

# An Exploratory Study of the Concept of Ecological Sufficiency through the lens of Public Understanding of Science

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## Abstract:

An exponentially growing number of publications show that the concept of ecological sufficiency is receiving increasing attention and acceptance among academic and policy circles. Despite the increasing popularity and its promises to become an "antidote to the expansive modernity"(as noted by an interview participant), underlying knowledge and policy-making practices that constitute the sufficiency concept remain a topic for the STS field to explore. For example, what does "enough" or "excess" mean in different contexts, and what are the ways of knowing these "boundaries"? In addition, what are the embedded political and responsibility aspects described by the scholars in the field and the policies on the ground? This study builds on 12 semi-structured interviews asking these questions to scholars who authored some of the most recognised publications about this concept. In order to explore such epistemic dimensions of the Sufficiency concept, interviews have been analysed with a constructivist grounded theory approach, adopting Public Understanding of Science (Wynne, 1992) and Configuring Fields(Stirling, 2019a) as an analytical lens for discussion.

Study results suggest that the public uptake of the sufficiency concept is significantly hindered by some of the simplified and top-down rationales applied to socio-material questions. For the sufficiency movement to avoid settling into a lighter version of modernity, deeper reflections on the embedded politics of knowledge-making appear necessary.

By discussing these challenges, this study aims to initiate dialogue between STS and sufficiency scholarships by highlighting insights important to recognise for the wider movement of transformations.

## Introduction:

The ecological sufficiency concept is becoming increasingly popular in academic publications, policy documents, and public media. This rising popularity coincides with the increasing public and political pressure to tackle unprecedented environmental challenges such as climate change, pollution, shortage of resources and many other challenges of today's world. The sufficiency concept provides many opportunities to address justice aspects of sustainability transformations as it implies not only that the unsustainable impact of human society should be dramatically reduced but also that this transformation should be done in a way that as many people as possible should have access to sufficient services and resources. While the concept provides opportunities for questioning the unjust and unsustainable concentrations of consumption and production patterns that make up the social norms, the ways in which we would know about these patterns and formulate the questions of sufficiency still appear understudied. Although there is a significant emphasis on crucial values such as environmental and social justice within the sufficiency discourses, epistemic sources of knowing about these values are relevant. Delving into these knowledge-making characteristics is particularly important because the scholars who write about the sufficiency concept do not describe it only as a theoretical perspective but often also as a proposed policy tool. By studying the underlying epistemic sources of the discourse, this thesis aims to demonstrate and discuss the importance of deeper reflections on the politics of knowledge-making as a significant determinant for public uptake of scientific knowledge. Recognising these challenges provides opportunities for the future trajectories of how this movement and its sources of knowledge might evolve towards socially more negotiable and desirable directions. As these challenges are shared among the many academic fields or possibly even inherently related to an understanding of science, it is hoped that this analysis provides important insights for other concepts and policy tools that address similar socio-material transformation challenges.

The conventional understanding of science communication is often imagined one directionally from the source of knowledge (science) towards its audience (public). A well-established branch of Science, Technology and Society studies challenges this normative understanding. Notably, Brian Wynne's (1992) seminal account, "Misunderstood Misunderstanding: Social Identities and Public Uptake of Science", provides essential insights into the complex interplay between the mode of scientific knowledge production and its public uptake. Wynne (1992) argues that this relationship is influenced by scientists' prescriptions of social identities and institutional and cognitive commitments. Reflexive recognition of its conditionality and a more pluralistic understanding of different forms of knowledge-making are discussed

as crucial determinants of how scientific knowledge interacts with its audience and other stakeholders. As the pressure on politicians and scientists to tackle global environmental challenges gradually increases and the different types of expertise are negotiated within these discourses, seeking the clues of this complex interplay within the cultural domain creates significant inroads for improving the social contract for institutional science.

Configuring fields approach (Stirling, 2019a) likewise provides essential insights into the embedded politics of knowledge-making and how some well-intended attempts to tackle such remarkable social and environmental challenges might miss the point. Significant reflexivity needs to be put in to recognise that the problematic power concentrations of late modernity exist and operate in multiple sites. Stirling (2019a) suggests that the insufficient recognition of the ontological parallax might lead the analyst to adopt a top-down “eagle-eye” position to such complex and connected problems in a way that appropriates the privileged position of the problematic incumbent structures. Recognising these problematic power concentrations that accumulated parallel with colonial modernity is necessary for the meaningful transformations intended by these academic accounts. Stirling (2019a) proposes a politically more grounded “warm eye view” that avoids looking at such socio-material problems from a greater ontological distance, which allows the analyst not only to pay attention to the scales or points that are connected to a specific place and time but also to see the topology of the concentrated power and its embeddedness within the described problem, so that fully addressing the intended change is possible.

Both of these approaches are useful for further scrutinising the knowledge-making resources of the sufficiency concept and hopefully help scholars address some of the challenges that hinder its wider acceptance among different social groups.

Sufficiency scholars described the public uptake of the sufficiency concept as a challenge. This thesis introduces these research questions to guide this inquiry:

- What are the possible reasons why scholars describe public uptake of the concept of ecological sufficiency as a challenge?
- What kind of knowledge-making practices contribute to these challenges' emergence?

Sub Questions:

- What are the ways in which we know about sufficiency in our lives beyond individual concerns, according to sufficiency scholars?
- What are the embedded politics of knowledge-making sufficiency scholars are subscribing to?

The interview results suggest that the traces of modern knowledge-making practices and simplifications about the socio-technical problems could be the reason for the complicated public uptake of the

sufficiency concept. Reflexivity on the political purpose of the idea, and the political aspects of knowledge-making, could help the Sufficiency movement to avoid settling into a lighter version of modernity.

## An introduction to the Sufficiency Concept :

The term “Sufficiency” or ecological sufficiency became popular among policy and academic discourses over the last few decades. An exponentially growing number of publications focus on the term “sufficiency”. The diverse ways in which the term is gaining popularity as a value, a management principle, a distributive justice determinant, a consumption reduction method, a historical lens, an economics framework or a climate change mitigation strategy is worth celebrating. As much as the plural characteristic of the movement around sufficiency is worth celebrating, it is also essential to recognise that no single definition or framework explicitly captures all the dimensions and characteristics of the concept and the social movement around it. Therefore, it appears necessary to see diverging framings and definitions documented in these two comprehensive systematic literature reviews, Jungell-Michelsson & Heikkurinen (2022) and Sandberg (2021). Sandberg (2021) groups different sufficiency strategies under topics like mobility, nutrition or housing, while Jungell-Michelsson & Heikkurinen (2022) look at different stances of economics.

## Early Appearances of the word sufficiency;

Tracing the etymological roots of the word sufficiency reveals how it evolved via different words and meanings throughout history. *Suffisant*, *enogh*, *plentee* in Middle English, *soufisant*, *foisonable* in Medieval French, and *sufficiens* and *satis* in Latin appears in mediaval records Skoda (2019). Similarly, the Greek word *sôphrosunè* and the Latin word *sobrietas* are considered the early ancestors of sufficiency (Cézard and Mourad 2019, as cited in IPCC 2023; 957). Skoda (2019) notes that the early usage of the word indicated a religious virtue in early modern England. During the Reformation, Protestant writers interpreted the earlier mentions of the word in a sense of fair distribution of wealth so that everyone could have enough. Following widespread prosperity and the growth of commerce and trade during the late thirteenth century, excess became a topic of concern. During these early years of emerging capitalism and rapid urban development, the term evolved from being deprived or excessive and shifted towards moderation (Skoda, 2019).

## Philosopher King’s Sufficiency;

A more recent past-century appearance of the word happens in Thailand through the concept of Sufficiency Economy Philosophy, articulated by Thai King Bhumibol Adulyadej in the 1970s (*Thailand Human Development Report*, 1999). Although contemporary sufficiency scholars often do not refer to the Thai King's sufficiency concept, a surface-level examination of "Sufficiency Economy Philosophy" (SEP) indicates some similarities in the sense of prioritising essential goods and services for all citizens, at least in the King's words. King Bhumibol Adulyadej observed the economic and material hardships of the rural population while touring the country after he inherited the throne in 1947 and later formulated the ideas of SEP in a speech at Kasetsart University in 1974. The idea appears as a development alternative to prioritising the well-being of the rural population over the globalising market and innovation-driven development ideas (*Thailand Human Development Report*, 1999).

Escalating the Asian Financial Crisis 1997 put the King's idea of sufficiency at the forefront of the national policy.

*"Recently, so many projects have been implemented, so many factories have been built, that it was thought Thailand would become a little tiger, and then a big tiger. People were crazy about becoming a tiger... Being a tiger is not important. The important thing for us is to have a sufficient economy. A sufficient economy means to have enough to support ourselves... It doesn't have to be complete, not even half, perhaps just a quarter, then we can survive... Those who like modern economics may not appreciate this. But we have to take a careful step backwards. (Dusit Palace, 4 December 1997)". (Thailand Human Development Report, 1999)*

King Bhumibol grew up and studied political science in Switzerland till his succession to the throne. He was also known for his interest in European culture, from music to literature and philosophy (Promchertchoo, 2016). In his biography, the King reveals the inspiration behind the Sufficiency concept was Schumacher's influential book "Small is Beautiful" (Handley, 2006). In his influential work "Small is Beautiful", which became a bestseller amidst the oil crisis caused by the Arab-Israeli conflict in the 70s, Schumacher (1975) provides an impressive critique of the economic theories of that time. Departing from the metaphysical shortcomings of modern knowledge-making tradition, he argues that modern 70s societies are highly fixated on endless growth and material wealth and lack a sense of societal and environmental well-being and justice. Criticising the economic theories of the time, Schumacher advocates and formulates a "Buddhist Economy" that puts social livelihood as an overarching value compared to financial profit. In his biography, King Bhumibol states that the idea of Buddhist Economics inspired him in his formulation of the Sufficiency Economy; he also initiated the relevant chapter of the book to be translated into Thai (Handley, 2006). In 2006, a military junta took over the government. It claimed that the current government was not following the King's formulation of the Sufficiency Economy Philosophy and declared a return to the original concept (Crispin, 2006).

## Distributive Justice

Sufficiency as a keyword holds importance in another highly relevant discourse to the emerging eco-sufficiency concept. Sufficiency has been advocated as one of the main principles of distributive justice in political philosophy and ethics in a broader sense (Casal, 2007). Distributive justice is concerned with the fair distribution of opportunities, benefits, burdens and resources as a consequence of an individual or collective action based on political decisions (Shields, 2020). Scholars writing about distributive justice often hold different positions favouring various factors, such as equality and priority as determinants of fairness. Sufficiency appears as an emerging parameter within these discourses and is often referred to as Sufficientarianism (Casal, 2007). In “Equality as a Moral Ideal”, Harry Frankfurt argues that the moral concern for distributive justice is not that everyone should have *equal* resources but that everyone should have at least *enough*. Moreover, when everyone has enough, other distributive justice factors, such as equality and priority, stop being a moral concern (Frankfurt, 1987). These two theses have become anchor points for future discussions about distributive justice and sufficientarian ethics.

A significant criticism elaborating on the negative thesis (if everyone has enough, equality and priority stop being a moral concern) highlighted that sufficientarian doctrine has focused solely on a singular threshold as *enough* is being mute to injustices caused by extreme accumulation of resources or burdens. Departing from this criticism, scholars attempted to define a more pluralistic version of sufficiency by considering not only one threshold as enough but also adding an upper threshold that corresponds to a level of contentment and subjective well-being (Casal, 2007; Shields, 2020; Huseby, 2020).

Moreover, recognising that a distributive justice approach solely relying on sufficientarian principles is complex to please, there have been attempts to further pluralise sufficientarianism by combining it with other distributive justice principles like equality and priority (Shields, 2020). For example, Roemer (2004) argues that an attractive ethics of distribution should be pluralistic and eclectic in a sense that does not claim superiority over others (Shields, 2020).

The debates about how the resources, burdens and opportunities should be distributed did not only concern the political philosophers. The literature shows that there have been attempts to link these ethical and political arguments to the discussions around the ecological sufficiency concept. For example, Laura Spengler attempts to connect these two seemingly separate debates by examining a multi-threshold sufficientarianism within sustainability and consumption (Spengler, 2016). Spengler (2016) does this by subscribing to an idea of a lower threshold that relates to a fair distribution of



resources and opportunities as a base while imagining an upper threshold related to environmental “limits” as a ceiling. Calling these thresholds as sufficiency minimum and maximum, Laura Spengler also proposes distinguishing these thresholds as scales. While sufficiency as minimum implies that everyone should have enough on an individual level, sufficiency as maximum relates to the cumulative level of excess (i.e. total emission of harmful substances). Therefore, this logic subscribes to an environmental ceiling as an upper threshold but does not elaborate on whether a certain individual(s) occupying a higher portion of the “limit” is not considered problematic. Another application of distributional justice sufficientarianism to ecological problems is Casal (2012), who proposes a fiscal policy to address climate change. While these two accounts aim to unify distributive justice sufficiency and ecological sufficiency, Kanschik (2016) argues that these two debates should remain separate due to the incompatibilities of their reasoning.

Perhaps some of the very problematic aspects of such arguments are that they often start with an assumption that some political person, institute, or organisation in power is in a position to distribute such “entities” like ecological limits or justice through logic. However, questioning the assumption that political power or incumbent force controls such distribution complicates this narrative. Are we living in a world where justice is distributed? By whom and how? Is there an Incumbent power that uses this knowledge and means to distribute burdens or benefits accumulated in a way that can be controlled? The distributive justice accounts of sufficiency that try to apply this logic to environmental problems tend to oversee the uncertain and complex dynamics of social life. Not fully acknowledging the democratic uncertain struggles and social movements that are not easy to fully formulate and control, sometimes changing directions yet unifying when the time is right, makes such accounts of sufficiency underpin the notions of control significantly. When such underpinnings of control are questioned, one would recognise that the world is not “made”; it is not under control and fairness, environmental flourishing, and resources are not only a distribution problem. Perhaps this notion becomes even more problematic when the distribution is about the burdens of environmental harm or suitability to use natural resources. Such logic highly undermines other values regarding a different relationship between other beings. Perhaps our understanding of essential questions about the diverse interactions between humans, other beings, and their environment, including living and non-living entities, should go beyond the distributional understandings to avoid settling into a standardised and straightforward understanding of society in a post-human sense.

## Diverse definitions;

“Sufficiency policies are a set of measures and daily practices that avoid the demand for energy, materials, land and water while delivering human well-being for all within planetary boundaries.”(IPCC,

2023, p.957). 6th assessment report mentions the term more than 230 times. It considers sufficiency one of the key policy strategies for mitigating climate change, especially in the chapter focusing on buildings. The report evaluates sufficiency within a model called SER (Sufficiency, Efficiency, Renewables) by referring to a framework developed in the late 90s by a French NGO called Negawatt. Fischer et al. (2013) define it as the modification of consumption patterns that help to respect the Earth's ecological boundaries while aspects of consumer benefit change. As one of the interview participants articulated, "I see the concept 'sufficiency' as an antidote to the expansive modernity. Sufficiency runs counter to the imperative of escalation in speed, distance, and volume in goods and services ruling (post)industrial societies. It promotes the overall aim of living well within ecological and social limits, rejecting an unduly technical and economic optimism."

