, which are formed and reproduced in dependency of persons, situations and societal structures accordingly. Thus, sets of behaviours can change between situations or after disruptive situations or windows of opportunity (getting older, moving to another city, an energy crisis etc.). Changes in system configurations can refer to change in parts of lifestyles (e.g., when infrastructures change, choice architectures and feedback loops change, see for instance Meadows, 1999, who take a systems change focus) in decision options and in defaults for the individuals as well.

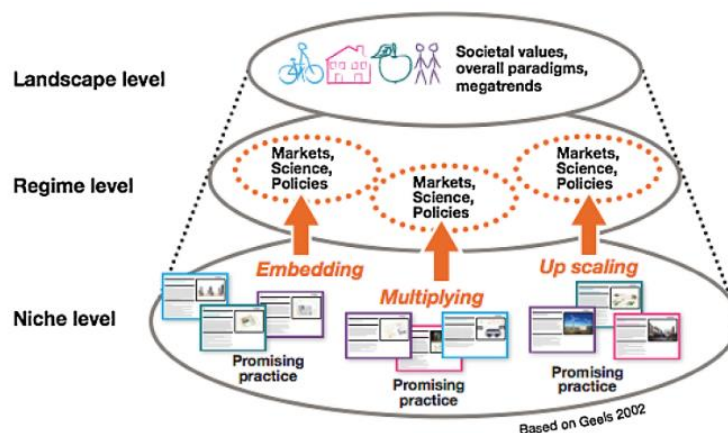
Given this system's perspective the process character of establishing and performing lifestyle is important to consider. Lifestyles do not simply exist but are formed by social contexts over a certain time and have a historically grown embeddedness in many social structures. Family, friends, neighbours etc. are reference persons in whose relation behaviours express themselves and influence the performance of lifestyles or single characters of a lifestyle on a micro level. The same applies to material infrastructures (such as accessible mobility systems), which are also formative for lifestyles. Focusing on individual lifestyle values (e.g., personal, collective, national) and socio-demographic characteristics such as gender roles and income are two of the most influential factors in sociological research when describing and differentiating lifestyles (see for instance Contoyannis & Jones, 2004). This is because they are directly linked to power relations and possible



behavioural options to be accessible and ‘preferred’ by an individual (see for instance discussed in relation to health, Mollborn et al., 2020). In particular income inequality is directly linked to emissions (Oswald et al., 2020; Vogel et al., 2021). For example, collective norms on the meso or macro levels determine which goals people pursue and are reflected in their performed lifestyles. The degree of materialism and status consumption a society is proclaiming as a norm often determine people's behavioural choices and lifestyle configurations, thus, the micro level lifestyle (Fitzgerald et al., 2015; Kasser, 2016). According to Sovacool and Hess (2017, p. 727), conflicting values can evoke tensions and lead to different patterns of behaviour in different situations or across varying time horizons. Furthermore, individuals are more or less good at dealing with these tensions between values that are proclaimed more or less explicitly. For example, when full-time job employment with 40 hours a week is a social norm but conflicts with personally held intrinsic values (e.g., seeking personal self-fulfilment and community by spending time repairing items or with community gardening, see for instance Quedstedt et al., 2018) or ecological values (cf. Hanbury et al., 2019 on the relationship between time affluence and ecological behaviour through working time reduction) people might behave very differently in dependence of situational constraints. A personal competence in dealing with these tensions can lead to different lifestyles despite the same social contexts. And vice versa, appropriate infrastructural or normative shifts might help to better deal with the tensions and guide people in acting in accordance to their intentions. In the analysis of lifestyles, therefore, personality-specific characteristics in terms of traits, self-concepts and identities while analysing infrastructural constraints as well should be taken into account to understand these interrelations between levels of lifestyles (Carducci, 2020; Goldsmith et al., 2014; Lastovicka & Joachimsthaler, 1988).

In a scenario-building approach on future sustainable lifestyles, Neuvonen et al. (2014, p. 67) outline the embeddedness and the mutual interplay between levels of society according to the multilevel perspective (Geels, 2011). Thus, “promising practices” that establish in niches – which sufficiency-oriented lifestyles or single practices would constitute accordingly – diffuse into the regime and meso level as they are increasingly embedded, for instance in market infrastructures or policies (see Figure 3, Neuvonen et al., 2014). Neuvonen et al. (2014) highlight that social, cultural, technological, political, economic, or institutional contexts are essential in reshaping or establishing and also embedding more future oriented and sustainable lifestyles (or also sufficiency-oriented lifestyles) whilst focusing on relevant immersive and promising practices already performed in niches of the society. Understanding these patterns, behaviours and social practices (as elements of lifestyles) and reflecting on their embeddedness in the various systems is of importance when analysing and describing lifestyles (see Figure 3, cited from Neuvonen et al., 2014, p. 68).

Figure 3 Spread of sustainable lifestyles according to Transition theory.

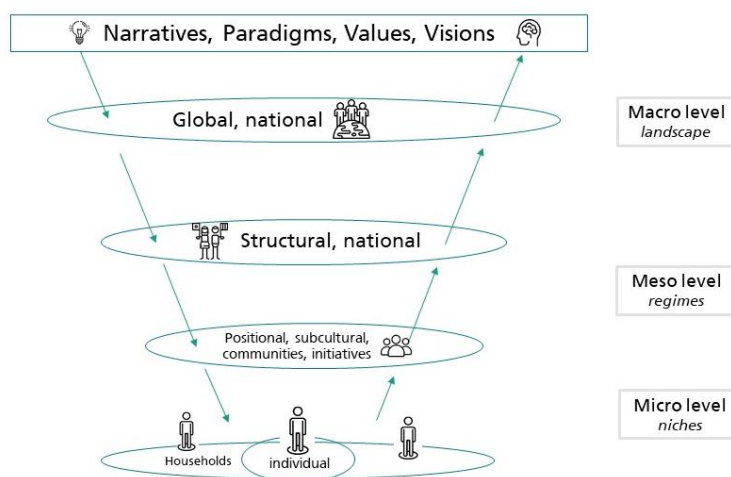


Note. Figure is depicted from Neuvonen et al. (2014, p. 68) and is originally based on the multi-level perspective from Geels (2002).

In recent years, lifestyle approaches have become a popular tool for analysing consumption patterns within certain or across several domains of everyday life (e.g., mobility, nutrition, and clothing; division of work / labour and gender roles). Moreover, the concept is applicable to the individual as well as the household and collective levels (e.g., describing the lifestyle in a certain community or a country). Jensen (2007) outlines four levels on which lifestyles can be described and which should be considered especially in the context of sustainability issues, i.e., the global level, the structural or national level, the positional or sub-cultural level, and the individual level (cf. Figure 4). He argues that lifestyle is visible to the outside world and differentiates individuals from one another but consumption – as one main focus when addressing sustainability issues – is a method of maintaining a certain lifestyle, but in itself is not a lifestyle¹. Jensen (2007) further describes the importance of goals to which behaviours and habits are subordinated and thus can be part of a lifestyle. In a way, lifestyle can also be seen as a materialised form of self-identity and behaviours always have a symbolic value as well.

Jensen (2007, p. 71) highlights some challenges that need to be reflected throughout the research process when analysing lifestyles. First, at every level of analysis, the concept of lifestyle is intertwined with a twin concept (e.g., lifestyle on a structural level is intertwined with nation as concept) and, thus, implies a certain vagueness or variability of the concept. In turn, this may prevent problem-solving for instance when identifying levers for more sustainable (or sufficiency-oriented) lifestyles as it might shift the focus away from the most relevant influencing factor to another and less influencing factor. For instance, promoting sustainable practices is attributed wrongly to questions of lifestyles but should instead be addressed with questioning wealth distributions (between nations) and question of power within systems. Therefore, an analysis of lifestyles can potentially identify problems (of consumption patterns that align to certain practices that constitute a lifestyle) but not solve the problem per se. Second, general mechanisms of goal performance should be considered when analysing individual lifestyles: goals determine which actions we take but these are not always consciously taken. Instead, we use artefacts, often technologies, for approaching these goals. People in general seek to automatise goal attainment, thus, forming habits. If we want to change a habit (such as unsustainable dietary behaviours), goals need to be reconsidered or at least partially explicitly recognised in order to change habits.

Figure 4 Overarching framework for lifestyle analyses on societal different levels



Note. Levels of interest to describe lifestyles, inspired by Jensen, 2007, and Wullenkord & Hamann, 2021. Icons: Flaticon.com

¹ Nevertheless, a certain way or level of consumption could be needed to be recognized as a member of certain social groups.

To sum up, lifestyles manifest in certain behaviours and they are determined and reproduced by hard and soft institutions (i.e., infrastructures and societal framework), e.g., regulations, cultural norms, values and attitudes. As such, the concept of lifestyles is (1) intertwined with consumption patterns, (2) refers to daily behaviours and (3) captures the embeddedness of citizens and communities in regard to socio-structural variables (e.g., gender, age, socio-economic background) and located within socio-political structures (=meso and macro level structures). Different lifestyles should be empirically distinguishable from one another by behavioural and socio-demographic characteristics. Different levels of lifestyle descriptions can help to understand the most influential factors in regard of lifestyle performance and also identify levers for change towards an intended lifestyle. Thus, the concept of lifestyle is a **helpful lens to study the role of citizens in the fulfilment of climate goals**. This implies that lifestyle changes have to be studied through a comprehensive approach to understand how individual decision-making capacities and behavioural change are influenced by collective, social, and structural factors. This could be captured by addressing less focus to the particular behaviour and on a very individualistic understanding of the lifestyle concept, rather on the contrary by aligning also with **practice theory** which accounts increasingly for the embeddedness of practices and reflects on the structural influences being intertwined with the practice itself (Hargreaves, 2011; Shove & Walker, 2014). In particular, when analysing lifestyles on micro and meso levels of society (see Figure 4), this approach would also be quite helpful.

In practice theoretical approaches, sustainable patterns of consumption – or in our case sufficiency-oriented patterns of consumption – are understood as part of varying social practices. Thus, the doing of practices and inconspicuous consumption become the focus of research instead of any particular or single choice of action that might be sustainable or not. Furthermore, material infrastructures, power relations, and interdependencies while performing certain actions are strongly addressed, thus decisive elements of the system that stabilise the performance and enacting of the behaviours (Hargreaves, 2011; Shove & Walker, 2014; Warde, 2005).

In line with considerations of lifestyle research in general (see above), our goal is to identify configurations between impact and intent-oriented measures that could engender change towards sufficiency-oriented lifestyles on different levels. In the next step we outline the most relevant indicators to 'build' a sufficiency-oriented lifestyle or to predict the extent of a sufficiency-oriented lifestyle.

2. Existing sufficiency-based pathways from prospective studies

In order to get a preliminary understanding of the potentials of sufficiency and map the most promising areas for decarbonisation, **16 major climate neutrality scenarios and a few other original prospective studies** have been analysed.

2.1. Climate neutrality scenarios

Table 1 below introduces the scenarios that were included in the analysis, notably the acronyms used in the subsequent pages of the report, as well as the references to relevant publications.

These scenarios have been identified during the literature review on sufficiency in task 2.1 of the project. They all include assumptions on reducing energy demand that go beyond technical efficiency and address changes in behaviours and lifestyles. They have been chosen to represent a variety of approaches and institutions, and for the instructiveness of their methodological frameworks. They also cover varied geographical scopes (World, EU Member States).



Table 1 List of the 16 climate neutrality scenarios

Name	Acronym	Reference
A low energy demand scenario for meeting the 1.5 °C target and sustainable development goals without negative emission technologies	LED	Grubler et al., 2018
A Societal Transformation Scenario for Staying Below 1.5C	STS	Kuhnenn et al., 2020
Providing decent living with minimum energy: A global scenario	DLE	Millward-Hopkins et al., 2020
Net Zero by 2050 - A Roadmap for the Global Energy Sector (International Energy Agency, IEA)	NZE	IEA, 2021
Scenario 1.5°C Sustainable Lifestyles (European Commission)	1.5 LIFE	European Commission, 2018
Net-Zero: Shared Effort (Climact and ECF)	SES	European Climate Foundation [ECF], 2018
Paris Agreement Compatible energy scenario (CAN-Europe and EEB)	PAC	Climate Action Network Europe (CAN) / EEB, 2020
Scénario négaWatt 2022 (Association négaWatt)	SnW	Association négaWatt, 2021
Transition(s) 2050 - Frugal generation scenario S1 (French Energy Agency ADEME)	ADEMEa	ADEME, 2021
Transition(s) 2050 – Territorial cooperation scenario S2 (French Energy Agency ADEME)	ADEMEb	ADEME, 2021
Futurs énergétiques 2050 - Sufficiency Scenario (French national electricity grid authority RTE)	RTE	Réseau de Transport d'Electricité [RTE], 2021
Resource-Efficient Pathways to Greenhouse-Gas-Neutrality – Variants GreenLife and GreenSupreme (German UBA)	RESCUE	German Environment Agency [UBA], 2019
Wege zu einem klimaneutralen Energiesystem (Fraunhofer ISE)	FIS	Sterchele et al., 2020
Zero Carbon Britain: Rising to the Climate Emergency (CAT)	ZCB	Center for Alternative Technology [CAT], 2019
The role of energy demand reduction in achieving net-zero in the UK (CREDS)	CREDS	CREDS, 2021
The future of urban consumption in a 1.5°C world (University of Leeds, ARUP and C40 Cities)	FUR	University of Leeds et al., 2019

The scenarios have been thoroughly studied and their main characteristics included in a grid that allows comparison. The grid summarises information on e.g., authors, scope, ambition, general methodological approach, underpinning values, levers and drivers of sufficiency, etc. It allows a quick understanding of common aspects and differences.

The **full grid will be accessible on the project website** (www.fulfill-sufficiency.eu/publications) soon. In the following, a summary of the most salient points is provided.

2.2. Scope and ambition

The range of scenarios incorporating sufficiency is diverse. The scenarios differ in who commissioned or prepared them (institutions, academics or NGOs), their geographical scopes (3 global, 3 European, 8 national and 1 local), and their modelling approach (techno-economic or macro approach, simulation or optimisation model).

Nevertheless, most of them also share important similarities:



FULFILL has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003656.

- They seek to reach climate neutrality by 2050 and attempt to be consistent with the global 1.5 °C target. Many of the scenarios conclude that these goals would be very hard to achieve without the sufficiency and lifestyle changes that they have considered.
- They cover a broad range of sectors, most notably housing, transports, industry and nutrition.
- They put a strong emphasis on demand-side², as final energy consumption decreases between 40 and 60 % by 2050 in these scenarios. They are amongst the most ambitious scenarios available in terms of reduction of final energy consumption.
- If lifestyles would become more sufficiency-oriented as envisaged in the scenarios, it would substantially reduce the constraints on general resource use and the need to rely massively on uncertain technologies such as negative emission technologies.
- Macroeconomic optimisation models generally include less detailed and parametrised depictions of sufficiency and lifestyle changes than bottom-up techno-economic or physical models.

It is also worth noting that some of these scenarios go beyond energy and GHG emissions by looking at other impact indicators (e.g., footprint in terms of use of material resources, total scenario costs, etc.) to highlight the additional benefits of a sufficiency-driven approach.

2.3. Areas and extent of sufficiency

There are obvious similarities in the areas where sufficiency assumptions are proposed in these scenarios. The key areas are **passenger mobility, buildings (and sometimes appliances and products), food diets, and industry (with sometimes the related freight)**.

However, the interpretation and importance of sufficiency differ from one scenario to another. The overall approach, the role of sufficiency in each sector, and the modelling vary. For example, the NZE scenario has approached sufficiency by focussing on the micro-level of individual behaviours (the term used is 'behavioural change', as in the PAC scenario as well), but without touching other fundamentals.