Sufficiency also appears as one of the critical pillars of "sustainable development" in an earlier publication. Departing from the environmental concerns discussed in the UN Earth Summit (also called Rio Summit), Huber (2000) articulates the three pillars of sustainability transformation: sufficiency, efficiency, and consistency. Huber's analysis departs from an industrial ecology approach. It discusses the limitations and advantages of these three approaches by comparing the socio-material harmony with the ecological processes (consistency), aiming at resource efficiency by utilising technological advance (efficiency) and reducing and limiting consumption through renunciation and frugality (sufficiency)(Huber, 2000). Huber utilises an IPAT formula, briefly shown below:  $\text{Ecological Impact} = \text{Population} \times \text{Affluence} \times \text{Technology}$ . As one of the early articulations of sufficiency, similar formulations under these three sustainability strategies appeared in many other publications.

In one of the early publications called "The Logic of Sufficiency", Thomas Princen argues that "seeking enough when more is possible is both intuitive and rational - personally, organizationally and ecologically. And under global ecological constraint, it is ethical" (Princen, 2005). It is often considered one of the central publications that discusses the characteristics of sufficiency not only as an individual value but as a social organisation principle. Princen also recognises that the question of enough is highly value-laden and ethics-induced when considered from a limited resources perspective. Princen argues that defining a universal understanding of sufficiency is impossible, but developing a philosophical habit of questioning enoughness for each context and socio-technical situation is highly desirable(Princen, 2005).

Princen articulates the concept using relatively easy-to-grasp logic. Perhaps it is easier for an individual to understand when something is too much. For example, after eating a certain amount of food, one would not feel well anymore, or a specific physical activity might cause pain when it has done too much. Princen is broadening this simple logic and sufficiency value into an organisational principle. How can sufficiency as an idea, sensible and intuitive from an individual perspective, become a management

principle? Princen (2005) builds arguments around empirical examples, such as communities prioritising well-being and a more harmonical mode of living over development, expansion and economic growth.

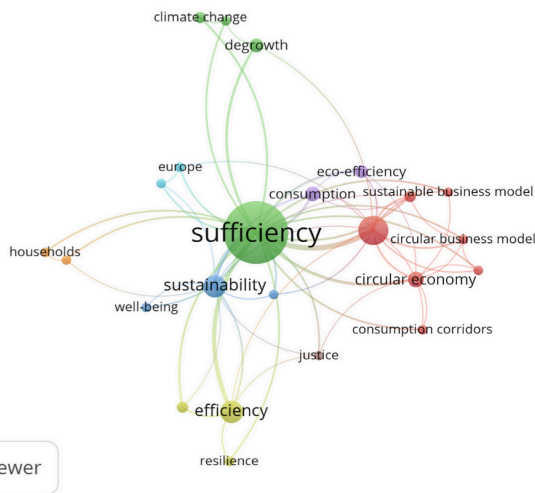
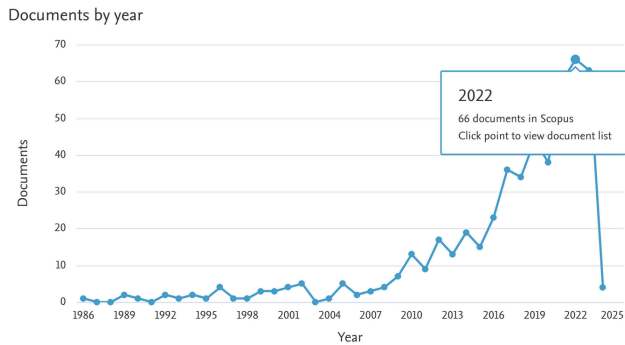
## It is becoming popular

Sufficiency as a keyword (mainly known as eco-sufficiency) has recently become increasingly popular in academic and policy discourses. Some recent developments that put the ecological sufficiency concept on public attention should give an idea about how the theoretical descriptions of sufficiency enter the public domain. One of the most influential ones was the IPCC 6th assessment report dedicated considerable space to discussing sufficiency-oriented measures for mitigation measures. Compared to the previous IPCC report (IPCC, 2014), there is a significant increase in the mention of the word sufficiency. An exciting change is that the fifth assessment report often uses sufficiency in the lower threshold, providing at least enough energy and resources to avoid deprivation. The sixth assessment report mentions the word more than 200 times and almost always refers to sufficiency.

A non-governmental think tank from France called the Association Négawatt is one of the critical actors developing and promoting the sufficiency concept and is also involved in academic solid and political cooperation with other actors in the field. The association also inventories the sufficiency, efficiency, and renewables framework the IPCC refers to in the latest report.

A brief exact-keyword search shows the concept's increasing popularity in many academic publications. A bibliometric analysis focusing on keyword co-occurrence patterns can demonstrate that some other keywords appeared next to sufficiency.

## Getting popular



A peak of the public appearance of the sufficiency concept happened in France. Macron’s government announced a “National Sufficiency Plan” in July 2022 to deal with the risk of energy shortage in connection with the war in Ukraine, anticipating a scenario in which Russia would stop supplying gas to the rest of Europe. One of the critical clusters of measures articulated by the government spokesperson was addressing civil society and involved recommendations such as turning off electric appliances whenever they are not used, reducing the room temperature and heating, avoiding peak hours for using electric appliances and obtaining programmable thermostats (*Service-Public.Fr*, 2022). Although the National Sufficiency Plan was communicated as measures intended to tackle both climate change and a potential energy crisis due to the war, an IPCC scholar and sufficiency advocate, Yamina Saheb, criticised the government policy by stating that the policies did not involve any long-term vision of transformations but only utilised the concept to tackle the acute energy crises and puts the burden of sufficiency on solely individual households (Saheb, 2023). Gable (2022), in a *Le Monde* article, compared the National Sufficiency Plan with the measures taken in the 70s by Pompidou’s government to mitigate another energy crisis caused by the oil crisis. Many interview participants referred to the National Sufficiency Plan of the French government as a positive sign that the eco-sufficiency concept has become acceptable to talk about even within the top policy circles. However, some participants also criticised the superficial usage of the word and its utilitarian focus within the policy.

French National Sufficiency Plan was one of many incidents that gained public attention. Also, Irish President Michael D Higgins mentioned the word sufficiency in a speech that was themed to criticise the neoliberal focus on economic growth (Leahy, 2023). Additionally, sufficiency was one of the main conference tracks of the World Resources Forum conference (WRF, 2023). A group of scholars built a “European Sufficiency Policy Database” database by gathering various policy approaches. It grouped them based on their time impact (long, short, mid), sector (transport, land use, building and similar), and policy instrument type (taxation, incentivising and similar)(Best et al., 2022). Another database gathered several businesses that apply sufficiency measures and pointed out examples of transformations within business norms (Niessen & Bocken, 2022). Scholars from various institutes presented sufficiency-oriented measures at a COP28 side-event online(COP28, 2023).

All these appearances, conference tracks, calls for policies, databases, public speeches, and increasing publications show a growing momentum around the concept being defined and developed as sufficiency or eco-sufficiency. As much as the direct definition and policy implications of the sufficiency concept do not appear to be concrete, making sense of the movement, mainly answering questions such as why the movement started gaining momentum dramatically, what the implications for the policy-makers, researchers and citizens, what are the future directions that the movement would go does not appear easy to answer at first glance (or even after looking at these publications and public appearances)

## Arguments being used

It is helpful to mention some of the popular arguments or other sources of knowledge-making that scholars put forward to understand the epistemic underpinnings of the concept on a deeper level. For example, most of the literature on Sufficiency appears to have a tone of advocacy. Often, the positioning of the authors describes what sufficiency is and what it or does not mean. Then, they often include arguments about why sufficiency measures are necessary and crucial. It is essential to recognise that scholars dedicate significant space to advocating for and calling for more sufficiency-oriented lifestyles and policies. Some of the popular arguments being used to advocate for sufficiency measures are listed below.

Scholars claim that energy efficiency or ecological efficiency-based policies are prone to rebound effects, increasing material and energy consumption as a result, even though the intention is to reduce them(Toulouse, 2015). Scholars often claim that sufficiency, frugality, and downshifting can help avoid such rebound effects and could be a necessary combination of efficiency-oriented approaches. However,

studies have also shown that the sufficiency approach might be prone to rebound effects too (Sorrell et al., 2020).

Limited resources, climate change, environmental depletion, and social injustices within the existing sustainability approaches are often the arguments scholars articulate to state why sufficient measures could be a helpful complement to the existing policy mixes.

### How the politics and agency are described;

For further discussion, it is helpful to note how scholars describe political agencies for applying sufficiency measures. Almost all scholars recognise that sufficiency is inherently value-laden and politically loaded. Considering that the interpretative flexibility of the concept is massive, there are also various approaches within the academic discourse about who should initiate the sufficiency measures, whether they should be voluntary or enforced by law, what are the businesses' roles in this, other political actors such as grassroots movements, economists etc. Fuchs et al.(2016) discuss how some sustainable consumption and production accounts oversee the role of power and agency in their formulations of socio-material change. Scholars claim that the intended social transformation with reduced consumption is not likely to be accomplished solely based on more data, more knowledge, better modelling or less controversial scientific knowledge but requires a change of power dynamics through collective action. The authors argue that not acknowledging the role different forms of power play in these transformations could inhibit the intended transformations instead of enabling them.

Similarly, Princen (2022) argues that sufficiency as a social organisation principle directly contradicts the idea of the modern state, which focuses on intrinsic expansion and growth. Considering the complexity and uncertainties of social movement, the effort should not be put into controlling or predicting such processes but further understanding the relational nature of the society, kinship and cultural movements. Furthermore, simplified formulations of sufficiency that do not consider structures, such as states where significant power accumulates, would not be deep in their understanding of social change.

Perhaps a different political approach, Spengler (2018) envisions sufficiency policies in a much more top-down manner. To enforce sufficiency policies, Spengler (2018) searches for political and moral justifications for interventions. Referring to the harm principle articulated by John Stuart Mill, political power could justify a controlling interference on lifestyle if the cumulative and collective consequences of a current practice harm society. Based on this logic, Spengler (2018) argues that sufficiency policies could imply absolute reductions in consumption patterns by reducing the unknown and complexity of scientific knowledge that does not give space for disagreements. For example, drawing a causal

connection between the “environmental carrying capacity” and the consumption patterns would allow policies to forbid certain things or create an enforced budget for resource use or “nudge”. Even though Spengler (2018) argues that the responsibility to realise sufficiency as a value within our lives should not be solely put on individuals, Spengler’s imaginary of collective action heavily relies on a central power and social control. Other aspects, such as social movements, care, cultural change, and different political actions, do not appear as valid sources of change agents.

Furthermore, most accounts describe agency and political aspects of sufficiency policies that do not include the power of knowledge in their accounts deep enough. Most accounts consider the political agency of knowledge-making as “truth speaks to power”. However, a common STS-induced approach towards scientific knowledge-making goes further in studying the embedded politics of knowledge not only as “power of knowledge” but “power within knowledge” or “power as knowledge”. Such dimensions of knowledge-making that perhaps can be called “political epistemology” appear to have not been acknowledged enough in the literature. What are the moral and political implications of the question being asked are often not well-reflected. For example, even though many accounts of sufficiency claim that putting responsibility on individuals should be avoided, success criteria are still formulated and measured as a change in individuals’ habits that are supposed to reduce consumption. However, more complex patterns of consumption and production and how scientific knowledge contributes to such patterns emerging in the first place are often not included in the problem statements. For example, many accounts mention that mobility policies should prioritise bicycle mode of mobility over automobiles; however, what kinds of political power influenced and infrastructuralized car-based mobility through the construction of highways, streets and oil refineries are often not included in the problem statements. Such deeper understandings of political power over socio-material questions are necessary to bring justice to such complex problems. Ways. A more comprehensive understanding of individual and collective responsibility appears necessary for the imaginaries of social transformations to engage with the social and political agency in fairer ways. Avoiding the simple formulations of agency on individuals would not suffice, but the political positionality of knowledge-making practices should be scrutinised. The angle at which we look at these problems is perhaps not wide enough.

## Theoretical Lens:

### Public Understanding of Science:

Brian Wynne’s seminal account, “Misunderstood Misunderstanding: Social Identities and Public Uptake of Science”, has significantly influenced the STS debates around public engagement within/with science. Against the backdrop of the post-Chornobyl scientific controversies concerning hill farming in Northern England, Wynne demonstrates how scientific expertise, with its institutional commitments and control as

an overarching value in its rationale, perceived and deployed problematic understandings of the social relationships that threatened provisional identities of the hill farmers. This scientific expertise and its understanding of society suffering from the lack of reflexivity significantly influenced how the controversy evolved around this case. This rationale was a significant factor in the public reaction towards scientific expertise becoming a threat to the social identities of the community (Wynne, 1992).

Wynne recognised the interaction between scientific and lay knowledge within a cultural domain by focusing on how scientific knowledge has its own social and cultural prescriptions in its very structure. Departing from how scientific expertise perceives social relationships within different communities, Wynne's diagnosis of challenges around public uptake of scientific knowledge focuses on how science understands society. A reflexive look at its assumptions about society is necessary for a healthier uptake of scientific knowledge and recognition of its legitimacy. However, scientific rational prioritising control as an overcharging value often cannot fully grasp the provisional, conflicting, yet coexisting social relationships that make up social identities due to the simplifications made (Wynne, 1992).

As the discourses around public uptake of science suggested more public participation as a potential solution to such challenges, Wynne made several other contributions to the discourses around the public legitimacy of scientific knowledge. In this account, he criticised how the efforts to involve public participation without sufficient reflexivity in scientific rationale sound like "hitting the notes but missing the music" (Wynne, 2006). Wynne argues that the conventional literature on public participation to increase legitimacy does not fully acknowledge how institutional science still performs its imagined publics in normative ways and instrumentalises a relationship that should be based on trust. He argues that modern scientific knowledge-making culture prioritises instrumentalism and control as critical points in its understanding of society, and this way of understanding is one reason for the rather tricky relationship and uptake. He also formulates different ways in which scientific rationale is unable to understand the public on dimensions such as cognitive deficit.

Wynne (2010) brings attention to the discourses around social and environmental challenges that extend beyond the local communities and become challenging globally. In this account, he demonstrates the scientific rationales that study massive phenomena such as climate change, which threatens communities at large. Scientific understanding and communication of such massive environmental and social concerns are some of the biggest challenges of today's modern world. Understanding the causality and effect of climate change requires a diverse range of expertise and interactions between various forms of knowing, living and policy making. For example, as an essential source of institutionalised scientific knowledge, the IPCC played an important role in framing climate change as a global phenomenon. It shaped the understanding of climate change with the 1.5 vs 2.0-degree goals and



played a significant role in formulating various policy-relevant knowledge that constituted the government's reaction to it.

Wynne (2010) claims that the IPCC might even be understating climate change's unpredictable and uncertain consequences due to its specific perception of social response to scientific claims. While the modelling and predictions about the long-term effects of climate change appear challenging, the IPCC attempts to formulate climate change with a level of certainty, assuming that it is necessary for the legitimacy of political action. By assuming that certainty is a prerequisite for the non-expert citizens' reaction to care, they pose a picture of the public that only takes action when science communication formulates a danger with certain predictability and precision;

*“In this situation, we can see the hint of a perversely self-fulfilling political assertion that ‘we cannot take the political risk of radical positive policy actions, because citizens will not accept it’. This assertion only confirms and consolidates its premise that citizens act instrumentally self-interestedly. The risks involved in breaking out of this frame seem insurmountable. They require a radically new political will fuelled not by threat and urgent necessity but by positive commitment to building collective agency and care and material restraint and modesty, founded on just those realities that exist in human societies. Without this commitment, we seem left with only technical fixes and superfixes as imagined options for response to ‘the climate challenge’, while we continue to be encouraged as passive citizens just to consume, even if ‘consuming green low-carbon’, in the collective all-consuming frenzy, even climate frenzy, which is contemporary global capitalism.” (Wynne, 2010)*

Apart from these cognitive reflection aspects, several other accounts emphasise political dimensions of public participation in science and policy. Durrant's (2010) account discusses different political stances towards public participation in science policy. Durrant's comparative account of two normative stances toward public participation is significant for articulating different political meanings of public participation (Durrant, 2010). Participation for its own normative goal corresponds more to the representative understanding of democracy, whereas participation balanced with expertise corresponds more to the deliberative democracy. Durrant's account is crucial for recognising how different approaches within STS with different political meanings of participation offer ways of engaging with science and policy. Linking STS discourses on public participation with political philosophy is essential for a politically grounded reflection on STS engagement with socio-technical discourses.

Brown (2015) provides a comprehensive overview of the engagement between science and technology studies and political philosophy in “Politicising Science: Conceptions of Politics in Science and Technology Studies”. STS scholars studied the political aspects of science and technology in many

publications. However, Brown (2015) suggests that the focus was still on science and technology more than the philosophy of politics. Aiming to bridge this imbalance by discussing and comparing several strands of literature, Brown (2015) provides a comprehensive overview of what science as a site of “politics” and as an adjective “political” might entail. He argues that different perceptions of politics might offer different directions. Therefore, questioning what is political and what is not becomes a political question. Additionally, when it is argued that science is political, it should be noted that the sociotechnical practices, including scientific knowledge-making practices, might have political origins and significant impacts without necessarily being a mode, site or object of politics (Brown, 2015). This broadened understanding of the politics of scientific knowledge opens up possibilities for deeper engagement and potential reflections.

While the modern tradition of scientific expertise treats science as a nonpolitical domain, abundant studies of STS challenged this assumption by demonstrating the political aspects of knowledge-making on several accounts. Today, it is safer to assume that many scientists reflect on the political aspects of their discipline to some degree. However, calling “everything is political” depolites the discourse. Then, the question becomes as to what degree science is political or political. Is there a boundary? If everything is political already, is there a need for further STS critique to demonstrate the political aspects of scientific knowledge? However, Brown (2015) suggests that revisiting Latour’s (1998) slogan for a more nuanced approach, “Science is not politics. It is politics by other means”. Bringing attention to the different recognitions of science as a politics of science, Brown (2015) further discusses the various STS accounts in their prescriptions to the different schools of political thought.

### Reflections on reflexivity:

As the politics of knowledge-making provides analytical entry points for the complex interplay between scientific knowledge and its public uptake, reflecting on these political dimensions and reflexivity, in general, appears as crucial determinants of its quality. Many accounts of public understanding of science research highlight the importance of reflexivity for a healthier relationship. While reflexivity is often embraced for its intrinsic value, similar to the politicisation of science, for a more nuanced understanding and implications, examining the limits, pitfalls, and dilemmas of reflexivity is a significant concern for understanding the complexities of how science interacts with policy-making and civil society.

Wynne (1992) argues that reflexivity is essential to a healthier relationship between different forms of knowledge. A lack of institutional reflexivity and self-awareness might cause a negative public response to the institutional forms of scientific knowledge and its translation into public policy and administration. The concern is not about the judgement of who is reflexive but the question of how deep the “reflexive recognition of its own conditionality” and ambivalence go in academic discourses. Scientists do reflect on

their assumptions and biases. However, Wynne (1992) argues that this reflexivity often comes in criticism or insecurity rather than an intrinsic appreciation of self-criticism. As scientific rationalities see ambivalence or uncertainty as an intellectual flaw, discussing the reflexivity dimensions publicly to the degree that goes deeper into the founding commitments and mentions its limitations and conditionality becomes a challenge.

Beck's seminal work "Risk Society: Towards a New Modernity" (1992) is considered one of the most influential publications that discuss reflexivity in connection to increased uncertainties that emerged within modern societies. Beck describes a concept called reflexive modernity. Compared to the traditional understandings of social risk and uncertainty, Beck argues that modern societies are increasingly intertwined with unexpected and unpredictable consequences caused by the growing complexities of scientific and technological change. In reflexive modernity, individuals and organisations are compelled to higher levels of reflexivity to question previously accepted assumptions and biases more and more. Such reflexivity is required in different aspects of social life, such as economics, culture, and politics. Reflexive modernisation also requires new forms of governance where top-down and traditional approaches must shift towards approaches that prioritise public participation, acceptance of uncertainty, modern democratic approaches to decision-making, and inclusivity. Recognition of reflexive modernity has many overarching implications for societies, such as an increased need for self-reflection, questioning the linear understanding of progress and development, and humility towards future uncertainties (Beck, 1992).

"A reflexive look at reflexivity in environmental sociology" builds on Beck's reflexive modernity and risk society concept. It discusses reflexivity as a critical dimension of governance, expertise, and lifestyle by incorporating scientific understandings of uncertainty, transparency and participation (Boström et al., 2017). Moreover, it also discusses the relevance of reflexivity for sustainability studies by asking questions such as: Is reflexivity a valuable concept for critically examining the existing sustainability research? How can reflexivity become an overarching buzzword to criticise researchers, policy-makers or practitioners? What qualities of reflexivity are necessary for environmental sociology accounts rather than just "more reflexivity"?

Moreover, it also discusses the individualisation of reflexivity by referring to the accounts of Beck (2009, 95) in sustainability discourse. The thesis reflexive individuals are described as individuals with a high sense of questioning their lifestyle choices regarding environmental and social harm. Several accounts criticised that since the reflexivity focusing on individuals is a risk for overseeing other forms of collective agency and responsibility. Summarising the different understandings and limits of reflexivity within environmental sociology (Boström et al., 2017) concludes with a suggestion for reflexive use of reflexivity. Therefore, putting the concept in context and being sensitive to its epistemic purpose is

essential. They suggest that reflexivity is a good starting point for further efforts of deliberation democratisation of scientific knowledge but should not be used as a closure point such as concluding judgement(Boström et al., 2017)

In “Science and Technology Studies on Trial”, Lynch and Cole demonstrate the challenges regarding the positionality of the STS field within the normative epistemic conditions by illustrating a court case. The field of STS often calls for interacting with the normative end epistemic dimensions of the science. However, not enough attention was given to the questions regarding what if STS is only to engage with the reflective analysis of the existing scientific discourses but also treated as a source of truth within the discourses themselves. Such imagination appears to take place in real life in this court hearing where an STS scholar is called to give an expert opinion on the legitimacy and credibility of another scientific field. The article further demonstrates the several challenges that become apparent when a field that is taking a deconstructive position towards scientific knowledge is expected to define, describe, and communicate its expert credibility and legitimacy under specific expectations, such as a court hearing. It becomes apparent that the interaction between the normative expectations of expertise (court) and a more reflexive and questioning approach towards knowledge-making (STS) poses several challenges and difficulties. Through such dilemmas, the authors demonstrate not only the empirical case of court, which puts an STS scholar in a position that poses difficult decisions, but also opens the field of STS’s role as an actor within the socio-political and scientific discourse(Lynch & Cole, 2005). It also demonstrates the limits of the reflexivity approach, where the success criteria of validity and credibility are set by actors with authoritative power outside of the field of expertise.

### Configuring Fields Approach:

Andy Stirling delves into existing analytical methods of socio-material transformations by discussing some of the challenges around the incumbent power regimes, including formulating problems and general change (Stirling, 2019a). In these mind-opening impressive accounts, “How deep is incumbency? A ‘configuring fields’ approach to redistributing and reorienting power in socio-material change” Stirling(2019a) demonstrates how these difficulties in recognising the role of incumbent forces might weaken the accomplishment of intended goals and reinforce these incumbent regimes instead of challenging it. Stirling proposes a novel “Configuring Fields” approach to tackle these analytical difficulties.

It is argued that the particular forms of stabilised incumbent forces played a significant role in the emergence of grand challenges such as poverty, environmental pollution, global inequalities, changing climate, nuclear risks, and ongoing wars (Stirling, 2019a). Despite decades of research aiming to address these problems, they persistently remain one of the highest political challenges of our times. To

tackle these difficulties, Stirling proposes various new strategies as part of the Configuring Fields Approach. First, he suggests that the ontological scope of the formulations should be as broad as possible, as the dynamics between socio-material formations and agency emerge in various forms (Stirling, 2019a). For example, suppose the sufficiency concept is applied to a housing-related policy. In that case, ontological elements of the formulation should not stay limited to the size of the apartment. However, they should be as comprehensive as possible, including many other dimensions, from history to culture, to norms in construction technology, and to the urban design paradigms, to incorporate how these problematic and unfair patterns emerged within the application site.

Arora and Stirling (2023) argue that this challenge is not well recognised in many sustainability accounts. Proposed responses to the grand challenges, such as environmental degradation and social justice, adopt a higher ontological distance that adopts the privileged viewpoint of the incumbent formations. The authors suggest that the political positionality of sustainability research often oversees the hegemonic and problematic concentrations and configurations of power that originate from centuries of violent colonial modernities. They argue that even the frameworks that formulate political incumbency in their accounts, such as multi-level perspective or strategic niche management, often need to incorporate coloniality of power within their conceptualisation efforts. Without such political reflections on how coloniality is embedded within the modern knowledge-making tradition, such accounts of sustainability transformations might perpetuate the existing and stabilised power regimes even if the intentions are challenging them (Arora & Stirling, 2023). To address these pitfalls, Stirling makes valuable suggestions that might inspire scholars to reflect on these collective challenges of knowledge-making within the late modernity knowledge landscapes.

First, the ontological scope should be as broad as possible (Stirling, 2019a). This is not an excessive list of actants and agencies, but the concern is environmental flourishing; the narrow focus on CO<sub>2</sub> emissions would not suffice; many other forms of agency, from knowledge-making to stabilised infrastructure, from social movements to the democratic struggles, should be incorporated in the picture. This is an important takeaway for the sustainability accounts that frame these problems as a single metric to measure and control in a reductionist manner.

Secondly, reflecting and recognising the ontological distance of the analyst to the observation site is crucial to avoid adopting a top-down view of the problems. Greater ontological distance might cause the particularities on the ground to look insignificant and the transformation trajectory neatly separated from the other pathways to the analyst. Stirling argues that some modern scientific knowledge-making traditions might depart from an ontologically neat separation between the observer and the observant (for example, an astrologist observing stars). However, beholding these elements of modern knowledge-making, even on topics involving human affairs, might complicate the observer's position.

The ontological separation between the observer and the observant is no longer neat. Today's grand challenges addressed in existing transformation studies focus on an observation site deeply amalgamated with cultural affairs. For example, the prevalent themes mentioned in sufficiency discourses, such as mobility, housing, nutrition, and clothing, are sites of cultural particularities that are difficult to decouple from the observer's self-identity. Therefore, human beings apprehend themselves in social studies—Giddens call this “double hermeneutic” (Giddens, 1984). The observer's convictions on the observation site are coloured with its understanding of self. This phenomenon is often described as ontological parallax and a popular theme often mentioned in studies focusing on the challenges of modernity. Recognition of this phenomenon within knowledge production that involves human affairs complicates the claimed precision and predictability of these existing transformation studies.

Another symptom of this top-down view is how political incumbency is formulated as a flat-surface axiomatic topology (Stirling, 2019a). Using various currencies from the GDP, distance of commute, kg of meat consumption, and size of apartments in m<sup>2</sup>, some of the transformation accounts use these currencies to create a dashboard that aims to optimise the gross impact of a particular social phenomenon in a simplified way. Within such demonstrations of problem statements and proposed dashboard-like formulations as a policy tool, some of the topological properties of these problematic socio-material patterns become very difficult to read. Even though the logical coherence of the reasoning is seemingly consistent, departing from a massively simplifying logic that discusses such complicated problems in an axiomatic manner would pose significant threats to the intended goals of change. The biggest problem within such rationales is the disproportionate emphasis on the scale of the problem while the topologies are not incorporated enough. For example, instead of focusing on the total amount of housing space existing in a place and trying to scale down the average apartment size per person, it might appear as a reasonable plan. However, the kinds of problematic accumulations of power in this picture would be rather difficult to grasp with this logic. What kinds of agencies caused bigger apartments to become a new norm? Or is there a group of people that owns an excessive amount of space for leisure while another group only has smaller apartments available? Alternatively, what are the roles of institutional knowledge that created a particular way of housing made from specific materials or norms? The change might not be substantial without acknowledging the deeply embedded topological structures of these socio-material problems (Stirling, 2019a).

Lack of reflections on the ontological scope and distance and the topological structures of incumbency could cause the analysts to formulate the transformations mentioned above in a way that looks predictable, controllable and neatly separated into categorical distinctions of various entities such as production, consumption, sufficiency, excess, deprivation, solution, problem. These assumptions of control based governance approaches can sustain them. Even though such neatly formulated categorical separations and transformation trajectories do not exist in the political realms of the “real world”, the

assumptions that it does might sustain the existing formations of privileged top-down views of these problems.

## Methods and Research Process:

At the beginning of the research, I was unfamiliar with the topic of sufficiency and the corresponding research fields to the degree that I did not know which research methods to choose or how to develop a concrete research question. For this reason, I did not try to follow a specific research method from the beginning; instead, I tried to explore different methods and observe if they helped me to understand the topic deeper or contributed to developing a different perspective. For this reason, I developed an exploratory approach that intuitively combines different methods and is more open to interpretative flexibility but allows greater space for learning rather than following epistemic consistency or seeking a conviction about what ecological sufficiency is or what it does. For this reason, I hope that the overall verbal tone of this thesis transfers this message as a continuation of a dialogue that started in my interviews but not a concluding remark about stabilised knowledge. In the following chapters, I will summarise the methods concerning the research process.

### Bibliometric analysis

My initial literature review posed challenges due to the abundance of different framings, topics and fields of applications. To overcome these challenges, I have conducted a bibliometric analysis to understand emerging patterns within the literature and capture a snapshot of the academic discourse. After briefly reviewing different approaches, I conducted a keyword co-occurrence analysis to visualise the most frequently used keywords next to the word “sufficiency” (Donthu et al., 2021). I have filtered publications that use the keyword “Sufficiency” in Scopus and excluded publications from different disciplines, such as medicine (such as vitamin D sufficiency). I experimented with additional keywords such as sustainability, innovation, policy, etc. I used the citation database Scopus.com to filter the publications and export them. I visualised this data using the software VOSviewer (Nees & Waltman, 2009). The result can be seen in the literature review section.