Other scenarios go further, although the terminology of sufficiency is not primarily used e.g., in LED, STS and DLE where assumptions such as a reduction in floor space per unit area or a limitation on the increase in passenger mobility are part of the sufficiency approach but introduced by the authors through other considerations (e.g., in LED a smaller dwelling is considered as more comfortable as it requires less cleaning time).

In contrast, sufficiency is introduced in SnW as a major pillar and value of the scenario and plays a deeper transformational role in all sectors. It contributes to broader societal changes through the notions of structural and organisational sufficiency. This approach is also shared in RTE, RESCUE, CREDS and CAT for example.

This variability also transpires in the level of parametrisation. In some scenarios the disaggregation is very high and allows to depict detailed changes in service and product usages (e.g., SnW and RTE), while in others (such as FIS or 1.5 LIFE) the indicators are much more aggregated. This undermines the possibility to compare the scenario assumptions and results.

It is also notable that few scenarios provide a detailed assessment of the energy/GHG saving potential of each of their sufficiency components in isolation. Be it because of the way the modelling works, or because it would be too artificial to isolate one aspect from another, or because it is too difficult to define a 'baseline', it hinders the possibility to rank these elements by quantified potential.

²Most of the scenarios studied use so-called "supply-demand" models which study separately the "demand" which focuses on the energy consumption of households and businesses in the different sectors due to their resource usages and corresponding activities; and "supply" which looks at the different means of energy production to meet this consumption.

2.4. Sufficiency levers

Sufficiency levers (i.e., changes in habits, activities and services, that contribute to less energy and GHG-intensive lifestyles) can be found in all key areas and sectors. Some are very recurrent in all the analysed scenarios; others are more scarce.

Table 2 below lists the identified levers with the number of occurrences in the 16 scenarios. It also provides examples of the associated drivers (i.e., modifications brought to infrastructures and societal frameworks, such as policy measures, that support and enable the sufficiency levers) that are mentioned qualitatively in the scenario descriptions (or more rarely quantified through specific indicators). It is important to note that this list of drivers is not exhaustive and that other changes may be assumed in the scenarios, e.g. implicit drivers or cross-cutting ones.

Table 2 List of the most frequent sufficiency levers per sector (ranked by the number of occurrences in the 16 scenarios) and examples of related drivers

Area	Levers	Number of occurrences	Examples of drivers
Mobility	Reduced holiday trips (number and distances)	15	Development of local tourism, Change in (advertisement-based) holiday imaginaries...
	Reduced professional trips (number and distances)	15	Increased use of videoconferencing, Limits on trips per employee...
	Development of alternatives to cars (cycling, walking)	15	Accessible cycling and walking infrastructures and services, Change in (advertisement-based) private car culture, Higher constraints on car...
	Increased public transportation	15	Accessible & facilitated public transport offers including (night) trains, facilitated traffic conditions for public transports...
	Reduced daily trips (number and distances)	13	More compact urban planning and reduction of soil artificialisation, Increased working from home, Higher accessibility to local daily services, Reduced working time, Digitalisation of services...
	Increased sharing of individual vehicles	9	Availability of quality car sharing and carpooling services, Higher accessibility of roads to shared vehicles...
	Reduced freight transport	8	Development of local commerce, Reindustrialisation of selected sectors...
	Reduced power and speed of vehicles	6	Speed limits on roads, Change in (advertisement-based) promotion of powerful vehicles, Availability of diversified mobility offers according to the needs...
Housing	Reduced living space sizes	12	Development of a more compact & frugal architecture, Development of modularity in dwellings and offices...
	Increased sharing of existing spaces	11	Facilitated flat sharing options & services, Facilitated services for summer house sharing, Availability of shared spaces in buildings (e.g., laundry room, shared conference rooms...), Development of co-working spaces, Development of multi-usage of existing buildings...

Appliances and products	Reduced appliance overuse & over-equipment	9	<i>More moderated social norms: thermal comfort, hot water comfort, clothing, cleanliness, etc., Available alternatives to appliance use (fashionable warm clothes, line drying, fresh food, etc.), Sufficiency-oriented default settings and user interfaces...</i>
	Less product purchase and increased lifetime	9	<i>Development of second hand markets and services, Reducing food waste along the supply chain, Availability of quality repair and reuse offers and services, Reduction of general product obsolescence, Development of functional economy services (e.g., leasing)...</i>
	Reduction in packaging	5	<i>Available alternatives to packaging (bulk sales, direct selling...)...</i>
	Moderated use of ICT-based activities	3	<i>Digital sufficiency principles and practices, Reduction of screen addiction (especially in young generations), Regulated deployment of digital technologies...</i>
Food diets	Reduced meat (and dairy) consumption	13	<i>Change in (advertisement-based) promotion of meat products, Availability of alternatives to meat especially in restaurants (e.g., schools)...</i>
	Less carbon-intensive food	9	<i>Development of fresher and seasonal food, Availability of local circuits for food purchase, Availability of urban farming spaces and services...</i>

As can be seen, there are some very recurrent levers, although they may not include the exact same aspects from one scenario to another. For instance, under the reduction of trips, aviation may be mentioned and included in the modelling or not (and the potential may vary depending on whether only national air traffic is taken into account or also international trips in a footprint approach).

As mentioned before, it is difficult to quantitatively assess these levers in isolation according to their energy/GHG reduction potentials, as the scenarios often do not provide a specific estimate of the impact and contribution of each lever to the total result. From the few that allow that, it appears that the highest sufficiency gains in carbon footprints could be sought in mobility, buildings, food, followed by industry/products. In any case, these assessments depend largely on the level of the sufficiency assumptions that have been retained in the scenarios.

2.5. Sources and justifications of the sufficiency assumptions

Sufficiency and related lifestyle changes are integrated through different rationales in the scenarios. For some, the consideration of planetary limits and minimum living standards (i.e., the objective to bring humanity within a safe space respecting the Earth's carrying capacity) is the primary explicit goal. Others relate lifestyle changes to benefits in terms of comfort, health, etc.

The construction of the sufficiency assumptions (level and pace of change until 2050) obeys to rules and criteria that are often not clarified in details, nor always accompanied by source-based justifications. Some of the assumptions seem rather target-based (i.e., the 2050 level is assumed from the beginning), or enabler-based (i.e., related to the supposed implementation of drivers and policies). But the necessary changes in infrastructures and societal frameworks are often not modelled explicitly and only described qualitatively as a supplement to the scenario (e.g., in SnW and CREDS).

Most of the time, the sufficiency changes are more or less explicitly derived through expert judgement from underpinning overall scenario narratives. These narratives may be linked to a predefined overarching scenario vision (such as in SnW, ADEMEa and ADEMEb) and/or set of values (such as



in RTE). The most frequently cited values are sustainability, cooperation, solidarity, localism, democracy, social justice, and the achievement of the UN Sustainable Development Goals.

Beyond general values, principles and criteria, the detailed justifications of each level and the pace of change of sufficiency-related assumptions (i.e., linear curve or S-curve or other) are often not provided. It may be because it has not been documented by the scenario and model builders, or the accompanying technical documents do not go into this depth in the description of the respective pathway. This makes it difficult to decipher how far the scenario building has mobilised methods beyond expert judgement and intuitions, such as tools and results from human and social sciences, to approach, parametrise, and foresee lifestyle changes (e.g., surveys, sociological analysis, theories of change, etc.).

It is fair to note that some scenarios clarify to a certain extent the social framework in which the sufficiency evolutions have been considered, as well as the potential barriers and preconditions for change. This is particularly notable in ADEMEa, ADEMEb and RTE, in which social scientists have been involved at an early stage in the process. In RTE, sufficiency is approached through the lens of social acceptability, building on surveys and studies showing how far some changes may be implemented or not. However, there is a risk of an excessive focus on the present situation and overlooking the fact that acceptability is not static and may change over time.

There is also limited analysis of how averaged indicators over a population may be related to the richness and cross-sectoral dimensions of the concept of lifestyles. Often, 'lifestyle change' is just superficially mentioned as a way to achieve the assumed changes but without further analysis. LED, STS and DLE make a distinction between 'Global North' and 'Global South' in the approach to sufficiency. FUR focuses on a particular social category (urban population in large cities). In other scenarios, assumptions on some levers are sometimes disaggregated by large social or geographical categories (e.g., mobility needs according to the types of living areas in SnW). But these approaches remain quite rough overall.

2.6. Other inspiring studies

Beyond traditional quantified energy and climate pathways at national or subnational levels (usually used to support or influence policy-making), there are other types of original prospective exercises that may provide additional insights on the topic of lifestyle changes for sufficiency.

For instance, scenarios may try to go further than population-averaged indicators to refine the depiction of social realities. Others may deploy more original exercises to imagine future sustainable societies through narratives, citizen participation groups, personalisation, gamification, art, science-fiction, etc.

Four examples were chosen due to the interesting insights they provide in relation to the goal of better representing sufficiency and lifestyle changes in prospective studies.

Follow-ups to the ADEME scenarios

The sufficiency-based scenarios from French Energy Agency ADEME have been introduced in the previous pages (as ADEMEa and ADEMEb). Their development has required a significant amount of work, and involved several models and experts from various disciplines.

They have also been followed by additional related analysis and studies. One of them is an ex-post sociological analysis consisting of confronting a panel of households with the scenarios and studying their reactions and interpretations. This casts new light on the challenges of desirability, feasibility and conditions for achieving the lifestyle changes assumed in the scenarios.

A narrative consisting of a text and illustrations was developed for each scenario, centred on daily life areas (housing, mobility, work, food, health, consumption, leisure, tourism, etc.) rather than economic sectors. In parallel, an interview protocol and an analysis grid were designed for households to be interviewed, and 31 two-hour interviews were conducted on a panel covering a wide range of socio-demographic characteristics.



Interpreting the societal transformations in the scenarios through the lens of perceived lifestyle changes adds value to the understanding of how different sociological profiles may react to the proposed changes, but also to the meaning they attribute to them. It also refines the analysis of the technical opportunities and socio-economic and institutional contexts in which these changes need to be embedded to be perceived positively in terms of constraints, risks, and benefits. It outlines how sufficiency changes can interact with desires or reluctances to shift to a different organisation of social life and the sense of community.

More information can be found here (in French) :

https://librairie.ademe.fr/cadic/6940/feuilleton_macroéconomie_transitions2050_ademe.pdf

'ZEN scenario' and lifestyle portraits

The ZEN (Zero net emissions) scenario was published in 2019 by Entreprises pour l'Environnement, an association of more than 40 of the largest French companies. It modelled a shift of the French economy towards carbon neutrality by 2050.

The scenario encompasses some lifestyle changes towards sufficiency and assumes deep transformations of *'the major systems that structure our lives'*, including higher urbanisation, electrified and service-based mobility, more local and vegetarian food supply, as well as a circular economy in both consumption and production modes.

To refine the depiction and modelling of these changes, the methodological approach builds on a social reasoning to better characterise daily life in a carbon-neutral society. The objective was to avoid the pitfall of relying only on 'statistically averaged' household descriptions, which trigger abstractness and feed a false perception of a very normative and standardised evolution of lifestyles by 2050. On the contrary, within the scenario, contrasted social groups have been created to represent a diversity of lifestyles, taking into account differences in family status, socio-professional categories, living areas, and willingness to change. However, this approach did not build on a genuine empirical sociological study to define the various groups, meaning that this way of breaking down the population into a few categories remains quite theoretical.

In this approach, various levels and paces of lifestyle changes were related to the assumed differences in attitudes and reactions of these groups, ranging from enthusiasm for climate action to forms of resistance, whether driven by desire (for change or stability) or fear (of change or stability), including an analysis of motivations that are not directly related to climate issues.

Based on data and studies of the past ten years, 'typical' portraits of households have been chosen and subjected to differentiated assumptions on the adoption of lifestyle changes by 2050. The analysis has notably taken into account:

- Their level of needs, on the basis of their initial situation in terms of quantity of services (energy needs, consumption of products and services, etc.), depending on three major determinants described in three sub-categories each: urban, peri-urban or rural place of living, family without children, with children or retired, low, medium or high level of income;
- Their level of motivation for change, based on a classification of households into three groups: the 20% most motivated or 'doers' (who typically already value sufficiency), the 20% of 'reluctant' who strongly resist injunctions to change, and the remaining 60% of 'variables', who are more flexible and implement varied strategies of participation or resistance to change through time depending on contexts.

This theoretically leads to distinguishing 81 sub-categories of households, of which 9 are investigated and described in more detail in the scenario. The overall assumption underpinning the scenario development and modelling is that what the group of 'drivers' is ready to do today will progressively become the norm for the "variables" group by 2050. In the meantime, the 'drivers' will adopt more radical lifestyles, while the 'resistant' will stick to their current lifestyles. Although this is

a simplification of reality and social dynamics, this differentiated approach helps pointing at specific barriers and conditions to foster sufficient lifestyles, and offers an original way of refining sufficiency assumptions and quantifying potentials.

More information can be found here: <http://www.epe-asso.org/en/zen-2050-imagining-and-building-a-carbon-neutral-france-july-2019/>

‘European Calculator’: how would you decarbonise Europe?

The EU Calculator is an attempt of introducing more interactivity in prospective thinking (by contrast to traditional models that may look like rather austere and inflexible ‘black boxes’ to non-expert audiences).

The tool has been developed online in a way that allows each visitor to ‘play’ with different levels of change to achieve carbon neutrality in Europe (or one of the Member States) by 2050. The result shows instantaneously on the visuals. There are notably several sufficiency-related levers that may be activated to various levels of ambition (travelled distances, modal shift, car occupancy, living space per person, appliances owned, type of diet, food waste, etc.). It is a compelling way of visualising the potentials of various options and comparing between levers of various nature (e.g., sufficiency vs more technological bets).

The model is obviously simplified to a certain extent to allow calculability, and the indicators are population averaged (thus not allowing for sociological refinements). They are also considered in isolation and not through consistent lifestyle entries. This is nevertheless an interesting step to improve the usability of models and scenarios, and to tackle the issue of the excessive normativity that may be felt when scenario authors decide on the level of sufficiency assumptions.

More information can be found here: <http://tool.european-calculator.eu/>

‘France Vision 2050’: putting words on lifestyle change

In this study carried out in 2020 and initiated by the French government, a group of various stakeholders has been conveyed to discuss how daily life could look like in a 2050 carbon-neutral and biodiversity-friendly society. Participants included decision-makers, NGOs, trade unions, academics, etc.

The result of this qualitative prospective analysis is 155 building blocks organised in 21 topics that describe aspects of the concrete life of citizens by 2050. The Minister of Ecology leading this work explained that *‘the ecological transition cannot be summarised by numbers and abstract plans only. There is a need to embody, visualise, and show concretely what the new world will be’*.

As an example, the building block n°31 in the category #Food describes how we will spend more time preparing food and cooking, based on fresher and healthier food compared to frozen and industrialised one. Grouped purchasing of food with neighbours will be much more common. The description also covers the conditions to facilitate the change, such as more cooking courses for the population, an adjustment of working time to allow sufficient time for cooking, and a balanced gender involvement in kitchen chores.

It is interesting to note that a significant number of these building blocks relate to sufficiency and restraining non-sufficient lifestyles (the terms ‘sobriété’ and ‘sobre’, which mean ‘sufficiency’ and “sufficient” in French, are used 68 times in the document).

This interesting initiative sought to surpass some of the current controversial arguments by trying to co-construct a shared consistent vision for the future. It is certainly not perfect as contradictions may still remain between some of the building blocks (for instance a strong development of more local tourism and at the same time a higher level of nature and biodiversity protection). There is also no quantification, so no guarantee that the cumulated changes indeed suffice to reach carbon neutrality.

More information can be found here (in French): <https://www.ecologie.gouv.fr/vision-france-2050>



In conclusion, there is already a number of sufficiency-based scenarios showing how key and relevant this strategy may contribute to remaining below 1.5°C. It also allows to identify the most promising areas and most considered sufficiency changes. However, sufficiency assumptions are often approached by sectors and in isolation, in ways that are not necessarily very representative of how people live (and change) their lifestyles in reality. The criteria to set these assumptions are sometimes not well clarified and may appear relatively normative and stylised. The role of meso-level frameworks (local initiatives, communities, etc.) is also hardly mentioned in how sufficiency might spread. There are some attempts at refining the traditional job of scenario building through various (notably qualitative) approaches to enrich the sociological depiction behind sufficiency trends and take more aspects into account. This highlights the relevance of the FULFILL project to contribute to these improvements.

3. Measuring sufficiency-oriented lifestyles

This chapter focuses on an exemplary way to operationalise the degree of and variance in sufficiency-oriented lifestyles. This leads to the need of simplifying the concept to main pillars to make it manageable, e.g., in surveys and later calculations from the data obtained by surveys. Building on the definition of sufficiency outlined in chapter 2 to operationalise the concept in the empirical work packages of the project two aspects are important:

- On the one hand the environmental impact of the (individual or collective) lifestyle is relevant. In this project we will focus on the climate impact indicated by estimations of CO_{2eq}-emissions for quantifications.
- On the other hand, well-being plays an important role as we are aiming for lifestyles that do not fall short on physical, psychological or social well-being.

Thus, the present research design needs to include these elements so they can be operationalised in the qualitative and quantitative research in the following WPs (WP3-5). The next sections will provide insights and exemplary ideas on how to measure them in a quantitative way. To strive for quantifications is important to be able to link our work to prospective studies (WP6) and to show effects of sufficiency as an input to policy making. However, in many ways the quantifications will fall short to grasp the full picture:

- Quantifications on a per capita basis need to be based on per person data. The scope and the budget of the project do not allow for actual measurements and FULFILL will therefore rely on self-reported data. Self-reported data is limited by the level of knowledge and expertise as well as social desirability. Furthermore, the level of detail that can reasonably be included in a questionnaire is also limited.
- To collect the necessary data, we will mainly draw on standardised questionnaires including questions that aim at calculating a carbon footprint. The downside of such standardised instruments is that they tend to neglect interactions between different domains of life such as place of living and mobility. Furthermore, due to their standardisation they are not able to collect a high level of detail, e.g., if people frequently eat meat due to household interactions or lack of alternative menus at their workplace. Or in how far a lack of well-being is related to a sufficient or a non-sufficient lifestyle.

Therefore, FULFILL combines the quantitative approach with a qualitative approach and citizen science approaches (task 3.1, WP5, 6, 7) to achieve more in-depth insights. To integrate the different perspectives, we aim at including actual climate impact of lifestyles as well as the interplay with well-being also in the qualitative approaches.



3.1. Carbon footprint

Living a sufficiency-oriented lifestyle on the micro level is characterised by favouring activities and consumption patterns that help to stay within the earth's planetary boundaries. According to or definition, such a lifestyle is also characterised by a high level of well-being and is not resulting or caused by social deprivation e.g. due to poverty. In this project, staying within planetary boundaries is operationalised as achieving low climate impact of individual lifestyles (see chapter 1. and Sandberg, 2021). The climate impact of lifestyles is measured by using carbon footprint estimates. In the following, an overview is provided for how the carbon footprint can be estimated at the individual level using SSH approaches such as questionnaire-based studies (see Figure 5). As the figure details and as it is common in the literature, carbon footprint calculators take a sector-based approach, differentiating as we do in the following e.g., between mobility and housing. However, this neglects cross-cutting lifestyle aspects as well as interactions between the sectors.

For calculating the carbon footprint, we draw on the emerging literature on carbon footprint calculators. Several carbon footprint calculators have previously been developed by a variety of institutions. Their main purpose is usually to provide citizens with a tool to gain insights into their individual footprint and to thereby raise awareness for the climate impact of their lifestyle (Pandey et al., 2011). They have also been used to design interventions and, thus, to potentially induce a reduction of emissions by estimating the amount of emissions to be compensated. However, this approach to shift responsibility to the individual could also be seen very critically and part of delaying important activities by powerful actors (Lamb et al., 2020). Nevertheless, it is a valuable approach to quantify individual footprints and identify individual levers for lowering them accordingly.

The level of detail differs greatly between calculators. The most common areas of life used to calculate the carbon footprint are food, transport, housing and further consumption (Brizga et al., 2017; Tukker & Jansen, 2006), with some calculators only focussing on a subset of these (Boucher, 2016). In addition, data on individual carbon footprints are typically not available on nationally representative level, only average or aggregate figures; hence, large-sample analyses of factors related with individual carbon footprint are rare.

Carbon footprint calculators typically use different system boundaries for the different sectors under study when it comes to the types of emissions considered. They typically do not cover lifecycle emissions. For heating and transport, they typically pertain to direct CO₂-emissions (i.e., from burning fossil fuel at the site or by the internal combustion engine vehicles); for electricity consumption, indirect emissions are considered from burning fossil fuel at the site of the power plant. For diet, the footprint calculators typically account for greenhouse gas emissions associated with livestock, i.e., methane emissions. Standard global warming factors are used to make CO₂ and methane emissions comparable, expressing emissions in terms of CO_{2eq}.

Previous studies have identified a discrepancy between individuals' environmental values and their carbon footprint, which relates to the well-studied attitude-behaviour gap (Auger & Devinney, 2007; Carrigan & Attalla, 2001). This lack of actions in accordance with people's intentions is partially caused by a lack of **sufficiency infrastructures** and **societal frameworks** that adequately incentivise pro-environmental and pro-sufficiency actions or make them more accessible (e.g., Tröger & Reese, 2021). In addition, it is widely recognised that carbon emissions vary greatly, both between and within countries, with higher income being systematically associated with higher carbon output on average (Boucher, 2016).

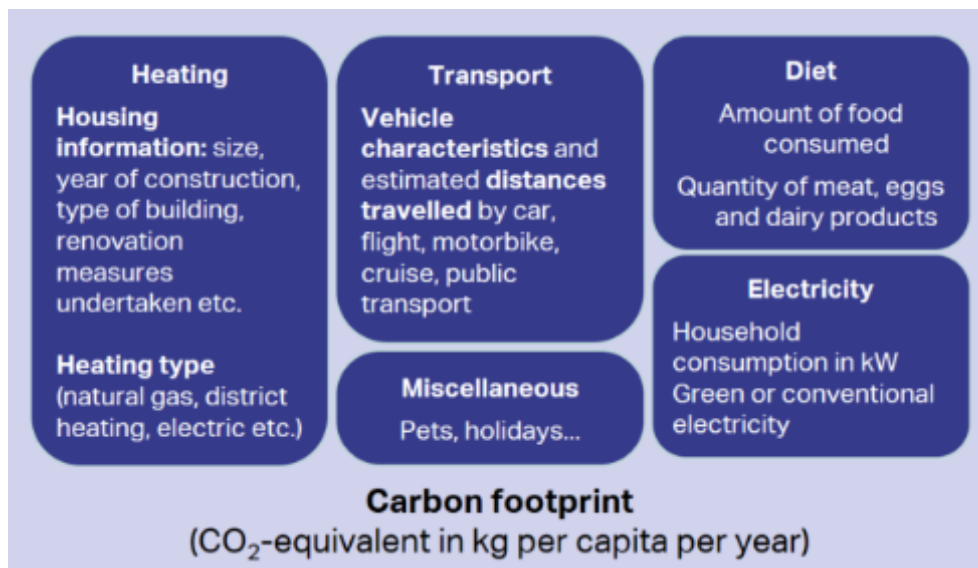
In this project, the aim is to use the calculator to have a measurement of emissions that can be allocated to each individual. However, it is important to note that a large share of the emissions is outside the individual sphere of influence. For example, for individuals living in rural areas, use of public transport may be difficult. Similarly, people renting their place of living usually cannot decide to refurbish. Or, when family members move out of a flat or house, higher rents for new (but smaller) flats prevent (elderly) people from moving out. These aspects will be further explored in WPs 4 and 5.

In addition, there is a tension between the limits of accounting for some emissions and their wider environmental impact. For example, driving an electric vehicle that is charged with electricity generated with renewables has low GHG emissions when used. This means, it is treated in a similar way as cycling with an e-bike. However, if emissions (and further environmental impacts) from its production and recycling are taken into account the picture changes considerably.

Finally, a low level of emissions is not necessarily identical with a frugal lifestyle. For example, heating a home to comparatively high indoor temperatures contradicts sufficiency even if it is achieved by renewable sources, e.g., electric heating using green electricity. This leads to the need to also add indicators that cover usage intensity even if they are not adding to emissions.

In the following, we briefly outline the structure and the logic of the carbon calculator used in FULFILL, distinguishing between heating, electricity, transport, diet, and miscellaneous consumption. This will cover the major sources of energy consumption by households as identified by Eurostat, i.e., space heating, water heating, cooking, space cooling, lighting and electrical appliances, and transport (eurostat, 2013), as well as the most relevant sectors for calculating an individual's carbon footprint as identified in the literature.

Figure 5 Carbon Footprint Sectors Overview



Heating and warm water

Energy use for heating depends on various factors including the climate, technological efficiency measures such as insulation implemented, or the heating system. Further characteristics include the size of the home and the usage patterns, e.g., having a smaller living space per capita, sharing of rooms, the number of rooms heated, room temperature, whether or not the heating system is turned down during absence or at night.

Thus, a good indicator is fuel consumption used for heating or - alternatively - heating costs. In combination with fuel type and average prices this allows to estimate the heating demand. As the efficiency of the system and the overall building standard play an important role in this, it is important to take them into account as well as heating demand based on local climate. To consider climate, it is relevant to know the region where subjects live.

In case fuel consumption and heating costs are not accessible, standardised estimations are possible using default values of average energy consumption per m² per year for space heating from official or reputable sources. These are based on information such as fuel type, building type (single

or family or apartments), building age and types of retrofitting measures implemented (e.g., insulation, exchange of majority of windows).

To more broadly assess lifestyles and for potential links with lifestyles, further interesting information will be included such as the average temperature of the main living room, the size of dwelling, and how much and how often the dwelling is typically heated. This additional information can also be used to assess the validity of our findings.

Transport

The modes of transport used and the distances travelled are highly relevant calculating individual carbon footprints. For transport-related emissions, we distinguish between distances travelled by private cars, motorcycles, and airplanes.³ This includes travelling as a passenger and driver, trips to and from work. Business trips will be excluded from the analysis due to the scope of the project.

For each mode of transport, the km travelled forms the starting point to estimate emissions. For private car and van use, it is furthermore relevant to know the number of people travelling, the fuel type and consumption of the car. If individual data is not available, estimations can be made based on demographically determined defaults by age, gender, income and preferably place of living level. The same logic can be applied for motorcycles or scooters.

Another category concerns emission intensive travel modes, in particular, air travel, which is one of the highest-impact individual consumption decisions (Lee et al., 2021). Flight-related CO₂ emissions can be estimated based on the number of flights and the distance travelled or the time spent on the plane.

To contextualise the data, it is of further interest in how far people use modes of transport with low or negligible emissions such as public transport, bike and foot. Furthermore, the available options and needs are relevant, e.g., access to public transport, number of cars or more generally accessibility of services (see the discussion on accessibility indexes in D.2.1.) as well as for example friends and relatives living overseas. These additional topics are also important to validate estimations on km travelled as these are likely to be difficult to report for many people.

Miscellaneous

Further topics will also be explored as they may strongly influence the carbon footprint and are linked to lifestyle decisions. This includes first of all consumption of household or personal non-food items such as clothes or IT products and leisure activities. Many of them are difficult to quantify in terms of emissions within a reasonable amount of effort for respondents. For the calculator, two additional topics will be explored: clothing consumption and number of pets such as horses, cats, and dogs and the pet-related CO₂ emissions. For example, having a dog can result in over 1.5T CO_{2eq} emissions over the course of one year (Martens et al., 2019).

Diet

The calculation of nutrition-related greenhouse gas emissions is calculated by taking the average CO_{2eq} emissions of the participant's main diet (vegan, vegetarian, pescitarian, mixed, high meat). This is then adjusted by gender, and whether the food is mostly regional and seasonal.

Electricity consumption

Carbon emissions for electricity use can be estimated from the national electricity mix and the individual electricity consumption. Alternatively, the electricity consumption can be estimated based

³ Cruises were removed from the questionnaire as hardly any cruises operated in 2021 due to the pandemic.

on monthly or annual costs. If these are not available a further option is to draw on average values from national statistics, preferably with some corrections like the type of home (house vs. apartment) or items with major consumption (e.g., sauna or pool).

In addition, information will be gathered if and to what extent people are using green electricity to a higher extent than in the national electricity mix, e.g., whether they subscribed to a green electricity tariff or are generating electricity e.g., through solar panels. Owners of solar panels, which generate electricity for the grid only, may receive a 'bonus' (i.e., negative CO_{2eq} emissions) equivalent to the CO_{2eq} emissions replaced in the grid. However, it is important to note, that while this influences the emissions from electricity use, the measures to achieve them are not sufficiency measures but consistency measures. Thus, to consider sufficiency, the level of electricity consumption is more relevant.

As mentioned above, in order to better distinguish the effects of sufficiency from other determinants of electricity consumption levels (efficiency, ownership of certain appliances, etc.) it will be explored in how far people are using electricity for luxury goods such as a sauna or a pool or a high-level appliance use.

3.2. Minimum well-being level

"Sufficiency is linked to the level of demand for goods and services [...] limited to a level, which still allows for a "good life" (Samadi et al., 2017, p. 127). As outlined in chapter one, well-being presents an important element of sufficiency, distinguishing sufficiency from a ban and pure reduction. The aspect that **sufficiency contains an increase of well-being** implies the advantage of a reduction from shifting the focus from "wants" to "needs" (although limitations in general are usually rather negatively associated, see also Darby & Fawcett, 2018; Di Giulio & Defila, 2021). However, it remains unclear how to define and capture well-being and the positive impacts on health in particular when tackling sufficiency.

Constructs related to well-being

Since well-being is often assessed with self-report questions, it can also be referred to as subjective well-being. Subjective well-being can be defined as the degree to which an individual believes his or her life to go well (Diener et al., 2009). However, some definitions differentiate between subjective and overall well-being, for instance the Organisation for Economic Cooperation and Development (OECD): A multi-facet framework of well-being from the OECD (2020) states that well-being consists of 11 dimensions, including (1) income and wealth, (2) work and job quality, (3) housing, (4) health, (5) knowledge and skills, (6) environmental quality, (7) safety, (8) subjective well-being, (9) work-life balance, (10) social connections, (11) civic engagement. It is noteworthy that this definition uses the term "well-being" as umbrella term as well as one dimension. Furthermore, it describes quality of life to encompass "how connected and engaged people are, and how and with whom they spend their time." (OECD, 2020, p. 20).