### Semi-structured interviews

Initial results of the bibliometric analysis followed my literature review, which helped to develop a provisional research question; “What are the production aspects of sufficiency?” the existing literature often stays limited to the questions around reducing consumption by addressing the consumption patterns of lifestyles. I initially wanted to test questions and topics that might address what sufficiency

means for producing things or the way things have been produced. From sourcing energy through different technologies to the artefacts that have been mass-produced, existing sufficiency literature did not address these dimensions related to the role of technology and innovation within the emergence or potentially in the solution of the described sustainability-related problems.

To develop these initial observations into a more concrete research question, I planned semi-structured interviews to ask these questions. Interview participants have been selected among the most frequently cited publications on sufficiency. A group of interview candidates rejected the invitations because their domain is mainly focused on consumption aspects of sufficiency.

I adopted the Constructivist Grounded Theory approach (Bryant & Charmaz, 2008). Constructivist Grounded Theory, as a flexible research method, allows researchers to obtain initial knowledge about a topic study and is an effective method to combine with interviews in an iterative way (Chun Tie et al., 2019). As my initial knowledge about the topic was limited, discussing and developing my initial observations with the interview participants iteratively allowed me to specify my focus. Through the interview process, my initial focus on the production aspects of the sufficiency concept shifted towards more epistemic dimensions of knowing about sufficiency as my conversations with the participants evolved in this direction organically. During this process, I also shared these initial thoughts with the following participants. Therefore, each interview had slightly different questions based on what I had learned from the previous one. Based on the feedback I received from my supervisor, I concentrated on the dialogue-making aspects of interviewing instead of seeing the dialogue solely as a source of information.

Interviews have been transcribed and analysed using MAXDQA Version 24 (VERBI Software, 2023). A mostly verbatim approach has been adopted for the transcription process to include pauses or allow a deeper reflection of the speaker's mode of feeling and thinking. For the direct quotations from the interviews, transcriptions have been edited to a more corrected version to reflect the thoughts of the interviewee more clearly. A first-level coding identified the common themes already existing in the sufficient literature. For example, sufficiency as a value or policy framework, relationship with efficiency, and businesses already had existing themes in mind, and first-level coding identified these in the interview transcripts. A second level of coding was applied to engage deeper with these themes and helped to break down these themes into different opinions, framings, disagreements, and exciting patterns. A third level of coding was applied to recognise these emerging patterns as interview results and became the titles of the interview results. Several hypotheses and supporting literature were tested during these coding processes. The coding, analysing and framing process was the longest and most challenging part of the research, as many conclusions could be made from the interview results.



However, none seem stable enough to give the research process the overarching theme or thesis statement.

For this reason, making a concrete decision about the overarching theories was challenging and required many iterations of literature review and analysis. As a grounded theory approach, I have put significant effort into not “polluting” the interview results with my existing observations or opinions but aimed at recognising themes and patterns that emerge from the interview transcripts in a grounded manner. Still, I have insecurities about the theories and results that emerged from my results, urging the reader to see them only as a part of ongoing dialogue rather than stabilised conclusions.

### Discourse Analysis:

During each phase of the research process, I have been following news, opinion articles, conference tracks, and policy documents about sufficiency. During the theorising phase of interview analysis, I made many iterations by going through multiple discourse materials to test the hypothesis under test. I also registered in multiple research networks, email, and social network groups such as Slack channels.

### Personal Reflections:

This project was part of my internship at the Fraunhofer Institute UMSICHT, a department interested in different sustainability concepts and their potential relationship to current sustainability practices within industrial ecology. The initial research framing and process have been designed per the institute’s interest in the topic’s relevance. As part of my internship process, I was interested in the topic of sufficiency and understanding and experiencing the research approach practised in my internship place for practical reasons. I decided to develop my thesis project on the same topic I studied in my internship. However, it became apparent during the interview that some epistemic practices, like the emerging questions about sufficiency, significantly differ between my study program and the place of internship. At this point, I started approaching my thesis topic from an entirely different perspective. The research question for my internship project stayed focused on the production aspects of the sufficiency concept. For my thesis, I decided to pursue more epistemic questions, such as the role of expertise or different kinds of political framings of scientific knowledge and social and moral challenges of knowledge-making in general. As the semi-structured interview process allows simultaneous divergence from the existing questionnaire, the first few interviews included questions about the production aspects of sufficiency, including my intuitive reactions and questions about the epistemic dimensions of sufficiency. After separating these two projects, I deliberated more about the questions involved in the interview process.

For example, I was actively involved in the epistemic questions I developed during the first interviews or in testing different hypotheses in the later phases.

In general, the design of both research projects was developed during the research process, not before or after. This makes me question the more linear and conventional forms of developing research design such as identifying a research gap within the literature, collecting data and filling in this knowledge gap. It felt like iterations of sense-making of the topic itself, together with questioning my research purpose and making decisions on its design simultaneously. It was more like a collective learning process involving dialogues with others rather than collecting data and arguing for closure on a certain conviction or opinion. Once I became more aware of the constantly evolving, non-linear and more circular nature of my research experience, I became more comfortable with the uncertainties of both research projects. For example, before each interview, I studied the literature my interview participants wrote more precisely and approached my interviews as a “data collection” exercise.

Nevertheless, as my reflections during the research projects directed me to different understandings, I focused more on the dialogue-making aspects of interviewing than the “data collection”, and I felt more comfortable with not fully knowing about the existing literature written by my interview participants. I observed that being more comfortable, present, and honest during the interviews allowed my conversations to go deeper and explore unexplored territories about my participants' personal experiences or opinions, which contributed significantly to my learning and research process. As I remember the first interviews as very nervous, insecure and more rigid in the process, I remember the later phases of interviews as something I look forward to, excited to share and exchange and cognitively very stimulating to be a guest to someone's world, even if it's virtually.

Another significant reflection I had during the research process was how my existing thoughts and opinions shaped the conversations significantly. For example, there is not really a category called “production aspects of sufficiency” in the literature. Even though the majority of the literature indeed focuses on reducing consumption, there is not really a categorical separation between production and consumption. While I was testing my initial hypothesis as production aspects, my formulation of the question itself potentially significantly influenced the answers of my interview participants. For example, some of the interview candidates rejected my invitation by stating that their expertise is limited to consumption aspects and they don't know anything about the production side of things. My reflection on this is that my criticism about the compartmentalised understanding of knowledge-making also applies to my practice, and I possibly exacerbated understanding through the way I formulated my questions. Not only the compartmentalised understanding of knowledge-making but almost all the challenges I identified about the political and epistemic dimensions of knowledge-making, the challenges of modernity, institutional commitments, and lack of understanding of ontological parallax. I eventually realised that all

these aspects that I identified as challenging or problematic apply to my practice of developing this thesis project and my way of thinking and knowing as well. Therefore, recognising this motivates me to be much more hesitant about every conviction or statement that this thesis seems to argue for. In the later phases of my project, I could think of these thoughts, arguments and results as only a minor part of an ongoing conversation rather than the final remarks or conclusion. Therefore, perhaps after a few more cycles of conversations, my or someone else's thoughts could change significantly, even in a contradictory direction. I believe leaving the open space for this way of seeing knowledge as a part of conversation allows researchers to balance their epistemic commitments to a logical consistency and coherence with a more humble version of understanding the world, society, and the often seemingly contradictory yet co-existing aspects of being human.

## Results:

### Some General Overarching points:

Empirical examples referred by the participants;

Many interviewees referred to similar real-life examples, such as the brand Patagonia, 15-minute cities, cycling lanes, second-hand clothing, avoiding air travel, meat consumption, and supporting repair initiatives. These examples do not offer entirely different measures or attitudes from the current sustainability discourses. However, the sufficiency concept or logic departs from a different way of thinking and questioning the existing social norms and modern life. The line of argumentation and reflection would follow a different style than other sustainability paradigms, such as circular economy or ecological efficiency. Even if the examples or measures suggested by the authors do not seem new to the sustainability discourses, the logic that puts the deliberate questioning of whether some habit or consumption habit is necessary or avoidable as a starting point seems to offer more questioning in comparison to the current sustainability discourses that tackle such complicated problems with simple measures such as tree planting or banning plastic straw.

Interview participants referred to some business practices that could reduce material consumption. For example, a participant referred to a manufacturer that owns the after-life responsibility of ship engines and generates one-third of its revenue from remanufacturing its products. Even though remanufacturing these engines would reduce the material necessity of their production process to some degree, the nature and the regular fuel consumption (diesel engines in this case) made the consumption reduction questionable. In another example, Xerox provides a service instead of solely selling copy machines and

takes responsibility for their machines' maintenance and replacement. Like the engine example, the regular paper consumption of copy machines was not considered enough in the picture. Likewise, interview participants referred to many business examples that reduce material consumption to some degree. However, the nature of their products and their dependencies on material consumption were not often fully addressed in the conversations.

Similarly, policy examples mentioned in the conversations addressed the unsustainable nature of the production and consumption norms to some degree. Still, they could not imagine a substantial change in social life. For example, one participant mentioned a city municipality that rolled back an outdated rule about including mandatory park places for new construction project plans. In other examples, prioritising refurbishment of old buildings instead of new projects prioritising the cycling lanes as a mode of mobility. Even though these examples indeed appear as deliberately questioning the consumption and production norms around these fields, their overall capacity to transform social life to a sufficient degree is questionable. Critically engaging with such examples, the STS scholar I interviewed seemed more doubtful of such practices. They mentioned that “the bike lanes are there so that the main roads can still belong to cars”. Likewise, some scholars were critical of the French government's National Sufficiency Plan as it lacked a long-term vision and tried to address an acute crisis.

#### Linguistic particularities of sufficiency,

Some remarks show how language played an important role in distinguishing sufficiency from other sustainability concepts such as ecological efficiency, consistency or circular economy. Interviewees also mentioned some parallels between these approaches or how they would relate to each other. How sufficiency and efficiency relate to each other and how they differ were mentioned in almost every interview;

*“The concept of sufficiency emerged as a response to the drive for efficiency. Since the Rio Conference 1992, the environmental discourse has been dominated by the call for resource efficiency, following the neoliberal era with its emphasis on private enterprises. Efficiency refers to a strategy of minimising the resource use for a given goal, consistency refers to a change in the quality of the resource flow to render it compatible with natural flows, and sufficiency refers to a transformation of the goals of resource use, complementing the two other strategies. While efficiency and consistency are about doing things right, sufficiency is about doing the right things.”*

While the expression “doing the right thing” vs “doing it right” was used by the innovation management scholar in a different context but still in connection to efficiency;

*“It’s more around two things; one is to ensure that the energy is used in the best possible way, and that means that you have to balance the concepts of efficiency and effectiveness. So, effectiveness is doing the right thing, and efficiency is doing things right. So, as you mentioned before, engineers normally get a task of efficiency. They very rarely get the task of effectiveness.”*

Another example was that many interviewees described sufficiency by referring to the inadequate and limited nature of efficiency-related measures. Sufficiency vs efficiency comparisons were one of the most frequented ways of describing sufficiency measures:

*“I mean, classically, when we talk about sustainability related issues, when we talk about things like energy, use of resources, we often focus on technological developments in these areas to increase efficiency and to increase energy efficiency, to increase resource efficiency. What we have seen is despite the significant technological developments over the past decades and also efficiency increases that we made the net effect of all of these developments has not led to increased sustainability. For example, a dramatic reduction in greenhouse gas emissions or dramatic reduction in resource use. It has probably slowed down emissions and resource use, but it really hasn’t reversed the trend, so efficiency obviously or the efficiency strategy through technological development can only take us so far towards sustainability.”*

While such types of arguments aim at differentiating and describing sufficiency by referring to efficiency, in two interviews, sufficiency measures were described as a type of efficiency that complicated the scholarly efforts to differentiate the concept from the others.

*“Well, if you use the account of sufficiency being some strategy to meet your needs with less resources and including using. You know, just let’s let’s leave it at that. Then you could say that production strategy on the production side could be meeting the same level of revenue by using less resources, which also would meet the definition of sufficiency.”*

*“Yeah, I think, well, one thing one thing I, of course, think is that where to draw the line between efficiency and sufficiency.”*

## Public understanding of sufficiency

Public perception of sufficiency was a central topic in almost every interview. Many articulated the public understanding and acceptance of sufficiency measures as a challenge for their impactful implementation. The comments below highlight the public resistance and pushback against the concept and show how the public's role in this debate is imagined in the eyes of academics. During the analysis of the interview results, it became more apparent that the public's role in the academic debate around sufficiency was often discussed as either rejection or acceptance. However, further engagement with the public in different forms did not appear in the conversations. Followup questions about the bottom-up approaches or how civil society can contribute to the formation of sufficiency knowledge and policy-making often remained unanswered by the interview participant, which indicates that even though the public uptake of the concept is seen as a challenge, scholars did not think about different ways of engaging with the public rather than solely seeking acceptance or avoiding resistance.

It is a hard-to-sell concept:

Public acceptance of sufficiency-related policy ideas is often met with strong resistance and pushbacks. Informants consider sufficiency as a necessary but “hard-to-sell” concept. A participant mentions that many individuals find the concept “unattractive” since they perceive it as a limitation rather than a positive lifestyle choice. Another one mentions a similar sentiment by pointing out that the more public attention the sufficiency concept receives, the higher the “resistance” will be because the concept sounds attractive only to a “minority” of the people. Another participant claims that one of the reasons why the sufficiency concept seems unappealing is that the concept contradicts the foundational principles of the existing economic system that influences the current consumption and production norms of today's societies. A participant with a governance affiliation mentions that they observe a strong opposition to reducing the use of cars and overall consumption. There is a societal division between different groups regarding environmentally unfriendly actions like car usage, meat consumption, and flying. The same participant goes even further to describe the nature of resistance and concludes that the public appearance of the sufficiency policies is not a “good” strategy due to the strong resistance around the mentioned topics:

*“Well, I think there are a lot a lot of risks around this concept and I, I'm not really convinced that it's good that the the term is gaining significance in in in policy because I think by telling people that they have to consume less and so on, It's not a really attractive concept to most people, it's an attractive concept to a minority of maybe 10% of population at maximum. (...) So the more you talk about this in the public discussion, the higher the resistance may become.”*

Sufficiency is getting popular in policy circles :

Participants often highlighted that despite the difficulty of public relations regarding the sufficiency concept, popularity and acceptance around policy and academic circles are significantly increasing. A participant mentioned that sufficiency is becoming more “acceptable to talk about in mainstream politics”, which was not the case before. Politicians often considered sufficiency or other post-growth-related topics a “taboo” subject and a difficult ground. However, policymakers are becoming more aware of the importance of such measures. Another participant confirms this sentiment by mentioning that previously, people would shy away from sufficiency due to its potentially contested nature or lack of knowledge and awareness around this term. However, nowadays, it has become more acceptable to talk about. They also add that one reason could be the increasingly visible signs of changing climate, such as environmental disasters such as floods and wildfires, which pressure policymakers and other social actors.