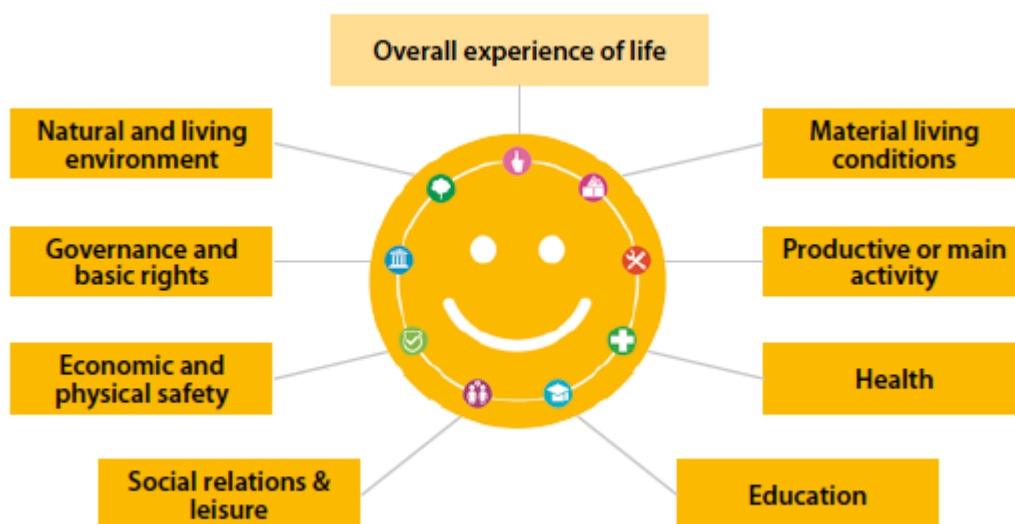
Well-being is often used interchangeably with similar and related constructs like health, or life satisfaction or happiness. All these constructs are defined as **multi-dimensional**. For instance, definitions of happiness partly contain "the big seven", variables that constitute and influence happiness. They are: family relationships, the financial situation, the work situation, community and friends, health, personal freedom and personal values (Engelbrecht, 2007; Layard, 2005; Stehnen et al., 2011). However, research states that happiness is influenced by cultural differences: not only the definition of happiness but also the motivation and drivers of happiness are strongly impacted by cultural features. Thus, for a European project like FULFILL covering several countries, the construct of happiness does not appear to be fully applicable (although cultural differences need to be considered using every term). **Another construct associated with well-being is the term "quality of life"** which is also closely related to the definition of subjective well-being outlined above.



Quality of life

Quality of life can be defined as "a broader concept than economic production and living standards. It includes the full range of factors that influence what people value in living, beyond the purely material aspects." (European Commission, 2015, p. 9). Thus, quality of life is also a multi-dimensional construct related to sufficiency and sufficiency lifestyles. It is often defined as including other interchangeably-used constructs such as life satisfaction and health. Moreover, it was translated into indicators and different scales by well-known scientific European and international institutes, for instance the European Commission / EUROSTAT and the World Health Organisation (WHO). Figure 6 presents the nine dimensions that constitute the definition of quality of life in the definition by European Commission / EUROSTAT (2015).

Figure 6 Nine dimensions that constitute the definition of quality of life in the definition by European Commission / EUROSTAT



Note. Figure is depicted from European Commission, 2015, p.9.

Similarly, the WHO states "Quality of life is defined as individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns." (World Health Organization, 1996, p. 5). Importantly, this definition does not aim to assess objective measures but the individual's perception of quality of life. This definition focuses not on medical diseases or diagnoses but instead on the effect and impact of diseases and symptoms and, ultimately, how they affect everyday life. Based on research with international health professionals and patients, the following 24 facets (see Table 33) were identified, which were grouped into the following four domains and one additional domain called "overall quality of life and general health" (World Health Organization, 1996, p. 6):

Table 3 Domains and facets of quality of life measurement

Domain	Facet
Physical health	Activities of daily living Dependence on medicinal substances and medical aids Energy and fatigue Mobility Pain and discomfort Sleep and rest Work capacity
Psychological health	Bodily image and appearance Negative feelings Positive feelings Self-esteem Spirituality / religion / personal beliefs Thinking, learning, memory and concentration
Social relationships	Personal relationships Social support Sexual activity
Environment	Financial resources Freedom, physical safety and security Health and social care: accessibility and quality Home environment Opportunities for acquiring new information and skills Participation in and opportunities for recreation/leisure activities Physical environment (pollution / noise / traffic / climate) Transport

It is noteworthy that both definitions of quality of life contain the dimension "environment", although it is framed slightly differently in both definitions - focusing rather on the proximity of nature and the physical surrounding in European Commission / EUROSTAT versus focusing rather on the social environment in the WHO but also considering aspects of nature and the physical surrounding. Also, the dimension of health presents a central part in both definitions. This highlights the relationship of quality of life with the environment and health and ultimately with sufficiency.

In the following, we will briefly present more details on how to measure well-being and quality of life, respectively, by the WHO: The WHO has developed two versions to assess the quality of life - a long version consisting of 100 questions (WHO-QOL-100) and a short version consisting of 24 questions (WHO-QOL-BREF). The latter WHO assessment was developed by many international institutes and tested in 18 countries and 19 languages. Thus, detailed information on the administration, national adjustment, and calculation of the QOL-score are available. **The WHO-QOL-BREF was created with the idea in mind to arrive at a measure of quality of life that can be applied cross-culturally.** The intention of its development was to have a **holistic and systemic approach to health aspects and quality of life**. The WHO states three main reasons for developing the WHO-QOL-



BREF: The existing measures at the time "do not assess quality of life *per se* [...]. Second, most measures of health status have been developed in North America and the UK, and the translation of these measures for use in other settings is time-consuming, and unsatisfactory [...]. Third, the increasingly mechanistic model of medicine, concerned only with the eradication of disease and symptoms, reinforces the need for the introduction of a humanistic element into health care." (World Health Organization, 1996, p. 6). When developing the above mentioned facets and domains, the WHO-QOL-BREF also considered "other markers relevant to the measurement of quality of life (e.g., role of the family, perception of time, perception of self, dominant religion)". (p.6). The WHO-QOL-BREF contains a total of 26 questions. "To provide a broad and comprehensive assessment, one item from each of the 24 facets contained in the WHOQOL-100 has been included. In addition, two items from the Overall quality of Life and General Health facet have been included." (World Health Organization, 1996, p. 7).

The connection between sufficiency and well-being / one's quality of life becomes more evident when highlighting the role of human needs. The sufficiency definition we adopted for FULFILL mentions the aspect of well-being. Since many dimensions in the well-being definitions outlined above can be achieved when basic human needs are met, **needs present the connecting element between well-being and quality of life on one side and sufficiency on the other side**. Thus, the relevance of well-being and needs for sufficiency research gets stressed.

Further variables influencing well-being

Many factors influence the perception of one's quality of life. In the following we will outline a health-related influencing factor as well as a lifestyle-related factor as examples of impacting variables. We present these variables since they seem to fit to the scope of FULFILL and its objectives.

Climate change related psychological stress and anxiety

A part of the definition of well-being can be seen as the absence of stress and physical or psychological diseases. Since the environment and health are two aspects outlined in the WHO and the European Commission / EUROSTAT definition, considering further aspects such as environmental stress, climate anxiety, and/ or eco-depression leading to the absence of well-being appears relevant. Literature on these phenomena shows that there is a close link between well-being and climate change. Regarding climate anxiety, the link to sufficiency seems to be as follows: climate anxiety can be defined as a chronic fear of environmental doom, which, however, is argued to serve as functional reaction in the face of climate change (Wullenkord et al., 2021) and thus leads to related climate change preventing behaviour including sufficiency-oriented behaviour (see also Coffey et al., 2021; Helm et al., 2018). On the other hand, climate anxiety can also be dysfunctional thus leading to a tendency of avoidance and/or denial of climate change and no climate change preventing actions. Hence, the level of climate anxiety might be a proxy to predict (in-)sufficiency behaviour: If one's climate anxiety is high, this person might feel unable to act and thus, might behave in a non-sufficiency-oriented manner behaviour to reduce the anxiety by acting and showing a sufficient lifestyle. However, it is important to note that there are many other climate change preventing activities that can be enhanced or hindered by climate anxiety; a sufficiency lifestyle is just one of them.

Moreover, research on the connectedness with nature (e.g., Menzel & Reese, 2021; Pritchard et al., 2020) shows that spending time in nature leads to stress relief and is associated with positive affective states and psychological functioning. Connectedness with nature touches the topic of sufficiency slightly, more precisely, the use of time and how to spend it (e.g., in nature) to increase one's well-being and but to avoid an increase in one's carbon footprint.

The influence of time availability and subjective time affluence

As indicated by the outlined definitions above, research also shows that time affluence has an impact on well-being (Geiger et al., 2021). Thus, it appears interesting to measure how people spend their time and whether their well-being suffers from time pressure and time poverty. In addition, more research on how people spend additional or leisure time can help to identify rebound effects



related to sufficiency lifestyles (e.g., additional time during the COVID-19 pandemic from not commuting to work might be spent with low carbon activities like sleeping more - contributing also to increased health and well-being aspects - or could be spent with working more, i.e., higher carbon footprint by using technologies to connect to work and not contributing to health and well-being related aspects).

4. Methodologies for the assessment of the potentials of sufficiency lifestyle changes

This part refines the methodological and conceptual investigation of how models may be used to assess the potentials of lifestyle changes for sufficiency. It provides methodological support and recommendations to the macro assessments of sufficiency planned in work packages 5 and 6, as well as helps identifying gaps and understudied aspects that the work packages 3 and 4 of the project could contribute to fill.

The analysis draws on the previous pages and on the outcomes of an **expert workshop** organised during the project. This event took place in May 2022 and gathered high-skilled specialists in modelling and prospective studies. The observations and suggestions of a dozen experts inspired the analysis (through their remarks during the workshop or written comments afterwards). **The project team expresses its gratitude and sincere thanks to these experts for their very useful and inspirational contributions.** Citations below stem from publications of these authors.

4.1. Integrating lifestyle change in forecasting studies

Two main ways of considering lifestyle change and sufficiency in forward-looking exercises may be identified, depending on whether these elements are treated endogenously or exogenously in the modelling phase. Each approach has its strengths and weaknesses and the chosen approach depends on the question put forward (van den Berg et al., 2019).

Endogenous modelling

Approaches of this sort aim at modelling internally the dynamics of social and lifestyle changes in order to assess the potential of some sufficiency drivers to foster these changes (e.g., policies, energy price increase, changes in social norm...). The objective is notably to try and answer the "how to?" question through modelling. As an example, models in this category can seek to better represent and understand the potential impacts of carbon pricing by better capturing dynamics, heterogeneity and non-linearities in household behavioural responses and the role that e.g., social learning plays in the impact of such a policy measure (Niamir, Kieseewetter, et al., 2020).

There is no doubt that the task is difficult. First, it has to be done within a predetermined framework constrained by modelling structures that were often not conceived to accommodate social and lifestyle changes (Saujot et al., 2021). As an illustration, sufficiency-driven lifestyle changes are likely to challenge the rational choice theory used within many models (van den Berg et al., 2019).

Also, bridging or merging social science knowledge and scenario building may come at a significant cost of simplifying complex descriptions from social sciences into model equations (Trutnevyte et al., 2019). There are obvious limits to the coverage of the lifestyle change system but in theory it allows a better representation of changes in specific lifestyle choices (van den Berg et al., 2019). The modelling requires a good depiction of the impact and causal chains of the studied drivers (Förster et al., 2019).

Although they have often not been primarily designed for that, integrated assessment models (IAMs) can for instance be adapted to include (some) lifestyle change elements. Improving the modelling of lifestyles by integrating new equations representing social phenomena appears to be

a privileged direction (Saujot et al., 2021), but the experience is still limited (van den Berg et al., 2019).

When IAMs cannot directly model lifestyle changes, another option is to couple them with other models that simulate lifestyle change dynamics, such as agent-based models (van den Berg et al., 2019). Various experiments are already ongoing (Trutnevyte et al., 2019), including attempts to represent the complexities of e.g., social interactions and spatial constraints and processes on energy demand. These first developments already show interesting results, such as that in the EU the regional dimension plays an important role in the impacts of a low-carbon transition that would be driven by behavioural changes (Niamir, Ivanova, & Filatova, 2020).

Exogenous integration

Scenarios and pathways of this sort, which are more frequent, build on lifestyle and sufficiency change assumptions that are set in advance by the scenario-builders and fed to a model (designed to assess the resulting impacts). This approach answers the “What if?” type of questions. The lifestyle changes are preconceived and taken for granted.

Obviously, it means that the model output depends on the quality and consistency of the assumptions, and that important societal and policy dynamics and interactions may be missed out in the modelling phase (Trutnevyte et al., 2019). When information is an exogenous input, it does not react to other changes happening within the model (van den Berg et al., 2019).

Scenarios in this category are often bottom-up where energy services and usages are depicted in a disaggregated way and sufficiency and lifestyle changes reflected in the assumed evolution of selected parameters / indicators (e.g., number of persons per vehicles, average m² per person, etc.). The resulting energy (and material) demand is then coupled with a supply model. The parametrisation is important because it has to be precise enough to distinguish sufficiency from efficiency and fairly represent lifestyle change evolutions (Förster et al., 2019).

More traditional top-down optimisation and input-output models often cannot easily reproduce and evaluate the effects of significant lifestyle modifications (Costa et al., 2021). Yet, some attempts have been made to use them as well. In that case sufficiency assumptions are “forced” one way or another into the model, through e.g., perturbing the consumption patterns within the calculation modules (Vita, Lundström, et al., 2019). However, some aspects of lifestyle change remain difficult to treat this way, e.g., sharing practices or downsizing of living spaces (Vita, Lundström, et al., 2019).

4.2. Methods for building assumptions

When lifestyle change is set exogenously, the assumptions in terms of pace and level of change rely on “disciplined expert intuitions” and potential normative choices consistent with the scenario vision and ambition. A key question is the robustness of these assumptions.

Table 4 below is an attempt to categorise and discuss the various approaches and options that could be used to build the sufficiency assumptions.

Table 4 Typology of sufficiency assumptions according to their scopes, sources, natures, and framings

Characteristics of the scenario hypotheses		Explanation	Potential limits
Scope and extent	Systematic	A 'sufficiency first' logic is applied on all societal domains and parameters. It reinforces consistency in lifestyle approaches.	It may hinder the possibility to assess and isolate the impact of specific items
	Partial	Only selected lifestyle changes are considered (possibly as 'gap fillers' after other demand-side measures have been applied)	'Shopping list' approaches fail to capture the real potential and essence of sufficiency, and may undermine a better understanding and acknowledgement of its rationale (Dufournet et al., 2019) and political meaning (Saujot et al., 2021).
Source of the assumptions	Translated from overarching narratives and values	Quantified assumptions reflect a set of underpinning societal changes and values associated with the scenario and chosen by the scenario builders; 'sufficiency' is often one of the values alongside others	It is key that these underpinning elements are as explicit as possible (Dufournet et al., 2019). Lifestyle changes potentially imply transforming the balance of values and preferences in a given way, which is not necessarily consensual (Saujot et al., 2021).
	Co-constructed with stakeholders	Assumptions are set together with a group of experts or citizens to reflect a consensual approach	There might be bias in the representativeness or interests within the group
Nature of the assumptions	Target / vision-based	The end-point (e.g., level in 2050) is set, e.g., with a sufficiency approach in mind (convergence towards a level of 'enoughness'), and the trajectory constructed through e.g., backcasting	Imagining long-term targets may be difficult and quite conceptual for some lifestyle change elements. There is also a risk of imposing normative assumptions. On the positive side, starting from the physical objectives to be achieved at 2030 and 2050 and back casting to identify the policies that may successfully lead us there is a logical process.
	Trend-based	The assumption is set on the pace of change (e.g., annual decrease), taking into account past trends and future prospects.	The risk might be to lead to insufficient levels of change by 2050 to reach the scenario target (e.g., climate neutrality) and/or pushing back in time the most difficult changes. It also reflects less the concept of sufficiency as a state to reach.
	Driver-based	The assumption reflects as best as possible a set of drivers and policies (infrastructures and societal frameworks) that are supposed to be adopted in the scenario.	The causal chain from the driver to the change in a parameter is often difficult to quantify. Policy impact might be over or underestimated. On the positive side, this is a way to explore the effects of changes in sufficiency infrastructures and societal frameworks.
Aspects considered to frame the level of sufficiency ⁴	Acceptance (public or political)	Assumptions are framed by perceived acceptability aspects.	Perceived acceptance based on present status quo (e.g., surveys) risks misrepresenting social dynamics of change. It may also lead to excessive self-censorship from scenario builders (Förster et al., 2019).
	SDGs	Assumptions seek consistency with Sustainable Development Goals, notably gender equality, decent work, etc.	SDGs are not necessarily all consistent with each other and trade-offs might be necessary.
	Other socio-economic aspects	Assumptions may take into account e.g., ageing population, dependency, familial trends, etc.	These criteria are rarely formally explained, and therefore may be taken into account but in unclear ways.

⁴ Note: these are only examples, as boundary and framing criteria are not always explicitly clarified in the scenarios.

4.3. Limits and methodological recommendations

Experts in the field highlight several general precautions and suggestions to improve the consideration of sufficiency-related changes in energy and climate pathways. It is to be noted that some of these methodological recommendations may apply broadly to other aspects as well (e.g., improving the modelling of efficiency or adoption of greener technologies).

- **Quantification limits:** A scenario, even very thorough and effective, cannot capture all aspects of human diversity and complexity of lifestyle changes. We touch here on boundaries of analytical frameworks and the usefulness of quantitative analysis (Creutzig et al., 2016).
- **Need for harmonisation:** There are still varied terminologies and conceptions for sufficiency and lifestyle change. These encompass its definitions, scope, parametrisation, and drivers. Increased harmonisation and understanding between experts would be beneficial (van den Berg et al., 2019; we also provide input in that direction in deliverable 2.1). Databases, such as the one developed by German researchers on sufficiency policies and measures, is a relevant step (Förster et al., 2019). Assumed targets (e.g., upper and lower levels of consumption to converge towards) vary among scenarios, but this might also be considered as a useful feature, since it allows the exploration of different societal values and configurations for the future.
- **Risks of excessive split between behaviours and technologies:** Sufficiency is often considered the 'non-technical' part of the energy transition, and sufficiency and efficiency may be treated very separately in scenarios and models; in reality, there are interactions between behaviours and technologies that need to be depicted as adequately as possible.
- **Consistency and interactions:** some of the parameters used to quantify lifestyle changes are interrelated, and inconsistencies may appear if the assumptions are set too independently from each other (e.g., increased teleworking has impacts on several mobility and housing aspects that need to be considered coherently); also, models often disregard feedback dynamics (Vita, Lundström, et al., 2019), and it is necessary to anticipate them in assumption setting.
- **Excessive sectorisation:** although sectoral depictions help remaining concrete and practical, scenarios and models could reinforce cross-sectoral synergies and consider additional factors and sufficiency changes that are not only related to one sector, e.g., changes in time use patterns, reduction of working time, broader social change movements, etc. (van den Berg et al., 2019).
- **Averages are not sociologically sound:** most energy & climate pathways, for manageability reasons, work on population averages without distinguishing between social groups, situations, or local contexts; this substantially limits the possibility to refine the approach of lifestyles and lifestyle changes. In addition, averages are a particular enemy to the confidence in sufficiency potentials as they increase the feeling of excessive normativity (Dufournet et al., 2019).
- **Rebound and spillover effects:** it is not always clear how (direct and indirect) rebound and spillover effects are taken into account in the assumptions and modelling. There is a common assumption that conscious sufficiency-driven lifestyles would be less prone to rebound effects than efficiency gains (because they are more conceived with the idea of moderating / constraining total use of resources, while efficiency is sometimes argued to increase productivity, see also chapter 1.1.), although this has to be further investigated. Some projects have started looking into this topic (Sorrell et al., 2020)⁵.

⁵ For instance <https://www.sustainableconsumption.se/>



- **Attractiveness of sufficient lifestyles:** changes towards sustainability may entail various benefits, beyond saving energy and carbon emissions; the co-benefits are not systematically assessed and highlighted in scenarios. It is relevant and recommended to provide a more complete picture of the impacts on health, well-being, social relations, social justice, new forms of wealth, etc. (Dufournet et al., 2019; Saujot et al., 2021).

4.4. The contribution of human and social sciences to model sufficiency lifestyles

The previous recommendations highlight the importance of multidisciplinary approaches to adequately tackle the methodological challenges of assessing lifestyles and sufficiency and all their potentials. In particular, the role of humanities and social sciences (SSH) serves as a key.

Since the core of the FULFILL project is to put such a multidisciplinary approach into practice to advance the state of knowledge regarding the potential of lifestyle changes in decarbonisation strategies, it is useful to thoroughly discuss at which stages and in which forms the contributions of SSH may be the most relevant and necessary.

Improving models and assessment modules

First, SSH are necessary to **improve the functioning of models** that integrate lifestyle change endogenously, notably through agent-based modelling and more elaborated integration of meso-level dynamics (e.g., the role of communities and sharing initiatives). There is a trend to use more survey data from SSH research to better depict behavioural responses, yet this data is not always compatible with the data used in conventional macro models (Niamir, Ivanova, & Filatova, 2020).

To improve the situation, energy and sector-specific models need to experiment more with integrating insights from SSH to improve the model representations of societal transformations, such as behaviour of various actors, transformation dynamics in time, and heterogeneities within and across societies. There are multiple strategies for achieving this, including the bridging, iterating, and (the most ambitious) merging strategies (Trutnevyte et al., 2019). This should however be designed in a transparent way so that the model does not become a complex 'black box'.

SSH can also provide views on **the most adequate level of disaggregation and parametrisation** in a model to depict lifestyle change dynamics in an accurate way. This includes notably going beyond averaged indicators for whole populations and better taking into account social aspects and differences. Population may be disaggregated into **categories or typologies** (based on e.g., socioeconomic indicators, environmental footprint estimates, lifestyle types, or else). This may be a useful approach to better depict varying trends and potentials, but also take into account sufficiency trade-offs within categories. However, such approaches in modelling face difficulties in data availability and comparability (Saujot et al., 2021), as well as challenges to combine micro and macro approaches (Niamir, Ivanova, & Filatova, 2020). It also requires finding a good balance to keep the models still workable.

Beyond models and their quantified outcomes, SSH can provide **a rich perspective to refine the depiction and understanding of what lies behind indicators and averages:** social typologies, differentiated dynamics, or other approaches may help increase the understanding of the potential and desirable variations around average trends, and better highlight important aspects (social justice, gender balance, etc.).

Lastly, SSH may help reflect on a scenario overall framework to uncover and discuss the **underpinning values and socioeconomic frameworks** that may be implicit but affect parametrisation, modelling approaches, and the setting of exogenous assumptions

Reinforcing the credibility of targets and trajectories

SSH can inform the definition of **more robust target-based sufficiency assumptions using a refined knowledge of trends and preferences** potentially taking into account social, geographical and cultural differences in various domains, e.g., sufficient living space per capita, sufficient accessibility of work and leisure activities, sufficient diets, etc. This may involve active participation of citizen groups that help scenario builders co-create the vision and narratives of the scenarios, or are confronted to scenarios to analyse how they react to the proposed pathways. SSH data on lifestyles in the past or in other regions (see also D.2.1.) may also be useful to put in perspective the targets that are considered for the future.

SSH can also bring valuable expertise on **boundaries to sufficiency assumptions**. These boundaries may be due to subjective limits felt by agents. In this case, research experimenting in how far individuals may be ready to reconsider their limits, and under which conditions, may provide interesting insights, e.g., in relation to thermal comfort, car use, etc. There are also boundaries that are more physical (relating to total available space, time, etc. to shift to new lifestyles), and where data gaps may need to be filled if these boundaries are to be more robustly assessed.

The dynamics and pace of change are also key aspects on which research output (behavioural and practice studies, analysis of sociocultural barriers and social imaginaries, surveys on preferences, etc.) may be mobilised (Dufournet et al., 2019). At present, scenarios sometimes rely on simplistic diffusion and adoption patterns of lifestyle changes, as if they were linear or always in the form of an 'S-curve' (i.e. in three basic steps: slow uptake in the beginning by few early adopters, then accelerated expansion of adoption and generalisation, and then the final longer time for the remaining least responsive part to eventually follow). In reality, lifestyle changes may obey to more complex rules, both in terms of diffusion in the population and at the level of individuals due to lock-in effects. For instance, adopting more sufficient mobility lifestyles and behaviours requires for some people to move to a new dwelling, which is a complex and sometimes long term decision. Furthermore, such decisions are not based on rational-choice only, but influenced by many constraints such as socio-economic status, as also how other parts of the lifestyle would change through moving to another flat or house, such as distances to work, accessibility of public transport, aspects of social infrastructures and community etc. However, the usability of such research on dynamics of change would be improved if the data output would come in a format that can be easily integrated in models (Niamir, Ivanova, & Filatova, 2020).

Finally, **SSH may bring with it useful considerations for the description of drivers and enablers to achieve the proposed changes**. There is increasing research on the design of energy sufficiency policies, including changes in infrastructures, choice architectures, and decision-making frameworks. However, the connection between this and quantified potential calculations in scenarios has seldom been made yet (Dufournet et al., 2019). This may create a bias towards believing that sufficiency changes are mostly related to individual preferences and choices, while overall governance, socio-technical frameworks and their transformation through policies and investments may matter as much or even more. It is also important to bear in mind that the success of (potentially constraining) policies rely on a sociologically-sound design that considers social justice and gender aspects. On all these points, sociologists, psychologists, urban planners and many more should work in close collaboration with political scientists and policy makers.

Progressing on the understanding and role of benefits

More sufficient lifestyles are useful to reduce energy use and carbon footprints, and this should obviously be a main outcome of a modelling assessment. However, they can also bring a number of **co-benefits and be part of a broader definition of a '(new) well-being for all' concept**. SSH can contribute to making this connection between sufficiency and well-being aspirations, so that the changes are considered from a broader perspective of desirability. This may be done e.g., through enriching the set of indicators in energy and climate models, as well as providing micro and meso examples of perceived well-being gains in the adoption of more sufficient lifestyles.



The benefits do not only relate to individual health or comfort aspects, but also to potential **micro and macroeconomic costs, reduced risks and increased resilience** (by being less exposed to volatility, availability and pricing of materials/services accessible from global markets).

5. Concluding thoughts

Based on the literature review and on the current debate tackling sufficiency and demand-side measures (e.g., IEA, 2021; IPCC, 2022) the research of FULFILL adopt the following definition in regard to sufficiency as principle:

FULFILL understands the sufficiency principle as creating the social, infrastructural, and regulatory conditions for changing individual and collective lifestyles in a way that reduces energy demand and greenhouse gas emissions to an extent that they are within planetary boundaries, and **simultaneously contributes to societal well-being**.⁶

This definition reflects the important interplay between **infrastructures and societal frameworks as enablers and levers** to lead and maintain sufficiency-oriented lifestyles and sufficiency **habits** (already) performed by individuals. They can serve as role models and could inspire others to act alike. Sufficiency-oriented lifestyles have grown in niches over the past years and potentially have the power to transform systems (e.g., Loy et al., 2021). But implementing and mainstreaming sufficiency orientation need **infrastructures and societal frameworks** that **enable people** to behave in accordance with their pro-sufficiency intentions. Sufficiency would need **policy measures in every key area** (see chapter 5.1.) that make sufficiency-oriented decisions easier and provide sufficiency-oriented default options for people. Furthermore, sufficiency highlights the perspective of **well-being and quality of life as driver and consequence** of sufficiency as a goal. This is important to design appropriate policy measures as also for communicating sufficiency. However, all of these relationships need more empirical research and understanding.

Thus, to capture the different aspects of sufficiency on the micro-level, we will consider a measure of sufficiency-oriented lifestyles that simultaneously takes an output-oriented approach in terms of reduction of carbon emissions through changes in sufficiency habits, and also considers quality of life and well-being.

In line with previous research and reviews (Sandberg, 2021; e.g., Saujot et al., 2021; Vita, Lundström, et al., 2019) and our additional analyses the following key areas for sufficiency lifestyles are outlined in this deliverable and will be focused on in the course of the FULFILL project.

5.1. Key areas for sufficiency lifestyles

All work packages will focus on these key areas for sufficiency-oriented lifestyles and consider potential societal frameworks and infrastructures to enhance and enable sufficiency-oriented lifestyles.

- **Travelling less** (shorter distance trips, flying less, etc.)
- **Reducing motorised transports and switching transport modes** (modal shift and preventing the use of fossil-fuel mobility, lighter and more shared vehicles, etc.)

⁶ FULFILL's sufficiency project definition is quite close to the definition of 'sufficiency policies' by the IPCC (2022, p. 35): "Sufficiency policies are a set of measures and daily practices that avoid demand for energy, materials, land and water while delivering human well-being for all within planetary boundaries." Our definition was formulated during the project application process prior to the publication of the IPCC report.

- **Less space-intensive living** and adequate room temperature (reducing and sharing residential and tertiary spaces)
- **Lower-tech and less materialistic consumption** (moderating the ownership and use of appliances & ICT, increased product lifetime, etc.)
- **Changing diets** (less meat-based and industrialised food, etc.)

The present deliverable provides:

- starting points for the measurement of sufficiency on the micro-level using SSH approaches,
- an overview and recommendations to integrate sufficiency on macro-level modelling (prospective studies),
- a basis for the connection of SSH and prospective studies.

Both the SSH and the prospective studies perspectives, clearly emphasise that they need to be linked and are related and embedded in the meso level however, this link is very challenging to implement. FULFILL will explore possible pathways for this in WP 4 on initiatives/municipalities and through further work in WP5. Furthermore, understanding the role of gender and gender equality for the performance and also as a consequence of sufficiency-oriented lifestyles will also be a cross-cutting research issue throughout the whole project. We outline some major concerns and potential relationships in regard to key areas of sufficiency that will be targeted in the following.

5.2. Gender dimension in FULFILL's research design

European societies – as many societies worldwide – are organised in an androcentric way claiming its perspective as neutral and objective and perceiving female perspectives as an addition and deviation (e.g., Bailey et al., 2020). FULFILL aims at taking a non-androcentric perspective to contribute to decreasing gender inequalities in society and **analysing sufficiency-oriented lifestyles with a view on gender (in-)equalities**. To account for gender in regard to climate change and climate policy advice is of high relevance (Reksten & Floro, 2021; Sauer & Stieß, 2021; Spitzner, 2021). In the field of sufficiency this is closely related to aspects of the care economy but also in regard to questions about who has the power to shift and transform relevant infrastructures that may help to decrease consumption and enable sufficiency within societies.

The **care economy** deals with care work for oneself and others such as other household members and third persons like relatives. It encompasses taking care of individual and societal essential needs. Examples are that in many nations worldwide females care for essential needs of living such as purchasing and preparing food, cleaning and washing, providing services such as taking children to school, caring for elderly family members. It also includes engagement in local communities and other forms of support, such as volunteering in community gardens or in the local church. Large parts of the care economy consist of services provided without payments such as by parents or househusbands/housewives.

The project takes the **gender dimension** (in the sense of the term by EU DG Research) systematically into account. Sufficiency policies count as ambitious policies that aim to promote justice and wellbeing. Such transformative changes influence the care and market economic frame as also local conditions to perform (care-)work related behaviour. Hence, the easiness to perform a certain behaviour or to carry out care work will change as well. Gender relations and power relations could change through such policies and infrastructural changes, with the hope of the normative goal that gender equality improve.