Politicians are hesitant to talk about it:

Most of the comments mention that the sufficiency concept is becoming more acceptable to talk about in public discourses and popular among academics and policymakers. Still, it is far from becoming a new norm compared to the mainstream policy paradigms such as ecological efficiency or sustainable technologies. They recognise that sufficiency is still challenging to adopt and promote, even though it is now relatively more acceptable. An interviewee points out that one reason for this could be the nature of incumbency, which defines the success criteria as potential votes. Since converting positive messages into votes with short-term impact provides better results, they avoid committing to long-term structural policy investments, which a sufficiency strategy might entail. For example, building highways is much more fruitful in terms of the potential votes compared to an education policy that may show its results a few generations later when the same policymakers will no longer be in office. They further add that the disproportionate emphasis on the economic rationale for policymaking is another challenge that keeps politicians away from sufficiency-related measures. Another participant highlights that the gained popularity of the sufficiency concept is still far away from the higher circles of governance and remains limited within more regional and smaller groups of people that are away from a political capacity that can address long-term and structural transformations. Another participant mentioned that politicians are still very much afraid to talk publicly about consumption and the potential measures to reduce consumption.

Cultural particularities:

While the interview conversations often involved comments about public acceptance and resistance as a challenge for the concept to be more widely accepted, scholars also often commented and reflected on the potential reasons for this particular public relationship. A participant's comments, for example, bring forward the interpretative flexibility of the concept. They mention that the different definitions,

understandings and interpretations of values such as sustainability, sufficiency, well-being, and environmental justice would highly impact how such concepts emerge, enter the public domains and shape social life in different forms such as policies or cultural change. One participant refers to an observation they made in a conference they attended as a speaker. When the speaker criticised the combustion engine as a norm in engineering education, the criticism triggered retired professors to the degree that the speaker thought their identities were highly connected to the technological artefact in concern, which is the combustion engine in this case. The informant argues that their resistance to his remarks was not only about the accuracy or consistency of their remarks but also about the identities constructed around the engineering discipline and certain artefacts, practices, or ideologies.

Apart from the cultural identities constructed around consumption and production norms or the knowledge-making itself, the same interviewee mentions the negative connotation around the concept as another reason for the difficult public uptake. The participant argues that people often see sufficiency as giving up or avoiding consumption for environmental and social values. However, sufficiency also implies distributive justice that provides well-being and fairer access to the essential goods and services for the society concerned. Some participants argue that the positive implications of sufficiency measures should be highlighted more. Highlighting such positive aspects as increasing well-being for the entirety of the population should be mentioned more often for broader acceptance and popularity of the concept. This argument came up in several other interviews as well. Some informants argue that the resistance around the concept comes from the people who are in the privileged position to consume luxury products or consume more since they perceive it as giving up on their advantages.

Another participant brings attention to the cultural differences that mediate the different communities' relationship with the nature around them. They recall a project initiated following the Rio Conference in 1992 called the Earth Summit. The project initiated in the Netherlands aims to promote an economic approach focusing on the happiness of the population of mid-sized countries. The participant says that shortly after the project's launch, it became apparent that countries have different epistemological approaches to entities such as happiness or well-being primarily due to many cultural particularities and religious understandings of such concepts. In the Netherlands, life expectancy was considered a measure of the well-being of the society, whereas, in Bhutan, a harmonious relationship with their surrounding is more important than a longer life. There is a widespread belief that if one lives a good life based on moral and ethical principles, they return to life as human beings again. Many interview participants add that Sufficiency might imply different measures for the people living in the suburbs of an Australian town compared to someone living in rural India. During the interview, some participants reflected on these interpretative, temporal and territorial differences and what sufficiency might mean. At the same time, it also requires a more global understanding of sufficiency and might not neglect the global inequalities while addressing the pressing environmental challenges.



### Scales of transformations;

A participant reflects on the difficulties of creating, navigating, and promoting social change on various scales. They note that some grassroots innovations often emerge as small community practices or eco-villages. Such examples consist of a very small fraction of society, and often, the social uptake of such ideas remains limited to small niche practices and communities. The participant finds it difficult to hope that a larger societal change towards an environmentally and socially fairer lifestyle would be possible through such small practices and communities. Some study these grassroots movements that often stay in small bubbles, and few become mainstream. Such thought motivated the participant to study social transformations on a larger scale now. They note that the question of how such a movement can be possible is a question of the century. While some people find it on the smaller cultural movements, they focus on more significant policy initiatives that can help with such transformations.

### Highlighting the positive aspects of the concept:

Few interviewees claimed that communicating the benefits of the concept could be helpful for wider recognition and acceptance. Despite the common belief that sufficiency is not attractive and applicable for the businesses that operate in today's economic infrastructure, participants add real-life examples, such as some businesses that implement sufficiency concepts in their business practices. These examples would challenge the widespread belief in sufficiency's potential to put companies in disadvantaged positions. A participant's research mainly focuses on these companies to highlight that sufficiency is not only about limitations or sacrifice but also something applicable. Several other interviewees emphasised this sentiment, mentioning that bringing up such positive examples would be helpful to challenge the negative connotations of the word sufficiency.

### The main issue is acceptance, not knowledge:

Two participants elaborated on the public acceptance of the sufficiency concept, recognising that the main challenge of implementation is more about accomplishing wider acceptance rather than the accuracy and legitimacy of scientific knowledge. Another participant highlights that even when individuals are determined to create a change and give up on certain social norms, peer pressure might inhibit such changes. For example, not owning a car in specific communities might be considered awkward. These comments are critical to show how the scholars reflect on the social uptake of scientific knowledge and the complex interplay of different social forces, such as peer pressure or how these forces impact specific modes of living in general.

## Stronger Narratives foreshadow sufficiency:

Some interview participants' comments about how, when and which policy narratives gain wider popularity demonstrate some complex dynamics of knowledge-making and policy-making. Many comments indicated that while the topics concerning consumption, sustainability and environmental justice are essential for life on earth, certain policy narratives foreshadow such topics from time to time. While some narratives quickly gain ground and broader public acceptance, policy narratives such as sufficiency are often overshadowed by other narratives that occupy political agendas. One participant sounded significantly frustrated while trying to influence regional politics towards sufficiency-related agendas; the public discourses in that region shifted towards geopolitical tensions and threats, leading to the policy investments to shift from sustainability-related topics to the defence industry. Another participant shared a similar sentiment, mentioning that the war in Ukraine shifted significant focus from environmental discourses to defence-related concerns.

## Controversies:

An interesting topic relating to public acceptance revolved around the controversies. Interestingly, conspiracy cases brought by informants consisted of both groups that were against the idea of sufficiency, speculating against it and the movements that adopted it instead in a way that was problematic in the informant's opinion. For example, one participant mentions the preppers movement, where people focus on doomsday scenarios by stocking up food and materials to develop practices that will allow them to survive after a potentially catastrophic collapse of society. Another example he provided is the transition town movement, which resembles a cult-like structure. On the other hand, some political actors that are firmly against the sufficiency policies were also mentioned as far-right conspiracy theorists. For example, an informant adds that some people in Canada protested against the idea of 15-minute cities, claiming that this is a government's plan to lock them down into 15-minute radius sections. He added that these are usually the people who resisted the COVID restrictions and vaccines with a similar sentiment. He also mentioned that the city of Paris was interested in the 15-minute concept, and some cities in Canada were also looking at similar ideas to see whether this would fit as a policy. Another participant shared a similar sentiment that some public uptake of this idea involved "controversial" ideas, such as the government wanting to force them to stay within 15 minutes of their home.

## Expertise

An important theme that emerged from the interviews relates to expertise. Some reflections represent how the scholars approach the nature of expertise, how it should be for topics such as sufficiency, what

the limits, challenges, and normative positions but also which aspects of sufficiency their expertise is focused on and which aspects remain beyond the limits of their knowledge. The theme of expertise is significant for a deeper discussion/understanding around what constitutes the role of knowledge experts in discourses around sufficiency and will help to answer questions like through what kind of expertise we would know about sufficiency in different contexts, what kind of expertise is essential for assessing our status regarding sufficiency, what are the challenges and limitations in the eye of the sufficiency experts. At first glance, the interview comments indicate a fragmented understanding of knowledge-making in the sufficiency discourses. A divide between social and technical domains is mainly present in the comments made by the informants.

“This is outside of my expertise.”

Perhaps the most significant fragmentation appeared in the answers to the questions about the technologies' role in emerging socio-material problems and their solutions. Many scholars mentioned that technology-related topics are outside of their expertise. At the beginning of the interview phase, questions addressed the production aspects of the sufficiency concept. As the literature on the sufficiency concept significantly focuses on reducing consumption through measures that focus on lifestyle changes, the initial research gap was considered as what sufficiency might entail for the production of things. As many scholars framed sufficiency as reducing consumption through demand, I was interested in asking questions about the responsibilities of businesses, organisations and people producing things. Therefore, I formulated the question in interview invitations as “sufficiency from a production perspective”. The questions involve production aspects or the necessary changes to be made within the existing norms of the use and development of technology. To these questions, almost all of the informants replied with a warning that their expertise is only focused on consumption aspects of sufficiency, and the production aspects are outside of their expertise or little known to them or sometimes as a “black box”. Some scholars even rejected interview requests for the same reason. Almost all interviewees started the interview by mentioning that they did not know the production aspects but just wanted to help.

Apart from the production aspects, my questions about technology also met with similar answers. As part of the hypothesis I was testing, which relates to production aspects of sufficiency, I wanted the conversation to touch on the normative aspects of technology and innovation. For example, what would sufficiency mean for the engineers working with a high sense of efficiency, making their products more efficient or producing things more efficiently? Would there be a balancing factor that could be included through sufficiency? Interviewees often perceived the questions related to technology as technological solutionism. The initial reaction was often, “I do not see much technology in this picture, ” which relates to the position of the movement against technological solutionism. When I reformulated my questions

during the interviews to draw their attention to necessary changes to depart from the mainstream understanding of technology and producing things, they often mentioned that technology-related topics are also outside their expertise. In some interviews, it appeared that technology as a topic falls under the disciplines of engineering, innovation management, etc. For example, one said, *“If you have a very technical question for me, you have to ask an engineer.”*

Only one participant was more reflective about this fragmented understanding of expertise and claimed that as a person with multiple degrees in biology, economics, and ecology, they often notice that the underlying questions behind today's knowledge-making challenges touch upon philosophical questions. They were also critical about leaving the technology-related topics to engineers; he said, “Don't be surprised if you ask about mobility to automotive engineers and their answer has four wheels”.

### Some influential experts mentioned by interviewees

Some of the experts mentioned by the informants are worth mentioning as their comments help describe their opinion about the expertise on sufficiency-related topics in general. Who did they find influential in this debate, and how is it worth mentioning to understand the discourse better and give hints about the academic environment they operate within? For example, one mentioned an influential innovation management scholar who has been giving talks about Industry 5.0 in a panel discussion. The participant brought up this point as an example because I was asking questions about the production aspect, and this panel was also about the industrial mode of production and the new trends that come with Industry 5.0. What caught his attention was how the speaker (I interviewed them later) described people as consumers. The people were mentioned as consumers, although in the participants' opinion, they were the people that should be considered stakeholders in these formulations, perhaps “customers” but not insistently consumers.

As part of the interviews, informants often recommended more literature from different scholars and authors or mentioned some influential scholars. Some influential scholars they mentioned were considered the early scholars of industrial ecology and corporate sustainability or even some influential names among the founders of some of today's industrial ecology-focused institutes and think tanks.

### Nature of Expertise

Not only the influential experts but also the nature of expertise was a discussion topic in the interviews. For example, one talked about how interdisciplinary research should look by referring to the shape of the letter “T”. Based on this image. In contrast, some research delves deeper and deeper into a specific field or question, and some research should connect these more profound studies to the upper part of T while

facilitating the connecting aspects between these research. He recognises an increasing need for this interdisciplinary research because today's problems are more connected.

### On the limits of expertise

While the sufficiency concept is not precisely mentioned, informants' opinions on the limits of expertise and how one would know about it were interesting. It also demonstrates their ideal mode of operation in scientific knowledge production and the recognised challenges, misconceptions, and normative aspects. One of the most striking conversations I had about the expertise was with the innovation management scholar. He recognises the awareness of the limits of expertise as the biggest challenge. He referred to the theories of Wittgenstein, who said that we know the world through language and that there are always misunderstandings. He recognises that observing a problem and formulating problems usually happens with a relatively high level of scientific certainty. However, once scientists start describing a solution to the problem they described with their scientific confidence, their solutions inevitably involve their values, worldviews, ideologies, etc. In his opinion, the challenge was that if the people on the receiving end of these proposed solutions hold different values or worldviews, they not only the proposed solution but the problem framing as well. Going further than formulating a problem and proposing a solution direction, they "risk" the reputation of their precise problem definition; therefore, they self-harm the reputation of their research. However, when I asked how he reflects these thoughts in his field, he dismissed my answer in a way. He said that for innovation policies, the formulation of purpose is all that matters (which contradicts his previous statements about expertise). This is perhaps one of the most dramatic differences between how the same person imagined and applied the ideal way of expertise. This remark does not demonstrate the general approach to expertise within the sufficiency movement as this response does not represent the scholars who are writing about sufficiency, it is still essential for noting the general tendency to see how scholars imagine the nature of expertise and quality standards but sometimes do not reflect on these thoughts within their practice. This separation between knowledge-making as a solution and knowledge-making as a problem, or how the problematic aspects of knowledge-making are always outside of the practitioner field, indicates the collective challenge of modernist thinking. The STS scholar I interviewed had a much more pluralistic understanding of expertise.

Some other remarks relating to the value-laden nature of scientific knowledge-making were also worth noting. An informant refers to the pluralistic nature of scientific knowledge-making. Different disciplines could have different values, ontologies, anthropologies and epistemologies, often not explicitly reflected by scientists within their work. Another important aspect is the basic principle of interdisciplinarity; one should not commit to assumptions that directly contradict the established discipline in charge of the topic. For example, no economist should assume that human behaviour is entirely based on competition and

that markets can solve all social problems, whereas no social scientist should assume that energy sources are unlimited; every engineer would easily prove how weak this assumption is.

*"[...] And we defined what we call the basic law of interdisciplinarity, which is that. You should never make assumptions which direct which are in direct contradiction to the established knowledge of a discipline, who is in charge of the issue. Yeah, no social scientist should assume that energy resources are unlimited. Every engineer will show him how stupid that is. But uh. No economist should assume that humans are only selfish or that resources are available, or markets for everything. And no engineer should assume that humans use all technical artifact rationally. Yeah. So. You have to always ask where do you make assumptions which are out of the domain of your competence and are they in line with what the science in charge would agree with. And I think this is, uh, for me, a very important thing, because when we do interdisciplinary work, uh, I do not argue with people that their uh scientific work could be better or needs to be contextualized with something like that. I'm telling them you are doing bad science or bad engineering because you are making assumptions which are unproven. And that is against the basic laws of your own discipline. You can't do that. So if you want to be a good engineer, if you want to be a good scientist, listen to the others because they can falsify what you assume. So this is turning the table a bit. And saying if you as an engineer and do not listen to social science, you're simply a bad engineer."*

Another challenge the same informant mentions about the interdisciplinary work was the choice of tools and frameworks to justify arguments. He argues that natural scientists often create convictions by referring to the models created and controlled by the same scientists. Tweaking parameters in these models could quickly help justify different results that emerged from using such models and the figures. Moreover, during these modelling phases, there would be many aspects that cannot be incorporated into the modelling as models cannot replicate the full complexity of the real world. Ultimately, they need to use stories to compensate for these aspects. So what happens in the end is "hard facts come from soft stories, and soft facts come from hard modelling" because of the oversimplification during the modelling. Therefore, the informant states that narratives are perhaps more convincing tools of expression than modelling.