All of the identified key areas to increase the sufficiency-orientation of lifestyles have a strong link with the gender dimension and/or the care economy (as we only exemplify in the following list). However, potential impacts remain unclear in many areas and need to be explored in detail.

- **Travelling less** (shorter distance trips, flying less, etc.) **and reducing motorised transports** (modal shift, lighter and more shared vehicles, etc.)
Lower levels of mobility can possibly be achieved by different designs of the built environment making sure that all services, workplaces, etc. are easily accessible in a safe way by active mobility such as walking or cycling. Possibly, this could reduce the need for accompanying children as they are able to reach their destinations on their own. However, it also poses questions such as how to transport purchases. Sometimes active mobility also takes more time than travelling by car - even in suitable environments.
- **Less space-intensive living** and adequate room temperature (reducing and sharing residential and tertiary spaces)
Smaller living spaces and using shared space have the potential to reduce the individual burden for cleaning and maintenance. Shared apartments could help community-building and satisfy the need for social relatedness, in particular for single parents. Furthermore, smaller and shared living space is cheaper, hence full time job employment is possibly less necessary and, in consequence, care work could be shared among a larger group of people. However, it could also imply higher efforts in managing the personal spaces, create enough space for everyone and their current needs (e.g. to relax quietly vs. social involvement or engagement).
- **Lower-tech and less materialistic consumption** (moderating the ownership and use of appliances & ICT, increased product lifetime, etc.)
A typical example for sufficiency in this area is to avoid the use of appliances that use a lot of energy, material resources and could be replaced by more energy saving practices. An example is the use of a tumble dryer. However, this means that someone needs to hang up the washing which is an additional workload most often carried out by women. The ownership and usage of fewer appliances could lower necessary investments, decrease electricity consumption and maintenance work. Again, this would save money and perhaps change gender related income dependency.
- **Changing diets** (less meat-based and industrialised food, etc.)
In many cultures, men consume more meat than women. Thus, changing meat consumption would be possible a harder challenge for men due to the habitual meat consumption. However, changing diets potentially puts more burden on the caregivers within the family structures, i.e. people doing the shopping and the cooking. It also involves a lot of social and cultural processes to adapt households to new ways of preparing food. It may be necessary to develop new routines and acquire new skills - which leads to additional efforts most likely for women.

As part of the systemic approach the **gender dimension** is highly important especially for the care economy and also when addressing lifestyle changes towards sufficiency which will be explicitly considered as a cross-sectional dimension within all work packages. In the context of the project, **intersections of gender with daily practices, health implications as well as energy poverty and access to capital/income are of special relevance**. These are considered in the preparation and implementation of WP3 and WP4, where information collected will be gender disaggregated. Furthermore, it will be analysed **how far sufficiency-oriented lifestyles and initiatives today contribute to increasing or decreasing gender inequality** and in how far they follow dominant principles within androcentric societies that value economic activities more than care work. WP5 will upscale these findings for the later WPs. Moreover, as part of the systemic impact assessment in WP6, a task is going to specifically address the gender aspect. In the development of policy recommendations (WP7), implications from these analyses will be considered. At the same time, when implementing the citizen science approach in WP7, we also aim for involving diverse samples and address gender dimensions to achieve sound and valid recommendations.

5.3. Sufficiency principle in upcoming work packages

Here we will provide brief overviews of how the concept of sufficiency, including well-being, will be addressed in the upcoming work packages given the defined key areas of interest for understanding sufficiency-oriented lifestyles:

Outlook on WP3

WP3 studies the situation of sufficiency-oriented lifestyles today. It combines quantitative questionnaire based social science research with qualitative interview based research designs. In its approach it replicates the interplay between outcome-oriented sufficiency measures by using a carbon footprint calculator, the simultaneous focus on health and well-being and the consideration of the strong role of structural drivers and barriers.

Outlook on WP4

WP4 aims to identify enablers and barriers for sufficiency lifestyles on the meso level. The focus will lie on intentional communities, initiatives and organisations supporting sustainable and sufficient lifestyles and / or offer respective services for individuals and households. The underlying assumption is that the intentional communities' success and outreach is not only determined by their activity level and personal engagement of their participants but also supported or hindered by surrounding aspects such as a local political framework, infrastructures or else (**sufficiency infrastructures and societal frameworks**). Thus, the drivers and barriers will be analysed both on the activity and outreach level of intentional communities and the external determinants on municipal level.

In the survey conducted within WP4 among initiatives and intentional communities, participants are first openly asked about their existing understanding of sufficiency. The following questions in the survey are based on the division chosen in the project into social, infrastructural, and regulatory conditions for changing individual and collective lifestyles. When selecting the persons interviewed in WP 3, the initiative and intentional communities were also taken into account, which are the core of the investigation in WP4.

Outlook on WP5

In WP 5, the macro-level social determinants and barriers (i.e., **societal frameworks**) that can enable or prevent **sufficiency habits** will be analysed. Based on the previous work packages, potential cultural differences between countries will be researched in the aforementioned key areas, e.g. whether customs in construction and urban planning might explain variations in mobility habits and willingness to share spaces, to which extent social and cultural norms around consumption and possession play a role on the intention to buy and use more products, or the impact of cultural norms on nutrition. It will help to reflect on the best policy approaches to foster sufficiency in these key areas. Task 5.3 on the macro-quantification of sufficiency potentials will also largely build on the preliminary methodological basis that has been developed in this report (in chapter 5).

Outlook on WP6

The WP 6 evaluates the potential impacts of up-scaled sufficiency practices and lifestyle changes for promoting and disseminating citizen engagement in climate action and for integrating energy sufficiency into the design of future sustainable policies at multiple levels. WP 6 relies on the quantitative estimates derived from Task 5.3, which, in turn, are based on the analyses carried out by WPs 3 to 5. Economic and environmental impacts are assessed using Input-Output analysis (IOA), based on an ad-hoc selected Multi-Regional Input Output (MRIO) environmental extended database. Social impacts, related to different areas of study (e.g., energy poverty, just transition, health,



gender/equality and time consumption), are assessed by means of the PSILCA database (a database for social LCA; the effective use of this tool, mentioned in the project description, is currently under review) and integrated with results from previous WPs and other European projects (HOPE and COMBI) to evaluate Health co-benefits.

On the one hand, the key areas outlined above will be included in the analyses in WP6 subordinate to their inclusion in the elaboration of the input data used for the analysis. WP6 relies on input from previous WPs for this part. The key areas are therefore considered, provided they have been included in earlier analyses. On the other hand, when displaying the results of the analysis, the data will be shown taking into account that subdivision.

Hence, the present deliverable builds the basis for the research conducted in the next work packages (WP3-WP6) which will consider the outlined definition of sufficiency and lifestyles as well as the identified areas.



References

- ADEME. (2021). *Transition(s) 2050*. <https://transitions2050.ademe.fr>
- Albert, M. (2019). Sustainable frugal innovation – The connection between frugal innovation and sustainability. *Journal of Cleaner Production*, 237, 117747. <https://doi.org/10.1016/j.jclepro.2019.117747>
- Alcott, B. (2008). The sufficiency strategy: Would rich-world frugality lower environmental impact? *Ecological Economics*, 64(4), 770–786. <https://doi.org/10.1016/j.ecolecon.2007.04.015>
- Alexander, S. (2013). Voluntary Simplicity and the Social Reconstruction of Law: Degrowth from the Grassroots Up. *Environmental Values*, 22(2), 287–308. <https://doi.org/10.3197/096327113X13581561725356>
- Alexander, S., & Gleeson, B. (2022). Collective Sufficiency: Degrowth as a Political Project. In S. Alexander, S. Chandrashekeran, & B. Gleeson (Eds.), *Alternatives and Futures: Cultures, Practices, Activism and Utopias. Post-Capitalist Futures* (pp. 53–64). Springer Singapore. https://doi.org/10.1007/978-981-16-6530-1_5
- Alexander, S., & Ussher, S. (2012). The Voluntary Simplicity Movement: A multi-national survey analysis in theoretical context. *Journal of Consumer Culture*, 12(1), 66–86. <https://doi.org/10.1177/1469540512444019>
- Association négaWatt. (2021). *Energy Transition Scenario for France*. <https://negawatt.org/Scenario-negaWatt-2022>
- Auger, P., & Devinney, T. M. (2007). Do What Consumers Say Matter? The Misalignment of Preferences with Unconstrained Ethical Intentions. *Journal of Business Ethics*, 76(4), 361–383. <https://doi.org/10.1007/s10551-006-9287-y>
- Bailey, A. H., LaFrance, M., & Dovidio, J. F. (2020). Implicit androcentrism: Men are human, women are gendered. *Journal of Experimental Social Psychology*, 89, 103980. <https://doi.org/10.1016/j.jesp.2020.103980>
- Boucher, J. L. (2016). Culture, Carbon, and Climate Change: A Class Analysis of Climate Change Belief, Lifestyle Lock-in, and Personal Carbon Footprint. *Socijalna Ekologija*, 25(1-2), 53–80. <https://doi.org/10.17234/SocEkol.25.1.3>
- Bouckaert, L., Opdebeeck, H., & Zsolnai, L. (2011). Frugality. In L. Bouckaert & L. Zsolnai (Eds.), *Handbook of Spirituality and Business* (pp. 269–276). Palgrave Macmillan UK. https://doi.org/10.1057/9780230321458_33
- Brizga, J., Ikstens, J., Gaugere, K., & Ernsteins, R. (2017). *Household pro-environmental behavior developments in Latvia: behavioral practice and values orientation*. https://www.researchgate.net/publication/338019025_HOUSEHOLD_PRO-ENVIRONMENTAL_BEHAVIOR_DEVELOPMENTS_IN_LATVIA_BEHAVIORAL_PRACTICE_AND_VALUES_ORIENTATION
- Brizga, J., Jørgensen, M. S., Lekavičius, V., Olesen, G. B., Rasmussen, R. V., & Kronby, H. (2022, April 22). *National policy dialogues in Denmark, Latvia and Lithuania. WP5 report from “Integrating Energy Sufficiency into Modelling of Sustainable Energy Scenarios”*. <https://vbn.aau.dk/en/publications/national-policy-dialogues-in-denmark-latvia-and-lithuania>
- Brown, K. W., & Kasser, T. (2005). Are Psychological and Ecological Well-being Compatible? The Role of Values, Mindfulness, and Lifestyle. *Social Indicators Research*, 74(2), 349–368. <https://doi.org/10.1007/s11205-004-8207-8>
- Carducci, B. J. (2020). Personality and Consumer Behavior/Lifestyle Analysis. In B. J. Carducci, C. S. Nave, J. S. Mio, & R. E. Riggio (Eds.), *The Wiley Encyclopedia of Personality and Individual Differences* (pp. 581–586). Wiley. <https://doi.org/10.1002/9781119547181.ch361>
- Carrigan, M., & Attalla, A. (2001). The myth of the ethical consumer – do ethics matter in purchase behaviour? *Journal of Consumer Marketing*, 18(7), 560–578. <https://doi.org/10.1108/07363760110410263>



- Center for Alternative Technology. (2019). *Zero Carbon Britain: Rising to the Climate Emergency*. <https://cat.org.uk/info-resources/zero-carbon-britain/research-reports/zero-carbon-britain-rising-to-the-climate-emergency/>
- Cherrier, H., Black, I. R., & Lee, M. (2011). Intentional non-consumption for sustainability. *European Journal of Marketing*, 45(11/12), 1757–1767. <https://doi.org/10.1108/03090561111167397>
- Climate Action Network Europe (CAN) / EEB. (2020). *Building a Paris Agreement Compatible (PAC) energy scenario*. Climate Action Network Europe (CAN) / EEB. <https://caneurope.org/building-a-paris-agreement-compatible-pac-energy-scenario/>
- Cockerham, W. C., Rütten, A., & Abel, T. (1997). Conceptualizing Contemporary Health Lifestyles: Moving Beyond Weber. *The Sociological Quarterly*, 38(2), 321–342. <https://doi.org/10.1111/j.1533-8525.1997.tb00480.x>
- Coffey, Y., Bhullar, N., Durkin, J., Islam, M. S., & Usher, K. (2021). Understanding Eco-anxiety: A Systematic Scoping Review of Current Literature and Identified Knowledge Gaps. *The Journal of Climate Change and Health*, 3, 100047. <https://doi.org/10.1016/j.joclim.2021.100047>
- Contoyannis, P., & Jones, A. M. (2004). Socio-economic status, health and lifestyle. *Journal of Health Economics*, 23(5), 965–995. <https://doi.org/10.1016/j.jhealeco.2004.02.001>
- Costa, L. [Luís], Moreau, V., Thurm, B., Yu, W., Clora, F., Baudry, G., Warmuth, H., Hezel, B., Seydewitz, T., Ranković, A., Kelly, G., & Kropp, J. P. (2021). The decarbonisation of Europe powered by lifestyle changes. *Environmental Research Letters*, 16(4), 44057. <https://doi.org/10.1088/1748-9326/abe890>
- Craig-Lees, M., & Hill, C. (2002). Understanding voluntary simplifiers. *Psychology & Marketing*, 19(2), 187–210. <https://doi.org/10.1002/mar.10009>
- CREDS. (2021). *The role of energy demand reduction in achieving net-zero in the UK – CREDS*. <https://www.creds.ac.uk/publications/the-role-of-energy-demand-reduction-in-achieving-net-zero-in-the-uk/>
- Creutzig, F., Fernandez, B., Haberl, H., Khosla, R., Mulugetta, Y., & Seto, K. C. (2016). Beyond Technology: Demand-Side Solutions for Climate Change Mitigation. *Annual Review of Environment and Resources*, 41(1), 173–198. <https://doi.org/10.1146/annurev-enviro-110615-085428>
- Creutzig, F., Niamir, L., Bai, X., Cullen, J., Díaz-José, J., Figueroa, M., Grübler, A., Lamb, W., Leip, A., Masanet, E., Mata, E., Mattauch, L., Minx, J., Mirasgedis, S., Mulugetta, Y., Nugroho, S., Pathak, M., Perkins, P., Roy, J., ... Ürge-Vorsatz, D. (2022). Demand-side solutions to climate change mitigation consistent with high levels of wellbeing. *Nature Climate Change*, 12, 36–46. <https://doi.org/10.21203/rs.3.rs-127928/v1>
- Darby, S., & Fawcett, T. (2018). *Energy sufficiency – an introduction*. <https://www.energysufficiency.org/libraryresources/library/items/energy-sufficiency-an-introduction/> <https://doi.org/10.13140/RG.2.2.31198.08006>
- Di Giulio, A., & Defila, R. (2021). Building the bridge between Protected Needs and consumption corridors. *Sustainability: Science, Practice and Policy*, 17(1), 117–134. <https://doi.org/10.1080/15487733.2021.1907056>
- Di Giulio, A., & Fuchs, D. (2014). Sustainable Consumption Corridors: Concept, Objections, and Responses. *GAIA - Ecological Perspectives for Science and Society*, 23(3), 184–192. <https://doi.org/10.14512/gaia.23.S1.6>
- Diener, E., Lucas, R. E., & Oishi, S. (2009). Subjective well-being: the science of happiness and life satisfaction. In S. J. Lopez & C. R. Snyder (Eds.), *The Oxford Handbook of Positive Psychology* (pp. 187–194). Oxford University Press.
- Dittmar, H., Bond, R., Hurst, M., & Kasser, T. (2014). The relationship between materialism and personal well-being: A meta-analysis. *Journal of Personality and Social Psychology*, 107(5), 879–924. <https://doi.org/10.1037/a0037409>
- Dufournet, C., Toulouse, E., Marignac, Y., & Förster, H. (2019). Energy sufficiency: how to win the argument on potentials? In *ECEEE Summer Study proceedings 2019*.