Likewise, about the choice of a model in the first place, his memory about the teacher started with the assumption that the market is in always equilibrium and at the end of 3 weeks of calculating through equilibrium modelling. He notes that tweaking a few parameters would quickly change the results, so perhaps the teacher should have reflected on this aspect while proving that the markets are always in equilibrium. Moreover, he questions why they would choose an equilibrium model for something

human-made? Therefore, using tools and models to demonstrate something carries assumptions about the study. These are reflections that scientists should reflect on in their studies.

*“[...] So I think narratives are more important than figures. We also say when we did scenarios, scenarios are always working on on hard facts, of course. You need figures to run a model. But then you if you, uh, if you look at the what what is the the issue you want to deal with you first? Have a kind of a narrative and you want to illustrate that with the model, and then you look at what the model can do and what it cannot do. And then in the end, you come to say that this element has been illustrated with this model, however, we know that there are different attitudes of males and females in that field, which the model cannot reproduce. So we have to modify the model results to take that into account. In an oral way, in a narrative way. And that means that in the end, the hard facts are from the soft stories and the soft facts are from the hard modeling. Yeah, because most of the oversimplification of of reality. And uh, they should be treated with care. They can be helpful. But if you interpret them too far, then they simply are misguided. And the. I think the the world is incredibly complex. Even the narratives that we make are simplifications. Our world views of simplifications. But then we make a computer program which is even more simplifying it. And why should we base our real world decisions on the most simplified tool that we have at hand? The most realistic tool is a good narrative. Which is supported by some examples case studies, which are full of facts and figures. But they are just elements to illustrate certain bits and pieces of the larger story. We simply cannot believe it in, but I have been modeling. I have been working developing models. I have been using them and I know if you have a certain kind, but here in mind how easy it is to tweak some parameters to get the desired results. Still, there are some people who believe in the models. And I don't understand how you can believe in a system which you know very much that you can tweak it as you. How can you trust in a thing which you? Know how to manipulate.”*

## Imaginariness of implementation

An overarching comment from one of the early and most prominent scholars of the concept captures how scholars projected the way to implement sufficiency policies quite well.

*“I suspect that all sufficiency decisions require collective caps, whether in industries, in cities, in companies, in society. Individual caps are not enough to avoid the free rider problem. To achieve a common agreement, that process is full of pitfalls and loopholes. There are variety of ways for how to do that, all of them uncertain and lengthy. Examples include bottom-up and top-down, incentives and government intervention, shifting habits and changing mindsets.”*

## Challenges of quantification:

Some informants described one of the challenges for creating and implementing sufficiency policies as difficulties in calculating various things. Some participants discussed using material or resource caps as an option to implement sufficiency measures. They imagined that it could be something similar to carbon budgeting. One of the difficulties described by scholars was the time we should be considered as the starting point of that calculation. When does the history of carbon emissions start? This question also directly relates to the question of responsibility as it could oversee the historical carbon emissions done by the countries who have industrialised long before the others.

Another informant highlights the temporality of different crises by referring to the water example. As the water shortage becomes an imminent problem, policy attention has already emerged in multiple regions to tackle it. The participant mentions that *“there are already policy local policies that limit the use of water”, such as “swimming pools and for washing your car”,* and claims that one of the reasons why it is rather challenging to implement similar policies with a more comprehensive and long term vision is that the issues such as climate change are difficult to grasp with a sense of time. It is a long-term crisis that spreads through time. We could not extend such policies to more businesses and producers of things because it would require careful consideration and calculation of various factors such as the purpose of use (of water), what the product is and how important it is to the community, and the distribution to which company and which customer is allowed to use these resources. For example, a *“certain number of cubic metres of water”* being used needs to be examined, including what purpose is at stake for the company. Therefore, it would be such a complicated endeavour that it requires *“very, very strong and very clear reasoning”* to justify.

*“Yeah, you will. I think maybe we can think of something like this in the for water, because at the moment we are seeing these, that water is becoming more increasingly scarce. And all over Europe. So and there are already policy local policies that limit the use of water. They limit the use of use of water and swimming pools and for washing your car and so on. But why not limiting water use at the production side? But this is. Similar to to situations of war, I would say. This is a crisis. And not a long term crisis like climate change, but a short visible short term crisis which is more acceptable to people as as a reason for, for limiting such a resource. And then when you do this you have to define very. For each type of use, you have to define how much a certain company or a certain consumer is allowed to use. So it's becoming very complicated. You cannot say that all the companies are allowed to use only. A certain number of cubic metres of water anymore, but you have to look at what are they using now? What do they need it for? Is it possible to to use less and and what is at stake for the company? So it's quite difficult and and*



*complicated I think. Which doesn't mean that it's not feasible, but the reasons must be very, very strong and very clear to do that."*

Another participant holds a different position on this concern. As massive changes are needed, waiting for a precise calculation within such policies would only delay the much-needed action. Therefore, we should focus on the change itself instead of waiting for a precise calculation of our footprint.

*"I guess my approach is that OK, even if we don't know the exact level, we know that in high consuming countries and high consuming classes. It has to be reduced a lot. So rather than getting stuck on like calculating the exact level, we have to start doing things. And if we redo? Like our footprints like 20% or 50% or 80%. But we have to start like acting. And most likely it's more like 80% that we need to reduce. So it's like really like massive massive massive changes that need to happen. So at some point, I was like, more focused on the change."*

Regulations that do not allow things in the first place:

One participant questions the current mode of operation of environmental policies regarding the products. He argues that instead of allowing products to circulate in the market with warning labels about their toxicity, why don't we prevent them from emerging in the market in the first place or require special permission or licence to be able to buy and use such materials? They believe that an enormous amount of toxic waste would be prevented with such measures.

*"But what is the first step? For example, I imagine that I want to consume sustainably. So I would be happy if they would not, if I would not have to read through hundreds of books to find out what I can buy and what I should not buy. But if I could be sure that nothing is on the shelf of our shop which is not checked for its sustainability. So choice editing. Why do you print a warning? This is toxic on things instead of banning them. Or only selling them with special permission if people need it for a certain purpose. Drug addicts need their cocaine or need their amphetamines or whatever. Uh, as a part of uh, of the treatment process, you cannot ban it completely because otherwise they they're going to die or what else? But it's it should only be accessible in a certain specific program. And need a justification. If you do that, I think the enormous amount of waste which we are producing right now would simply be reduced significantly."*

Sufficiency should be initiated and protected by policies:

An interviewee mentioned that in the current way in which the political and economic environment operates, companies trying to implement sufficiency measures would be disfavoured by their competitors

who provide cheaper products and services that take advantage of immense material and energy flow. Therefore, sufficiency-based business models should be incentivised and protected by different regulations. Another participant also noticed a similar issue and argued that since sufficiency measures do not decrease production costs, they should be protected by different policies aimed at regionalising the markets, separating markets, and similar measures.

A participant's vision of sufficiency policies is worth mentioning as it illustrates a more end-to-end vision of how they can be developed and implemented and by whom. The participant is somewhat sceptical about the state's involvement as an initiator of sufficiency policies and believes that if we are going to move toward a sufficiency economy, we probably should not rely on governments as a first mover and start doing things by ourselves as civil society to build local levels of sufficiency economy within the shell of today's global neoliberal market economy. They believe that the core would replace the old shell over time, so to speak. If enough people get involved at the grassroots level, this could influence the macro-level political economy. Although no one knows how it would happen precisely, they still hope it will happen upstream.

*“Now if you come to the conclusion that a government or a state is unlikely to get involved sufficiently. If you believe in the problems, and if you're concerned about the direction of civilization, then you need to think up a different strategy [...] Micro examples of an alternative way, a way based on sufficiency. UM. And there's probably. In interaction there will be an interaction between those grassroots examples and political economy structure, government. So nobody will know quite how that might play out, and it will probably play out differently in different contexts, but the idea. That if. Enough people get involved in the grassroots level. Eventually, when hopes this will philtre upwards and start influencing policy. But to think that policy will be a significant first mover. It's not incoherent, but people are entitled to be sceptical about whether governments are suddenly going to embrace kind of a radical ecological sustainability agenda when the system itself seems to want more, not less.”*

#### Infrastructures:

Only a few interviewees envisioned sufficiency-related policies as highly intertwined with the existing and future infrastructures. They claim that regulatory solutions could lead to more sufficiency-oriented infrastructures. For example, Deutschland Ticket promotes public transport, which could help reduce car-based mobility. Additionally, policies that invest in physical infrastructures such as “*good mobility infrastructure, a good healthcare infrastructure, and good education infrastructure*” could perhaps be more indirectly “building blocks” of sufficiency policy. However, the relationship between technology and

how decision, development and deployment of technologies infrastructurise certain social norms of consumption and production was not often part of the conversation.

### Creating cultural influence:

Interview participants repeatedly mentioned the cultural aspects of sustainability transformations while describing how they envision sufficiency measures.

*“One story is a friend of mine decided that one of the reasons he wants to buy a much smaller car than his previous. And less pollution and so forth. And all his friends came saying is something wrong with your income? Is your job no longer secure? So it was good friends, good wishes and good willing. Do you need help? Is there something wrong? But no, I just wanna. I want. To set myself. I want less pollution. Are you sure there is? Nothing behind it. At at about that, he told me that at about the same time when I had a a little Japanese sports car and I abolished it and bought myself a second bike. And people said, what are, what have you been doing? I said, I've sold my car. I am. I'm biking now. Oh, that's a radical break, yes. So yes, but as you see [...] So leaving the frame and doing a different thing can be really liberating people to follow you so. That was one example then. In this case, we are always talking about the upper limit of what is sufficiency.”*

A participant focusing on sufficiency-driven business research brings attention to the business culture. They recognise that Patagonia is usually mentioned as a typical example for many scholars. Nevertheless, many other businesses demonstrating how sufficiency measures can be used as a business strategy go unnoticed. For example, “*Vitsu never has sales and teaches their staff not to sell more than they need*” and “COMMON, a cooperative in France,” where you can rent mobile phones instead of purchasing them, and the price decreases gradually. So many examples were identified in their research. These companies could be considered real-life examples of how sufficiency ideas could be implemented as a business strategy and not harm their businesses. As there are many examples, such as these companies, the participant created a database to present an available source of examples. The participant finds this critical as these companies are essential in showing the possibility of implementing sufficiency strategies to other companies that are somewhat sceptical. They think that communicating such examples, the applicability of sufficiency, and how it is not harmful business practice as opposed to the general belief would help influence the mainstream business culture towards more sufficiency-based practices. Other examples, such as labour associations and business networks, could be called “front runners”, and such examples should inspire others and create cultural change.

*“They say oh. Of course, Patagonia saying don't don't buy this Jacket. That and then you can say yes, but also there's, you know, Vitsu who never have sales and you know, try to teach their staff to not sell more than people actually need or there's COMMON which is a French cooperative and you rent your phone. But the longer you rent it from them the cheaper it gets every month because you actually could. You know, promote longevity. [...]I think this is something these examples of businesses that are already doing it should just be more spread full stop. And and I think there's also some awareness of this for instance, in Germany with some of the what are they called, I think labour associations, so or the the business associations as well. So there's some awareness of front runners. And they oftentimes say if you show us businesses that are doing a good job, then we can show our members how to do a good job. But we need examples of where to go, so I think this is a great enabler to actually say, look, these guys are doing a good job. This is how it could be this is not your sector where we have somebody else in your sector that is also doing a great job. This is how it could be and then they a have a bit of an orientation point of where to go.”*

## Ownership of the companies

One participant claims that the different legal forms of companies could influence the popularity of sufficiency business practices. For example, limited liability companies or joint stock companies are often not suitable. Perhaps cooperatives, in which customers are often considered important stakeholders, could be a better anchoring point for more sufficiency-oriented businesses.

## Market niches

An informant questions whether it is feasible for the companies to give up on their motivation to produce ever bigger and faster cars but focus on perhaps a “sufficient” mode of producing things - imagining that would be a smaller and slower vehicle in this instance. Even if they do so, they do not know if a market segment exists for such niche products. They imagine that it would be limited. Therefore, he finds the question interesting: Could companies operationalise sufficiency-related strategies voluntarily, or would they have to be forced through policy?

## Material caps

Some informants discussed potential sufficiency policies in the form of material caps. Whenever they did so, I followed up with a question asking how these material caps would be created and implemented. An informant referred to “a wonderful article” from a Degrowth scholar, Jason Hickel. The total materials

circulating through economic activity was written as “84 billion tonnes” in the article the participant referred to. We would need to reduce this to 50 billion tonnes by 2050. Therefore, sufficiency policies in the form of material caps could take this as a goal. “Sustainable steady state” would then be accomplished. If reducing the material size of the economic activities is our goal, we could question how much each sustainability strategy, such as efficiency and circular economy, would contribute to this goal. The informant then argues that we would find out that we need sufficiency-related material caps to accomplish the remaining part, “several billion tonnes” of the intended goal. It would also mean breaking it down into different sufficiency approaches, like creating material caps for the companies to produce.

Another participant imagines an upper threshold for the apartment size per person. For example, companies could produce apartments less than 30 square meters squared per person. Currently, it is 45m<sup>2</sup> per person on average. They imagined this threshold as a one-person apartment, which could be 40 m<sup>2</sup>, with two people 60 and 80 m<sup>2</sup> by maximum. They also imagined that the change to initiate a sufficiency-oriented society would start with companies at the regional level. A region with separated and localised market niches would become the first example, then popularising it to more significant movements and geographies. Such an attempt would require policy backing. We already have similar policies created by world trade treaties that limit imports to certain degrees. Then, in the future, he imagines that such treaties would become more popular. With treaties increasing, companies with different ownership schemes, such as cooperatives, could create caps, such as producing 100k cars this year.

Another informant also has a similar anticipation. They imagine a case in which Australia starts practising a sufficiency-based economy. Departing from a reasoning formed by the participant as “*carbon is the resource of concern*”, based on a budget to keep the mean temperature under 2-celsius degrees, cap and trade regulations would keep the carbon emissions under a certain threshold that ecological and social justice elements linked to it. They imagine such thresholds to be calculated and implemented by the state through “command and control or direct regulation”. Another option would be having a “state-based” policy that directly regulates how much carbon would be emitted through economic activity. One policy option for this approach is nudging or incentivising through different pricing mechanisms based on the participant’s comments.