- Elgin, D., & Mitchell, A. (1977). Voluntary simplicity. *Planning Review*, 5(6), 13–15. <https://doi.org/10.1108/eb053820>
- Engelbrecht, H.-J. (2007). The (Un)Happiness of Knowledge and the Knowledge of (Un)Happiness: Happiness Research and Policies for Knowledge-based Economies 1. *Prometheus*, 25(3), 243–266. <https://doi.org/10.1080/08109020701531379>
- Erba, S., & Pagliano, L. (2021). Combining Sufficiency, Efficiency and Flexibility to Achieve Positive Energy Districts Targets. *Energies*, 14(15), 4697. <https://doi.org/10.3390/en14154697>
- Etzioni, A. (1999). Voluntary Simplicity: Characterization, Select Psychological Implications, and Societal Consequences. In A. Etzioni (Ed.), *Springer eBook Collection. Essays in Socio-Economics* (pp. 1–26). Springer. https://doi.org/10.1007/978-3-662-03900-7_1
- European Climate Foundation. (2018). *Net Zero By 2050: From Whether To How*. <https://europeanclimate.org/resources/a-net-zero-emission-european-society-is-within-reach-but-getting-there-starts-today-2/>
- European Commission. (2018, November 28). *A Clean Planet for all: A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy* (COM (2018) 773). Brussels. <https://climatecooperation.cn/climate/a-clean-planet-for-all-a-european-long-term-strategic-vision-for-a-prosperous-modern-competitive-and-climate-neutral-economy/>
- European Commission, E. (2015). *Quality of life: Facts and views* (2015 Edition). *Eurostat Theme Collection*. Publication Office of the EU. <https://doi.org/10.2785/59737>
- eurostat. (2013). *Manual for statistics on energy consumption in households* (Eurostat Theme Collection). Luxembourg. European Commission. <https://doi.org/10.2785/45686>
- Eversberg, D., & Schmelzer, M. (2018). The Degrowth Spectrum: Convergence and Divergence Within a Diverse and Conflictual Alliance. *Environmental Values*, 27(3), 245–267. <https://doi.org/10.3197/096327118X15217309300822>
- Fanning, A. L., O'Neill, D. W., Hickel, J., & Roux, N. (2022). The social shortfall and ecological overshoot of nations. *Nature Sustainability*, 5(1), 26–36. <https://doi.org/10.1038/s41893-021-00799-z>
- Fanning, A. L., & O'Neill, D. W. (2019). The Wellbeing–Consumption paradox: Happiness, health, income, and carbon emissions in growing versus non-growing economies. *Journal of Cleaner Production*, 212, 810–821. <https://doi.org/10.1016/j.jclepro.2018.11.223>
- Figge, F., Young, W., & Barkemeyer, R. (2014). Sufficiency or efficiency to achieve lower resource consumption and emissions? The role of the rebound effect. *Journal of Cleaner Production*, 69, 216–224. <https://doi.org/10.1016/j.jclepro.2014.01.031>
- Fischer, C., & Grieshammer, R. (2013). *When less is more: Sufficiency: Terminology, rationale and potentials*. <https://www.oeko.de/publikationen/p-details/when-less-is-more-sufficiency-terminology-rationale-and-potentials>
- Fitzgerald, J. B., Jorgenson, A. K., & Clark, B. (2015). Energy consumption and working hours: a longitudinal study of developed and developing nations, 1990–2008. *Environmental Sociology*, 1(3), 213–223. <https://doi.org/10.1080/23251042.2015.1046584>
- Förster, H., Zell-Ziegler, C., & Eichhorn, D. (2019). Energy efficiency first; sufficiency next? In *ECEEE Summer Study proceedings 2019*.
- Fujii, S. (2006). Environmental concern, attitude toward frugality, and ease of behavior as determinants of pro-environmental behavior intentions. *Journal of Environmental Psychology*, 26(4), 262–268. <https://doi.org/10.1016/j.jenvp.2006.09.003>
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy*, 31(8-9), 1257–1274. [https://doi.org/10.1016/S0048-7333\(02\)00062-8](https://doi.org/10.1016/S0048-7333(02)00062-8)
- Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, 1(1), 24–40. <https://doi.org/10.1016/j.eist.2011.02.002>



- German Environment Agency [UBA]. (2019). *RESCUE Scenarios: Resource-Efficient Pathways to Greenhouse-Gas-Neutrality*. German Environment Agency. <https://www.umweltbundesamt.de/en/topics/climate-energy/climate-protection-energy-policy-in-germany/rescue-resource-efficient-pathways-to-greenhouse>
- Giannetti, B. F., Agostinho, F., Almeida, C., & Huisingh, D. (2015). A review of limitations of GDP and alternative indices to monitor human wellbeing and to manage eco-system functionality. *Journal of Cleaner Production*, 87, 11–25. <https://doi.org/10.1016/j.jclepro.2014.10.051>
- Goldsmith, R. E., Reinecke Flynn, L., & Clark, R. A. (2014). The etiology of the frugal consumer. *Journal of Retailing and Consumer Services*, 21(2), 175–184. <https://doi.org/10.1016/j.jretconser.2013.11.005>
- Gram-Hanssen, K. (2012). Sustainable Lifestyles. In *International Encyclopedia of Housing and Home* (pp. 117–123). Elsevier. <https://doi.org/10.1016/B978-0-08-047163-1.00557-9>
- Gregg, R. B. (1936). *The value of voluntary simplicity*. https://www.duaneelgin.com/wp-content/uploads/2010/11/the_value_of_voluntary_simplicity.pdf
- Grubler, A., Wilson, C., Bento, N., Boza-Kiss, B., Krey, V., McCollum, D. L., Rao, N. D., Riahi, K., Rogelj, J., Stercke, S. de, Cullen, J., Frank, S., Fricko, O., Guo, F., Gidden, M., Havlík, P., Huppmann, D., Kieseewetter, G., Rafaj, P., . . . Valin, H. (2018). A low energy demand scenario for meeting the 1.5 °C target and sustainable development goals without negative emission technologies. *Nature Energy*, 3(6), 515–527. <https://doi.org/10.1038/s41560-018-0172-6>
- Haberl, H., Wiedenhofer, D., Virág, D., Kalt, G., Plank, B., Brockway, P., Fishman, T., Hausknost, D., Krausmann, F., Leon-Gruchalski, B., Mayer, A., Pichler, M., Schaffartzik, A., Sousa, T., Streeck, J., & Creutzig, F. (2020). A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: synthesizing the insights. *Environmental Research Letters*, 15(6), 65003. <https://doi.org/10.1088/1748-9326/ab842a>
- Hanbury, H., Bader, C., & Moser, S. (2019). Reducing Working Hours as a Means to Foster Low(er)-Carbon Lifestyles? An Exploratory Study on Swiss Employees. *Sustainability*, 11(7), 2024. <https://doi.org/10.3390/su11072024>
- Hargreaves, T. (2011). Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change. *Journal of Consumer Culture*, 11(1), 79–99. <https://doi.org/10.1177/1469540510390500>
- Hayden, A. (2019). Sufficiency. In *Routledge Handbook of Global Sustainability Governance* (pp. 151–163). Routledge.
- Helm, S. V., Pollitt, A., Barnett, M. A., Curran, M. A., & Craig, Z. R. (2018). Differentiating environmental concern in the context of psychological adaption to climate change. *Global Environmental Change*, 48, 158–167. <https://doi.org/10.1016/j.gloenvcha.2017.11.012>
- Hertwich, E. G. (2005). Consumption and the Rebound Effect: An Industrial Ecology Perspective. *Journal of Industrial Ecology*, 9(1-2), 85–98. <https://doi.org/10.1162/1088198054084635>
- Hickel, J. (2021). What does degrowth mean? A few points of clarification. *Globalizations*, 18(7), 1105–1111. <https://doi.org/10.1080/14747731.2020.1812222>
- Hickel, J., & Kallis, G. (2020). Is Green Growth Possible? *New Political Economy*, 25(4), 469–486. <https://doi.org/10.1080/13563467.2019.1598964>
- Hickel, J., & Slamersak, A. (2022). Existing climate mitigation scenarios perpetuate colonial inequalities. *The Lancet Planetary Health*, 6(7), e628–e631. [https://doi.org/10.1016/S2542-5196\(22\)00092-4](https://doi.org/10.1016/S2542-5196(22)00092-4)
- Hook, J. N., Hodge, A. S., Zhang, H., van Tongeren, D. R., & Davis, D. E. (2021). Minimalism, voluntary simplicity, and well-being: A systematic review of the empirical literature. *The Journal of Positive Psychology*, 1–12. <https://doi.org/10.1080/17439760.2021.1991450>
- Huneke, M. E. (2005). The face of the un-consumer: An empirical examination of the practice of voluntary simplicity in the United States. *Psychology & Marketing*, 22(7), 527–550. <https://doi.org/10.1002/mar.20072>



- IEA. (2021). *Net Zero by 2050 - A Roadmap for the Global Energy Sector*. International Energy Agency. <https://www.iea.org/reports/net-zero-by-2050>
- IPCC. (2022). *Climate Change 2022: Mitigation of Climate Change. Summary for Policymakers*. Working Group III Contribution to the IPCC sixth assessment report (AR6). IPCC. <https://www.ipcc.ch/report/ar6/wg3/>
- Isham, A., Verfürth, C., Armstrong, A., Elf, P., Gatersleben, B., & Jackson, T. (2022). The Problematic Role of Materialistic Values in the Pursuit of Sustainable Well-Being. *International Journal of Environmental Research and Public Health*, 19(6), 3673. <https://doi.org/10.3390/ijerph19063673>
- Jensen, M. (2007). Defining lifestyle. *Environmental Sciences*, 4(2), 63–73. <https://doi.org/10.1080/15693430701472747>
- Jungell-Michelsson, J., & Heikkurinen, P. (2022). Sufficiency: A systematic literature review. *Ecological Economics*, 195, 107380. <https://doi.org/10.1016/j.ecolecon.2022.107380>
- Kallis, G., Kostakis, V., Lange, S., Muraca, B., Paulson, S., & Schmelzer, M. (2018). Research On Degrowth. *Annual Review of Environment and Resources*, 43(1), 291–316. <https://doi.org/10.1146/annurev-environ-102017-025941>
- Kang, J., Martinez, C. M. J., & Johnson, C. (2021). Minimalism as a sustainable lifestyle: Its behavioral representations and contributions to emotional well-being. *Sustainable Production and Consumption*, 27, 802–813. <https://doi.org/10.1016/j.spc.2021.02.001>
- Kasser, T. (2016). Materialistic Values and Goals. *Annual Review of Psychology*, 67, 489–514. <https://doi.org/10.1146/annurev-psych-122414-033344>
- Kasser, T., Rosenblum, K. L., Sameroff, A. J., Deci, E. L., Niemiec, C. P., Ryan, R. M., Árnadóttir, O., Bond, R., Dittmar, H., Dungan, N., & Hawks, S. (2014). Changes in materialism, changes in psychological well-being: Evidence from three longitudinal studies and an intervention experiment. *Motivation and Emotion*, 38(1), 1–22. <https://doi.org/10.1007/s11031-013-9371-4>
- Kasser, T., Ryan, R. M., Couchman, C. E., & Sheldon, K. M. (2004). Materialistic values: Their causes and consequences. In T. Kasser & A. D. Kanner (Eds.), *Psychology and consumer culture: The struggle for a good life in a materialistic world* (pp. 11–28). American Psychological Association. <https://doi.org/10.1037/10658-002>
- Khamis, S. (2019). The aestheticization of restraint: The popular appeal of de-cluttering after the global financial crisis. *Journal of Consumer Culture*, 19(4), 513–531. <https://doi.org/10.1177/1469540519872071>
- Kondo, M. (2014). *The Life-Changing Magic of Tidying*. Ebury Publishing.
- Krausmann, F., Gingrich, S., Eisenmenger, N., Erb, K.-H., Haberl, H., & Fischer-Kowalski, M. (2009). Growth in global materials use, GDP and population during the 20th century. *Ecological Economics*, 68(10), 2696–2705. <https://doi.org/10.1016/j.ecolecon.2009.05.007>
- Kropfeld, M. I., Nepomuceno, M. V., & Dantas, D. C. (2018). The Ecological Impact of Anticonsumption Lifestyles and Environmental Concern. *Journal of Public Policy & Marketing*, 37(2), 245–259. <https://doi.org/10.1177/0743915618810448>
- Kuhnhenh, K., Costa, L [Luis], Mahnke, E., Schneider, L., & Lange, S. (2020). *A Societal Transformation Scenario for Staying Below 1.5°C* (No. 23). Berlin. <https://www.boell.de/de/2020/12/09/societal-transformation-scenario-staying-below-15degc>
- Lamb, W. F., Mattioli, G., Levi, S., Roberts, J. T., Capstick, S., Creutzig, F., Minx, J. C., Müller-Hansen, F., Culhane, T., & Steinberger, J. K. (2020). Discourses of climate delay. *Global Sustainability*, 3. <https://doi.org/10.1017/sus.2020.13>
- Lastovicka, J. L., Bettencourt, L. A., Hughner, R. S., & Kuntze, R. J. (1999). Lifestyle of the Tight and Frugal: Theory and Measurement. *Journal of Consumer Research*, 26(1), 85–98. <https://doi.org/10.1086/209552>
- Lastovicka, J. L., & Joachimsthaler, E. A. (1988). Improving the Detection of Personality-Behavior Relationships in Consumer Research. *Journal of Consumer Research*, 14(4), 583. <https://doi.org/10.1086/209138>