### Planetary Boundaries, Wellbeing Economy

The Planetary Boundaries concept was among the most often mentioned epistemic sources for the sufficiency thresholds. The Planetary Boundaries concept often appeared in Sufficiency literature to argue that current human activities are already beyond the capacity of nature to endure. Additionally, some interview participants referred to the concept as a method to articulate a contextual sufficiency

threshold as an upper or lower limit. An informant, for example, refers to the case of Amsterdam, where there was a mapping between the planetary boundaries and the city's assessment of several well-being factors such as education, mobility, housing and health. In Amsterdam's case, the project team conducted a mapping study that assesses which key areas fall within the planetary boundaries and which remain outside. Based on such an assessment, they created some action plans to adjust. One interviewee talks about how the project team came up with a living size of 30 m<sup>2</sup> apartment as a threshold, which seems significantly "too small". The informant was questioning as a sufficiency scholar whether other participants of the citizens had a similar conclusion about this. Based on this example, they concluded that they were unaware if such a number was decided with the people or based on a tool, but the participants reflected that it should be defined together with people.

It is just good to keep in mind not to communicate and apply.

The informant scholar, who also has a direct policy affiliation, was somewhat critical about communicating and implementing such measures in the first place. They claim the concept is a valuable logic to keep in mind but not communicate with civil society or promote publicly.

*"I I don't know, I I think. It is a good concept for research and for to to have it in your mind that you have also to look at the the the absolute consumption and and throughput of resources you have for your lifestyle and for our. Lifestyles taken all together, but I think in in the public discussion and in in communication about sustainability, it's not not such a good and successful concept. So I think it's it's good to have it in the background to to have it work in the background in the, in the machine room ((laugh)), maybe of the think think tanks who develop strategies to to become more sustainable, but maybe not that much in in public communication."*

Maybe a deep reset:

Two informants were articulating a case of deep and sudden transformations, the collapse of a current regime inevitably. For example, one informant mentioned a "kind of chaotic collapse" of the current "growth economy" due to its insatiable needs for materials and resources. A sufficiency-based economy emerges from the ashes of the old one. He is expecting a form of revolution.

## Discussion of the results:

Interview results and the literature review demonstrate that the sufficiency scholarship brings important and much-needed reflections about the excessive emphasis on economic growth and resource efficiency

within sustainability discourses. Through empirical examples, scholars provide important clues about how decades-long efforts to make sustainability transformations were unsuccessful. Shifting the discourses from a narrow focus on high modernity approaches such as technological solutionism and industrial understanding of environmental sustainability to a deeper questioning of society's relationship to the material world around us.

Apart from reflecting on the limitations of the existing sustainability approaches, sufficiency scholars also critically engage by problematising the morally agnostic stance taken in many sustainability discourses that keep a blind eye to the social values such as justice, equity and treating the world around us merely as an object for management. By bringing attention to the justice aspects of sustainability transformations and deliberately emphasising that everyone should have enough and we should avoid excess, the scholars are undertaking a much necessary conceptual work of connecting the social sphere with the materiality of the social norms. By raising questions such as what is enough in different settings and contexts, the sufficiency idea is an exciting movement that hopefully enables us to mediate our relationships with the materials around us socially and environmentally more fairly.

The analysis of the interviews also demonstrates that sufficiency scholars are reflective not only on the moral aspects of the sustainability transformations but also on knowledge-making itself to some degree. As seen in the results section, scholars often made critical remarks about the interdisciplinary nature of their expertise, scientific mode of operation that critically engages with choice of methodology, implicit biases, unnoticed assumptions, and the complexity of sociotechnical problems. Especially the remarks about recognising the local, temporal, and cultural particularities necessary for the sufficiency concept to be operationalised in different settings show how significant effort and reflection were put into identifying political aspects of scientific knowledge.

While such reflections are very promising and have great potential to open up technocratic decision-making culture into questioning, reflections made by sufficiency scholars did not go deep enough to recognise some of the more complex and unsettling relationships between science and society. Their reflections often recognised the political aspects of science as "truth speaks to power". However, STS scholarship demonstrated that the political characteristics of knowledge-making go more profound and scrutinise not only the power around knowledge but power within(as) knowledge as well. I will argue that the sufficiency movement, to some degree, did not reflect enough on these aspects of knowledge-making. During the following chapters, it will become more apparent that deeper reflections on the embedded politics of knowledge-making is still necessary for the sufficiency movement to avoid settling into a lighter version of modernity. Even though some of the sufficiency scholars claim that the concept could become an antidote for some of the problematic aspects of late modernity, such as ongoing environmental degradation, the endless pursuit of growth in speed, space, scale and material

throughput, some of the epistemic choices and formulations of the problem still has traces of modern knowledge-making practices that significantly contributed to the emergence of these grand challenges at the first place. These aspects complicate the role of the sufficiency concept within the environmental policy discourses. Interview results suggest that the collective challenge of recognising the problem spaces of modern knowledge-making tradition is still present and requires a much deeper reflection and engagement.

### Acceptance or Resistance:

An important symptom of this lack of recognition is a strong resistance against the idea of sufficiency, which was one of the most common themes in the interviews. Informants mentioned in almost every interview that it is a “hard-to-sell” concept; politicians are “afraid” to discuss anything related to reducing material consumption. An informant’s observation about the nature of the problem addressed these concerns with an even sharper clarity. “So here we have the problem of acceptance and not the problem of lack of solutions.” When I asked a follow-up question on whether opening such topics to a broader public to debate would help with public “acceptance” of the concept, their position appeared somewhat sceptical about the potential public performance of the very concept itself.

*“I think telling people that they have to consume less and so on It's not a really attractive concept to most people. It is, it's an attractive concept to a minority of maybe 10% of the population at maximum. (...) So I think the more you talk about this in the public discussion, the higher the resistance may become.”*

Several similar comments indicate that exploring the unsettling relationship between the sufficiency concept and its public uptake becomes a vital precondition for its public performance and realising its potential. During the analysis of the interview comments, it becomes apparent that the public appears on the resisting side of the sufficiency policies remains a question for the many informants. Wynne's (1992) examination of the relationship between lay and expert knowledge offers pivotal insights into the public understanding of science. In this impressive account, he identifies the interplay and recognition of diverse forms of knowledge as an essential factor for its legitimacy and trust;

*“(...) reflexive recognition of its own conditionality is a pre-requisite for science's greater public legitimation and uptake; yet this requires more than an intellectual advance from science; it requires institutional reform of its modes of organisation, control, and social relations. This would involve, inter alia recognition of new, socially extended peer groups legitimated to offer criticism of scientific bodies of knowledge from beyond the confines of the immediate exclusive specialist scientific peer group.”(Wynne, 1992)*



Departing from Wynne's suggestions regarding the "reflexive recognition" of different ways of knowing and living, in the following chapters, I will examine the knowledge-making practices within sufficiency scholarship and discuss the potential reasons why the public seems to appear to be resisting the sufficiency policies.

In nearly every interview, participants voiced concerns about the public's perception of the sufficiency concept. This shows the keen focus on civil society as a pivotal stakeholder in this discourse. However, in most conversations, resistance or acceptance appeared as the only way the public can participate in the discourse. Scholars often describe sufficiency measures that directly or indirectly influence the ways of living. Examples, such as reducing meat consumption, air travel, and smaller apartment size, are often described as measures that individuals can commit to or could be incentivised through policies. Also, the examples related to infrastructures, such as urban design, architecture, and standardisation of certain qualities such as product repairability, for instance, could be seen as measures that more indirectly influence public life or the social norms of living.

While the vision of sufficiency measures often requires such changes that directly influence society and its particular choices and norms, how different stakeholders can participate in the decision-making process was not a topic that naturally came up in the interviews. How the interviewees answered the questions about the participatory aspects of knowledge and policymaking indicates that the scholars needed to think more about these aspects. Questions such as how to involve different stakeholders in the debate often remained unanswered.

### How responsibility is framed within sufficiency discourse:

There are many instances within the sufficiency literature and the interview dialogues that the logic of sufficiency is often applied to the lifestyles and habits of social groups of different scales and sizes. In many instances, the sufficiency policies are operationalised to provide conditions that allow people to live with lower environmental impact without significantly sacrificing their well-being. Often, the formulation departs from an understanding that the individuals are not responsible alone for creating such lifestyle changes, and policies should create the right conditions; the performance criteria are still measured based on the the action taken by an individual. However STS scholars argue that the increasingly popular and mainstream scientific efforts to link a global phenomenon such as climate change and individual actions of everyday life intensely is a factor of social alienation (Wynne, 2010; Sarewitz, 2011).

The politically loaded nature of the sufficiency concept is rightfully acknowledged in the sufficiency literature and in the interview responses. However, the politically loaded nature of scientific knowledge-making does not seem to be recognised enough by the scholars. In sufficiency literature, the main framing of the issue is still looking at human lifestyles such as the apartment size, dietary choices,

ideal distance to commute, mode of transport. Causal links between the patterns of individuals lifestyle choices and their macro impacts on earth are certainly relevant to study. However when extensive focus put on individuals choices or patterns measured with average numbers, other forms of political agency and responsibility becomes difficult to include in the problem framing. For example, once trajectories of modern infrastructures such as electric cables, highways and borders are stabilised, expecting individuals to choose or even imagine a different mode of living becomes challenging. Neglecting how modernity operates in a way that it standardise the imaginaries of livelihoods, creates strong asymmetries in understanding and formulating the political agency and responsibility in these accounts. Modernity heavily influences and materialises ways of living through infrastructures like electric grids, dams and borders literally in concrete(Arora & Stirling, 2023). Attributing the responsibility to individuals to mitigate environmental and social problems (even if the responsibility to create conditions for it is on policymakers) should be examined as a political and moral mode of knowledge making. Recognising the concentrated political power within the socio-material regimes shaped by modernity requires a much more carefully reflected political epistemologies(Stirling, 2019a).

## Control within knowledge-making and policy-making practices

The notion of control appears to hold a central value within scientific rationale and the imagined ways of policy implementations within the wider sufficiency discourse. In some instances, scholars subscribe to a logic that prioritises the coherence and consistency of the knowledge for the sake of scientific legitimacy. In some instances, the control and readability of the parameters appear as an overarching value even if such logic comes with massive simplifications and is insensitive to particularities of social life.

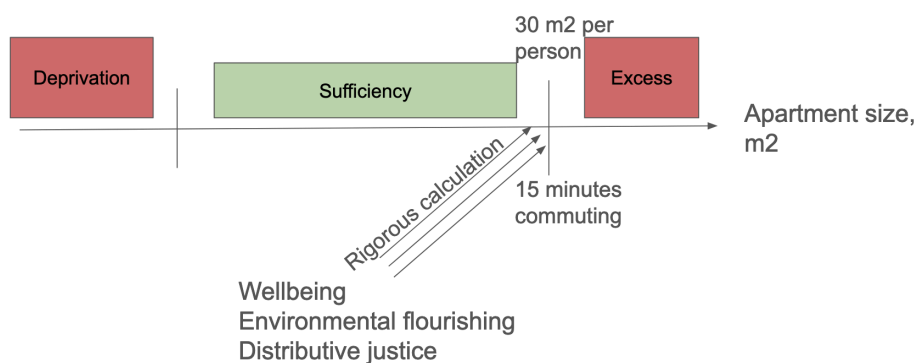
For example, arguments such as calculating the total amount of material resources circulating within economic activities divided by the population for the distribution based on the weight of the material, putting material caps controlled by policies, rigorous calculation of the carbon budgets allocated to citizens every year, the attempts to formulate the ideal size of an apartment in a city or the ideal duration of commute in minutes (15-minutes cities). In such instances, the scholars subscribe to the assumption that the only way to mobilise societal action is through enforced policies legitimised with kinds of scientific knowledge based on a numerical calculation. This problematic assumption that scientific legitimacy is a prerequisite to mobilising social and political momentum significantly overlooks other social values, such as commitment to collective agency and care as a fuel for political will and socio-material change(Wynne, 2010).

## Axiomatic relationship between incommensurable qualities

To be able to formulate policy-relevant scientific knowledge for the sufficiency concept, scholars often subscribed to a logic that draws an imaginary relationship between incommensurable values such as well-being, social justice, apartment size, meat consumption, and CO2 emissions. Scholars often departed from a concept called “planetary boundaries”, often referring to Rockström et al.(2009) to describe a threshold as a basis for formulating sufficiency thresholds. The concept of planetary boundaries focuses on controlling variables based on materials such as CO2, O3, and nitrogen to formulate a safe “operating space” on Earth. While the concept imagines a connection between individuals’ actions and the collective impact of human activity on earth since it shares the same currency (Co2, for example), it also creates an imagination of controlling the planet based on quantified variables. As if the planet itself “operates” based on these variables, controlling them would create a sense of planetary control, which has been criticised as an illusion of control or “cockpitism” (Stirling, 2019a).

In many cases, sufficiency scholars prescribed the concept of planetary boundaries as an imaginary threshold to formulate different kinds of currencies, such as apartment size and ideal forms of commuting (15-minute cities). These arguments that focus on controlling social life and its planetary impacts imagine an axiomatic relationship between incommensurable values such as environmental flourishing, justice and the amount of material consumption. A simple illustration of the epistemic activity that some scholars have used to find the sufficiency threshold can be seen below.

### Axiomatic relationship between incommensurable qualities



These attempts to build an axiomatic relationship between consumption habits and their planetary impacts and thresholds also allow scholars to focus on scale. As sufficiency is often articulated in connection with the degrowth concept that often aims at scaling down the material impact of economic activities of societies, this notion of scaling down with an understanding of social justice and enoughness appears to be a valid solution; sufficiency scholars often subscribed to.

However, one neglected aspect of such socio-material questions is that they require an understanding of scale and topology (Stirling & Arora, 2021a). Trying to downscale consumption habits formulated by currencies such as apartment size or units of meat consumption, scholars focus on a scale to the degree that the topological patterns would not be easy to incorporate. Problematic aspects of collective human impact caused by consumption are not only the scale but the specific concentrations of power through infrastructures and political agency. Modernity played a significant role in materialising such concentrations of power through colonialism, exploitation of nature, assumptions of singular and superior knowledge, imaginations of control, military supremacy and appropriation of privileges (Stirling & Arora, 2021b). When there is not enough attention given to such topological concentrations of power, some accounts of degrowth and sufficiency risk repeating the similar knowledge-making tradition that played a significant role in the emergence of such problems. Even with the good intentions and goals of social change and environmental flourishing, without recognising the role knowledge played in creating such problems, some of the sufficiency accounts might not address this knowledge regime; that crucial to recognise if the intention is a substantial social and environmental healing. It is not only the knowledge-making regime but also the political regime or incumbency or the political agency that needs to change. Attempts to look at such problems from a greater ontological distance and lack of recognition of ontological parallax, even if it might be able to change some symptoms of the problematic status quo, by overseeing the concentrations of power might not be fully able to address the change that requires to go deeper in such massive socio-material questions. Without fully understanding such dimensions of socio-material transformations, such accounts that imagine a control panel based on variables and axes with massively simplified currencies, such as minutes kg, that give the illusion of control on social and ecological livelihood, they could even inhibit the change that is long desired and intended (Stirling, 2019).