- Layard, R. (2005). *Happiness: Lessons from a new science*. Penguin.
- Lee, D. S., Fahey, D. W., Skowron, A., Allen, M. R., Burkhardt, U., Chen, Q., Doherty, S. J., Freeman, S., Forster, P. M., Fuglestad, J., Gettelman, A., León, R. R. de, Lim, L. L., Lund, M. T., Millar, R. J., Owen, B., Penner, J. E., Pitari, G., Prather, M. J., ... Wilcox, L. J. (2021). The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018. *Atmospheric Environment (Oxford, England : 1994)*, 244, 117834. <https://doi.org/10.1016/j.atmosenv.2020.117834>
- Loy, L. S., Tröger, J., Prior, P., & Reese, G. (2021). Global Citizens - Global Jet Setters? The Relation Between Global Identity, Sufficiency Orientation, Travelling, and a Socio-Ecological Transformation of the Mobility System. *Frontiers in Psychology*, 12, 622842. <https://doi.org/10.3389/fpsyg.2021.622842>
- Meadows, D. (1999). *Leverage Points: Places to Intervene in a System*. <http://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/>
- Meissner, M. (2019). Against accumulation: lifestyle minimalism, de-growth and the present post-ecological condition. *Journal of Cultural Economy*, 12(3), 185–200. <https://doi.org/10.1080/17530350.2019.1570962>
- Menzel, C., & Reese, G. (2021). Implicit Associations With Nature and Urban Environments: Effects of Lower-Level Processed Image Properties. *Frontiers in Psychology*, 12, 591403. <https://doi.org/10.3389/fpsyg.2021.591403>
- Millward-Hopkins, J., Steinberger, J. K., Rao, N. D., & Oswald, Y. (2020). Providing decent living with minimum energy: A global scenario. *Global Environmental Change*, 65, 102168. <https://doi.org/10.1016/j.gloenvcha.2020.102168>
- Mollborn, S., Lawrence, E. M., & Hummer, R. A. (2020). A gender framework for understanding health lifestyles. *Social Science & Medicine (1982)*, 265, 113182. <https://doi.org/10.1016/j.socscimed.2020.113182>
- Neuvonen, A., Kaskinen, T., Leppänen, J., Lähteenoja, S., Mokka, R., & Ritola, M. (2014). Low-carbon futures and sustainable lifestyles: A backcasting scenario approach. *Futures*, 58, 66–76. <https://doi.org/10.1016/j.futures.2014.01.004>
- Niamir, L., Ivanova, O., & Filatova, T. (2020). Economy-wide impacts of behavioral climate change mitigation: Linking agent-based and computable general equilibrium models. *Environmental Modelling & Software*, 134, 104839. <https://doi.org/10.1016/j.envsoft.2020.104839>
- Niamir, L., Kiesewetter, G., Wagner, F., Schöpp, W., Filatova, T., Voinov, A., & Bressers, H. (2020). Assessing the macroeconomic impacts of individual behavioral changes on carbon emissions. *Climatic Change*, 158(2), 141–160. <https://doi.org/10.1007/s10584-019-02566-8>
- O'Neill, D. W., Fanning, A. L., Lamb, W. F., & Steinberger, J. K. (2018). A good life for all within planetary boundaries. *Nature Sustainability*, 1(2), 88–95. <https://doi.org/10.1038/s41893-018-0021-4>
- Oates, C., McDonald, S., Alevizou, P., Hwang, K., Young, W., & McMorland, L.-A. (2008). Marketing sustainability: Use of information sources and degrees of voluntary simplicity. *Journal of Marketing Communications*, 14(5), 351–365. <https://doi.org/10.1080/13527260701869148>
- OECD. (2020). *How's Life? 2020: Measuring Well-being*. OECD Publishing. https://read.oecd-ilibrary.org/economics/how-s-life/volume/-issue-_9870c393-en#page23 <https://doi.org/10.1787/23089679>
- Oswald, Y., Owen, A., & Steinberger, J. K. (2020). Large inequality in international and intranational energy footprints between income groups and across consumption categories. *Nature Energy*, 5(3), 231–239. <https://doi.org/10.1038/s41560-020-0579-8>
- Pandey, D., Agrawal, M., & Pandey, J. S. (2011). Carbon footprint: Current methods of estimation. *Environmental Monitoring and Assessment*, 178(1-4), 135–160. <https://doi.org/10.1007/s10661-010-1678-y>
- Pangarkar, A., Shukla, P., & Taylor, C. R. (2021). Minimalism in consumption: A typology and brand engagement strategies. *Journal of Business Research*, 127, 167–178. <https://doi.org/10.1016/j.jbusres.2021.01.033>



- Petschow, U., Moore, N. a. d., Hofmann, D., Pissarskoi, E., & Lange, S. (2021). Cornerstones and positions of a precautionary post-growth economy. In B. Lange, M. Hülz, B. Schmid, & C. Schulz (Eds.), *Post-Growth Geographies* (pp. 323–346). transcript Verlag. <https://doi.org/10.1515/9783839457337-024>
- Princen, T. (2003). Principles for Sustainability: From Cooperation and Efficiency to Sufficiency. *Global Environmental Politics*, 3(1), 33–50. <https://doi.org/10.1162/152638003763336374>
- Princen, T. (2005). *The logic of sufficiency*. MIT Press.
- Pritchard, A., Richardson, M., Sheffield, D., & McEwan, K. (2020). The Relationship Between Nature Connectedness and Eudaimonic Well-Being: A Meta-analysis. *Journal of Happiness Studies*, 21(3), 1145–1167. <https://doi.org/10.1007/s10902-019-00118-6>
- Quested, E., Thøgersen-Ntoumani, C., Uren, H., Hardcastle, S. J., & Ryan, R. M. (2018). Community Gardening: Basic Psychological Needs as Mechanisms to Enhance Individual and Community Well-Being. *Ecopsychology*, 10(3), 173–180. <https://doi.org/10.1089/eco.2018.0002>
- Reksten, N., & Floro, M. S. (2021). Feminist Ecological Economics: A Care-Centred Approach to Sustainability. In R. Bali Swain & S. Sweet (Eds.), *Sustainable Consumption and Production, Volume I* (pp. 369–389). Springer International Publishing. https://doi.org/10.1007/978-3-030-56371-4_18
- Réseau de Transport d'Electricité [RTE]. (2021). “Futurs énergétiques 2050” - Consommation et production: les chemins de l’électricité de RTE pour la neutralité carbone. <https://www.rte-france.com/analyses-tendances-et-prospectives/bilan-previsionnel-2050-futurs-energetiques>
- Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., Wit, C. A. de, Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., . . . Foley, J. A. (2009). A safe operating space for humanity. *Nature*, 461(7263), 472–475. <https://doi.org/10.1038/461472a>
- Rodriguez, J. (2018). The US Minimalist Movement: Radical Political Practice? *Review of Radical Political Economics*, 50(2), 286–296. <https://doi.org/10.1177/0486613416665832>
- Samadi, S., Gröne, M.-C., Schneidewind, U., Luhmann, H.-J., Venjakob, J., & Best, B. (2017). Sufficiency in energy scenario studies: Taking the potential benefits of lifestyle changes into account. *Technological Forecasting and Social Change*, 124, 126–134. <https://doi.org/10.1016/j.techfore.2016.09.013>
- Sandberg, M. (2018). Downsizing of Housing. *Journal of Macromarketing*, 38(2), 154–167. <https://doi.org/10.1177/0276146717748355>
- Sandberg, M. (2021). Sufficiency transitions: A review of consumption changes for environmental sustainability. *Journal of Cleaner Production*, 293, 126097. <https://doi.org/10.1016/j.jclepro.2021.126097>
- Sandlin, J. A., & Wallin, J. J. (2022). Decluttering the Pandemic: Marie Kondo, Minimalism, and the “Joy” of Waste. *Cultural Studies ↔ Critical Methodologies*, 22(1), 96–102. <https://doi.org/10.1177/15327086211049703>
- Sauer, A., & Stieß, I. (2021). Accounting for gender in climate policy advice: adapting a gender impact assessment tool to issues of climate change. *Impact Assessment and Project Appraisal*, 39(3), 262–273. <https://doi.org/10.1080/14615517.2021.1904710>
- Saujot, M., Le Gallic, T., & Waisman, H. (2021). Lifestyle changes in mitigation pathways: policy and scientific insights. *Environmental Research Letters*, 16(1), 15005. <https://doi.org/10.1088/1748-9326/abd0a9>
- Schneidewind, U., & Zahrnt, A. (2014). *The politics of sufficiency: making it easier to live the good life*. Oekom-Verlag.
- Sekulova, F., Kallis, G., Rodríguez-Labajos, B., & Schneider, F. (2013). Degrowth: from theory to practice. *Journal of Cleaner Production*, 38, 1–6. <https://doi.org/10.1016/j.jclepro.2012.06.022>



- Shaw, D., & Newholm, T. (2002). Voluntary simplicity and the ethics of consumption. *Psychology & Marketing*, 19(2), 167–185. <https://doi.org/10.1002/mar.10008>
- Shove, E., & Walker, G. (2014). What Is Energy For? Social Practice and Energy Demand. *Theory, Culture & Society*, 31(5), 41–58. <https://doi.org/10.1177/0263276414536746>
- Sorrell, S., Gatersleben, B., & Druckman, A. (2020). The limits of energy sufficiency: A review of the evidence for rebound effects and negative spillovers from behavioural change. *Energy Research & Social Science*, 64, 101439. <https://doi.org/10.1016/j.erss.2020.101439>
- Sovacool, B. K., & Hess, D. J. (2017). Ordering theories: Typologies and conceptual frameworks for sociotechnical change. *Social Studies of Science*, 47(5), 703–750. <https://doi.org/10.1177/0306312717709363>
- Spangenberg, J. H., & Lorek, S. (2019). Sufficiency and consumer behaviour: From theory to policy. *Energy Policy*, 129, 1070–1079. <https://doi.org/10.1016/j.enpol.2019.03.013>
- Spengler, L. (2016). Two types of 'enough': sufficiency as minimum and maximum. *Environmental Politics*, 25(5), 921–940. <https://doi.org/10.1080/09644016.2016.1164355>
- Spitzner, M. (2021). Für emanzipative Suffizienz-Perspektiven. *PROKLA. Zeitschrift Für Kritische Sozialwissenschaft*, 51(202), 95–114. <https://doi.org/10.32387/prokla.v51i202.1934>
- Stehnken, T., Muller, E., & Zenker, A. (Eds.). (November 2011). *Happiness and innovation: Avenues for further research* (evoREG Research Note #18). http://www.evoreg.eu/docs/files/shno/Note_evoREG_18.pdf
- Stelzner, M. (2022). Growth, Consumption, and Happiness: Modeling the Easterlin Paradox. *Journal of Happiness Studies*, 23(2), 377–389. <https://doi.org/10.1007/s10902-021-00402-4>
- Sterchele, P., Brandes, J., Heilig, J., Wrede, D., Kost, C., Schlegl, T., Bett, A., & Henning, H.-M. (2020). *Studie: Wege zu einem klimaneutralen Energiesystem: Die deutsche Energiewende im Kontext gesellschaftlicher Verhaltensweisen*. Freiburg. Fraunhofer ISE. <https://www.ise.fraunhofer.de/de/veroeffentlichungen/studien/wege-zu-einem-klimaneutralen-energiesystem.html>
- Thomas, S., Brischke, L.-A., Thema, J., & Kopatz, M. (2015). Energy sufficiency policy: an evolution of energy efficiency policy or radically new approaches? In *ECEEE Summer Study (pp. 59-70)*. Toulon: ECEEE. <https://nbn-resolving.org/urn:nbn:de:bsz:wup4-opus-59222>
- Toulouse, E., Gorge, H., Le Dû, M., & Semal, L. (2017). Stimulating energy sufficiency: barriers and opportunities. In *ECEEE Summer Study (pp. 59-70)*. Toulon: ECEEE.
- Tröger, J., & Reese, G. (2021). Talkin' bout a revolution: an expert interview study exploring barriers and keys to engender change towards societal sufficiency orientation. *Sustainability Science*, 16(3), 827–840. <https://doi.org/10.1007/s11625-020-00871-1>
- Tröger, J., & Wullenkord, M. (2022). Was ist genug? Begründung, Potenziale und Empfehlungen für mehr Suffizienz(orientierung). [What is enough? Rationale, potentials and recommendations for more sufficiency (orientation).] *Psychosozial*, 45(2), 44–59. <https://doi.org/10.30820/0171-3434-2022-2-44>
- Tröger, J., Wullenkord, M. C., Barthels, C., & Steller, R. (2021). Can Reflective Diary-Writing Increase Sufficiency-Oriented Consumption? A Longitudinal Intervention Addressing the Role of Basic Psychological Needs, Subjective Well-Being, and Time Affluence. *Sustainability*, 13(9), 4885. <https://doi.org/10.3390/su13094885>
- Trutnevyte, E., Hirt, L. F., Bauer, N., Cherp, A., Hawkes, A., Edelenbosch, O. Y., Pedde, S., & van Vuuren, D. P. (2019). Societal Transformations in Models for Energy and Climate Policy: The Ambitious Next Step. *One Earth*, 1(4), 423–433. <https://doi.org/10.1016/j.oneear.2019.12.002>
- Tukker, A., & Jansen, B. (2006). Environmental Impacts of Products: A Detailed Review of Studies. *Journal of Industrial Ecology*, 10(3), 159–182. <https://doi.org/10.1162/jiec.2006.10.3.159>
- University of Leeds, ARUP, & C40 Cities. (2019). *The Future of Urban Consumption in a 1.5°C World*. <https://www.arup.com/perspectives/publications/research/section/the-future-of-urban-consumption-in-a-1-5c-world>



- Vadén, T., Lähde, V., Majava, A., Järvensivu, P., Toivanen, T., Hakala, E., & Eronen, J. T. (2020). Decoupling for ecological sustainability: A categorisation and review of research literature. *Environmental Science & Policy*, 112, 236–244. <https://doi.org/10.1016/j.envsci.2020.06.016>
- van Acker, V. (2017). Lifestyles and Life Choices. In J. Zhang (Ed.), *Life-Oriented Behavioral Research for Urban Policy* (pp. 79–96). Springer Japan. https://doi.org/10.1007/978-4-431-56472-0_3
- van den Berg, N. J., Hof, A. F., Akenji, L., Edelenbosch, O. Y., van Sluisveld, M. A., Timmer, V. J., & van Vuuren, D. P. (2019). Improved modelling of lifestyle changes in Integrated Assessment Models: Cross-disciplinary insights from methodologies and theories. *Energy Strategy Reviews*, 26, 100420. <https://doi.org/10.1016/j.esr.2019.100420>
- Veal, A. J. (1993). The concept of lifestyle: a review. *Leisure Studies*, 12(4), 233–252. <https://doi.org/10.1080/02614369300390231>
- Vita, G., Hertwich, E. G., Stadler, K., & Wood, R. (2019). Connecting global emissions to fundamental human needs and their satisfaction. *Environmental Research Letters*, 14(1), 14002. <https://doi.org/10.1088/1748-9326/aae6e0>
- Vita, G., Lundström, J. R., Hertwich, E. G., Quist, J., Ivanova, D., Stadler, K., & Wood, R. (2019). The Environmental Impact of Green Consumption and Sufficiency Lifestyles Scenarios in Europe: Connecting Local Sustainability Visions to Global Consequences. *Ecological Economics*, 164, 106322. <https://doi.org/10.1016/j.ecolecon.2019.05.002>
- Vogel, J., Steinberger, J. K., O'Neill, D. W., Lamb, W. F., & Krishnakumar, J. (2021). Socio-economic conditions for satisfying human needs at low energy use: An international analysis of social provisioning. *Global Environmental Change*, 69, 102287. <https://doi.org/10.1016/J.GLOENVCHA.2021.102287>
- Ward, J. D., Sutton, P. C., Werner, A. D., Costanza, R., Mohr, S. H., & Simmons, C. T. (2016). Is Decoupling GDP Growth from Environmental Impact Possible? *PloS One*, 11(10), e0164733. <https://doi.org/10.1371/journal.pone.0164733>
- Warde, A. (2005). Consumption and Theories of Practice. *Journal of Consumer Culture*, 5(2), 131–153. <https://doi.org/10.1177/1469540505053090>
- World Health Organization (1996). WHO-QOL-BREF: Introduction, Administration, Scoring and Generic Version of the Assessment. <https://www.who.int/tools/whoqol/whoqol-bref>
- Wullenkord, M. C. (2020). Climate change through the lens of self-determination theory: How considering basic psychological needs may bring environmental psychology forward. *Zeitschrift Umweltpsychologie*, 24(2), 110–129. <https://portal.research.lu.se/en/publications/climate-change-through-the-lens-of-self-determination-theory-how->
- Wullenkord, M. C., & Hamann, K. R. S. (2021). We Need to Change: Integrating Psychological Perspectives Into the Multilevel Perspective on Socio-Ecological Transformations. *Frontiers in Psychology*, 12, 655352. <https://doi.org/10.3389/fpsyg.2021.655352>
- Wullenkord, M. C., Tröger, J., Hamann, K. R. S., Loy, L. S., & Reese, G. (2021). Anxiety and climate change: a validation of the Climate Anxiety Scale in a German-speaking quota sample and an investigation of psychological correlates. *Climatic Change*, 168(3-4). <https://doi.org/10.1007/s10584-021-03234-6>
- Zell-Ziegler, C., Thema, J., Best, B., Wiese, F., Lage, J., Schmidt, A., Toulouse, E., & Stagl, S. (2021). Enough? The role of sufficiency in European energy and climate plans. *Energy Policy*, 157, 112483. <https://doi.org/10.1016/j.enpol.2021.112483>