This is not a rare misunderstanding within transformation and sustainability studies. Such problems require high recognition of ontological parallax as the analyst and the subject of the research does not have the ontological distance that is similar to physics looking at such problems from way above in a manner that things look categorically separated and can be controlled based on such variables, such accounts inherit the privileged power position that the concentration of power also inherits. Looking at such problems from the way above perhaps gives sufficiency accounts a possibility of neatly separated categorical distinctions such as deprivation, enoughness or excess. However, the power of different kinds of accumulated political agencies appears difficult to incorporate into such analysis. However, as rightly acknowledged by some of the sufficiency scholars, acknowledging how power concentrations play a role in creating, shaping and maintaining such problematic consumption patterns is crucial for meaningful and deeper engagements if the aim is socially and ecologically desirable change (Fuchs et al., 2016).

However, even though scholars recognise the role of incumbency to some degree, the privileged “eagle-eye” view that adapts the similar top-down controlling position to such problems is often not recognised enough. The analysts' position, looking from way above (planetary level) to such problems, which are also inherently related to how different values are embraced within democratic processes and contestation, exacerbates controlling narratives that the problematic power concentrations are willing to pursue. This perhaps could explain why there is a correlation between the timing of gaining popularity of the sufficiency accounts and the increasing political pressure on governance regimes that try to navigate these pressures. For example, the Thai king's motivation to push forward a sufficiency plan during a continental economic crisis, Macron's government to push forward the sufficiency plan in an energy crisis fueled by war or even the inspiration that the Thai King found in Schumacher's Buddhist Economy idea that has become a bestseller in a time of economic crisis again fuelled by military conflicts. Looking at these examples makes it difficult to ignore the patterns of how and which policy ideas become more pushed forward by policymakers in certain times, only to forget them shortly after the temporal crisis is over. Perhaps sufficiency is trying to be utilised by such incumbent forces as a legitimising tool to push the responsibility from decision-makers to civil society. At the same time, the concept's deeper meanings and transformative power are being ignored or neglected.

When sufficiency accounts inherit such a top-down eagle-eye view of such problems that priorities the rational consistency of socio-material questions inherit the illusion of control, they risk serving such incumbent actors' political manoeuvring space more than the wellbeing of their citizens as the empirical examples often show such plans are often made without a goal of deeper engagement and wide-range societal change. Interpretatively, this could be why there is such a tension between the concept of sufficiency that the scholars are describing and calling for and the citizens that perceive this as interfering with their lifestyles or the politicians that are afraid to refer to it. Looking at the discourse from a more grounded and bottom-up perspective could help the formulations of scientific sufficiency to widen the picture by incorporating the interplay between scientific knowledge and its wider acceptance within society. The worm-eye view could help to make sufficient accounts to bring such aspects of political positioning into their framing by acknowledging the collectively shared democratic struggle around the socio-material change that is desired and accepted.

Another aspect of sufficiency-related problems that often need to be better acknowledged is how technology plays a role in materialising the problematic consumption patterns as an infrastructure. Considering the expansion of modernities through multiple territories with its development projects such as energy infrastructure, telecommunication infrastructure, mobility infrastructure, health-care system, business norms and economic and geoengineering projects, socio-material throughputs of our societies are highly affected by how we shape such infrastructures. While mainstream political discourses tend to formulate societal problems regarding technological fixes, sufficient scholars rightfully recognise that the

sole technical solutions to such social and political issues are problematic. While in most of the interviews, scholars criticised techno-optimistic approaches; they also avoided commenting on the kinds of changes necessary to challenge such techno-optimistic regimes. They often stated that they either do not see technology in the picture or it is outside their expertise. Although this attitude shows that the scholars are reflective about the boundaries of their expertise, it also shows that they were not fully acknowledging the socio-technical aspects of the consumption patterns that have been cemented through the infrastructures in a more multi-faceted way. However, one innovation management scholar I interviewed was not reflective enough in a similar sense and formulated technological solutions as socially desirable. An influential innovation management scholar I interviewed did not reflect on the assumed asymmetrical knowledge difference of technical vs social but a formulation of socially desirable in technical terms without hesitation. While sufficiency scholars appear reflective about their knowledge in some sense compared to the high-modernity stances within the innovation management field, in another sense, they seemed to leave the political ground on socio-technical change to solely technical approaches such as conventional innovation paradigms. STS scholars have long discussed technological change's social and political dimensions and criticised the expert-driven approaches to technology or innovation policies. If sufficient scholars engage with STS accounts, they could gain more legitimacy and better tools to engage and challenge such technocratic accounts on sustainability and policy discourses. Not recognising the importance of technology in the picture and assuming that only innovation experts can talk about technology, they seemed to inherit the modern assumptions of treating the social and material (also technological) domains separately. Even though the sufficiency concept is proposed as an antidote to the technocratic visions of modernity, by not fully acknowledging the compartmentalised understandings of knowledge and expertise that modernity pushed forward, they seemed to pursue the modern knowledge-making tradition to some degree. As it was acknowledged by Stirling (2021), the sufficiency movement, in this way, risks settling for an alternative and lighter version of modernity.

### Situating the Logic of Sufficiency:

Beyond the aforementioned epistemic choices that the scholars are making, examining what kinds of problem spaces are identified as a field of application is essential. The abundance and diversity of the kinds of problems and topics that sufficiency scholars are addressing show that the concept of sufficiency can be applied to many problems with different determinants. For example, the axiomatic relationship being drawn is applied to the apartment sizing and CO<sub>2</sub> emissions or energy consumption. However, specific patterns emerging in the literature and the interviews show that specific problems seem to be a more frequent choice of application than the others. For example, the most common themes within the sufficiency discourse were meat consumption, mobility choices, apartment size, clothing, and energy consumption. Even though the framing implied that responsibility is not solely on

individuals, such currencies are a success criterion for policy-makers to measure the impact of sufficiency policies. However, the flexibility of the concept and the diversity of the topics being tackled showed that the currencies mentioned above do not seem naturally exclusive to the others. For example, could one not question other currencies with similar reasoning? What kinds of currencies and boundaries would we draw if we questioned the material and economic spending to, for example, megaprojects? Or could one not question with the same sufficiency logic, for example, the disproportionate policy support in specific fields such as cutting-edge innovation programs, or military projects? Or even if we take the same currencies such as meat consumption and apartment size, could we not use the same logic to question anti-patterns such as the concentration of production and consumption that has become excessive? The point is that perhaps there is not one choice of application superior to the other however the majority of the sufficiency scholars seem to be insisting on specific currencies of individual consumption. Perhaps another symptom of holding greater ontological distance to the subject of study, something as human as dietary choices when being studied from a greater distance adopting this privileged top-down point for the sake of logical and scientific consistency, causes sufficiency discourse to be situated far from the political realm even the topics themselves are so intimate. This greater distance, standardising approach, lacking a more politically grounded situatedness, is relevant if the sufficiency movement seeks wider public recognition and acceptance.

## Conclusion:

The ecological sufficiency concept is becoming popular within policy and academic circles. From dedicated conference tracks to politicians such as the Irish president or the French Prime Minister, from the IPCC climate change mitigation report to an increasing number of academic publications show that there is a growing momentum around the ecological sufficiency concept. The literature focusing on the ecological sufficiency concept often holds an advocative undertone to convince the reader why it is necessary. However, the ways in which we know about elements of the concept, such as excess, sufficiency, deprivation, environmental justice, and ecological ceiling, appear ambivalent at first glance. To explore such epistemic underpinnings within the discourse, this study directed these questions to the academic scholars who authored some of the key literature on the sufficiency concept. Semi-structured interviews were conducted and analysed using a constructivist grounded theory approach (Bryant & Charmaz, 2008). *Configuring Fields* (Stirling, 2019) and *Public Understanding of Science* (Wynne, 1992) has been adopted as an analytical lens to discuss the results.

The literature review emphasises that the concept critically engages with the existing environmental policy discourses by questioning the high modernity tendencies such as technological solutionism or policy narratives that neglect multi-faceted injustices embedded within the existing sustainability

transformations. Scholars are bringing forward crucial arguments by discussing how accelerating environmental degradation is linked with the social norms of excessive consumption and production. They also argue that the current policy efforts to tackle these socio-material challenges with technological solutions that emphasise resource efficiency as an overarching goal have significant shortcomings due to rebound effects, limited resources, and global injustices. The scholars often rightfully point out that these approaches' underlying ideological underpinnings highly relate to the challenges of modernity. Scholars often describe these approaches as ecological modernisation and propose the sufficiency concept as an antidote and shift of mindset to counter it.

However, the interview results investigating the epistemic roots of the sufficiency concept reveal that the sufficiency concept itself and its epistemic resources are also prone to some of these challenges that can fall under the same idea of ecological modernisation. The traces of modern knowledge-making tradition and some of its problematic approaches appear highly present in various forms of literature and interview conversations and complicate the promise of the sufficiency concept as an antidote to the expansion of modernity. Even though the sufficiency scholars provide critical reflexivity dimensions that tackle the social and environmental challenges of late modernity, their reflections often did not go deep enough to recognise how some aspects of modernity are deeply embedded within the scientific knowledge-making tradition. By analysing and discussing some of the political and cognitive traces of modernity that appear within the sufficiency discourses, this study aims at deepening these reflections and enlarging the scope of criticism towards knowledge-making direction.

These traces mostly appeared in the form of political situatedness of sufficiency policy problems and some of the prescriptions of society within scientific rationale. Firstly, scholars often mentioned that the public uptake of the sufficiency concept is challenging. However, their vision of public engagement within knowledge and policy-making did not go beyond the axis of rejection or acceptance. Secondly, control appeared as a very central theme within the ways in which scholars envisioned sufficiency policies. The assumption that the only way to mobilise societal action is through policies prioritising control is often contested by scholars as it alienates individuals from owning these social and environmental problems. Furthermore, some of the policy approaches that aim at standardising some social attributes through a vision of sufficiency lack the pluralistic sense of society.

Another important theme was how responsibility is framed within the sufficiency discourse. Even though the responsibility to undertake the burdens of socio-material transformations was often allocated to policymakers, the performance criteria for measuring the success of these consumption reductions were often formulated based on the individual life habits in various currencies, such as the size of the apartment, modes of mobility and amount of meat consumption. However, the other important actors that contributed to the emergence of these consumption habits were not addressed. One could apply the



reasoning of sufficiency to various other problems, such as what sufficiency would mean for the people producing things or some of the other apparent excess-inflicted sites such as megaprojects or knowledge-making itself.

The other problematic aspects are related to the political framing of the sufficiency problems. Being inspired by the Configuring Fields Approach (Stirling, 2019), what is apparent in the sufficiency discourses is that top-down rationale that inherits the privileged power position. Adopting these assumptions of control and utilisation of the concept poses risks of exacerbating the existing problematic accumulations of power, even if the intention is to challenge it. By drawing axiomatic relationships between incommensurable values such as apartment size, well-being and environmental justice and withholding to a position of looking at these problems from a greater ontological distance, existing formulations of the sufficiency concept seem to fail at demonstrating the properties of the accumulated power incumbency that is being intended to change. To make these power structures visible, Stirling(2019) proposes an alternative way of looking at these problems (worm-eye view) by enlarging the ontological scope as much as possible, deeper reflections on the ontological parallax and more attention to the topological characteristics of incumbency.

Wrapping up the study results, these traces of modern knowledge-making practices risk some of the intentions expressed within the sufficiency discourses. Much deeper reflections on the knowledge-making itself appear necessary for the sufficiency movement to effectively contribute to these ideals, such as being an antidote to the expansion of modernity, environmental flourishing, and just transformations. Additionally, a more comprehensive scan of literature and discourses around sustainability transformations reveals that these challenges do not seem specific to the sufficiency concept itself but are very much apparent in various other concepts in different forms and types. Therefore, some of the findings might also be relevant to other concepts. These challenges that perhaps could be attributed to modernity are highly present within the scientific knowledge-making tradition itself (including this thesis), and attempts to solve it through concepts like sufficiency without fully addressing some of its epistemic and social commitments appear rather challenging. Perhaps a more open recognition of these challenges and accepting it as a collective struggle rather than compartmentalising what is modern could be a better strategy for future trajectories.

## References

- Arora, S., & Stirling, A. (2021, May 5). *Degrowth and the pluriverse: Continued coloniality or intercultural revolution?* - STEPS Centre. Pathways to Sustainability.  
<https://steps-centre.org/blog/degrowth-and-the-pluriverse-continued-coloniality-or-intercultural-r-evolution/>

- Arora, S., & Stirling, A. (2023). Colonial modernity and sustainability transitions: A conceptualisation in six dimensions. *Environmental Innovation and Societal Transitions*, 48, 100733. <https://doi.org/10.1016/j.eist.2023.100733>
- Beck, U. (1992). *Risk society: Towards a new modernity*. Sage Publications.
- Best, B., Thema, J., Zell-Ziegler, C., Wiese, F., Barth, J., Breidenbach, S., Nascimento, L., & Wilke, H. (2022). Building a database for energy sufficiency policies. *F1000Research*, 11, 229. <https://doi.org/10.12688/f1000research.108822.2>
- Boström, M., Lidskog, R., & Ugglå, Y. (2017). A reflexive look at reflexivity in environmental sociology. *Environmental Sociology*, 3(1), 6–16. <https://doi.org/10.1080/23251042.2016.1237336>
- Brown, M. B. (2015). Politicizing science: Conceptions of politics in science and technology studies. *Social Studies of Science*, 45(1), 3–30. <https://doi.org/10.1177/0306312714556694>
- Bryant, A., & Charmaz, K. (2008). *The Sage handbook of grounded theory*. Sage publ.
- Casal, P. (2007). Why Sufficiency Is Not Enough. *Ethics*, 117(2), 296–326. <https://doi.org/10.1086/510692>
- Casal, P. (2012). Progressive Environmental Taxation: A Defence. *Political Studies*, 60(2), 419–433. <https://doi.org/10.1111/j.1467-9248.2011.00924.x>
- Chun Tie, Y., Birks, M., & Francis, K. (2019). Grounded theory research: A design framework for novice researchers. *SAGE Open Medicine*, 7, 205031211882292. <https://doi.org/10.1177/2050312118822927>
- COP28 side event. (n.d.). *Sustainable lifestyles for climate action and policies for ALL - YouTube*. Retrieved March 7, 2024, from <https://www.youtube.com/watch?v=8yuscHiSiiU>
- Crispin, S. W. (2006). *In Thailand, a return to “sufficiency.”*
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Durant, D. (2010). Public Participation in the Making of Science Policy. *Perspectives on Science*, 18(2), 189–225. <https://doi.org/10.1162/posc.2010.18.2.189>
- Energy Sobriety -What does the Energy Sobriety Plan provide for households? | Service-Public.fr*. (2022). Retrieved March 7, 2024, from <https://www.service-public.fr/particuliers/actualites/A16012?lang=en>
- Fischer, C., Griefs shammer, R., Barth, R., Brohmann, B., Brunn, C., Heyen, D. A., Keimeyer, F., & Wolff, F. (2013). *When less is more—Sufficiency: Terminology, rationale and potentials*.
- Frankfurt, H. (1987). Equality as a Moral Ideal. *Ethics*, 98(1), 21–43. JSTOR.
- Fuchs, D., Di Giulio, A., Glaab, K., Lorek, S., Maniates, M., Princen, T., & Röpke, I. (2016). Power: The missing element in sustainable consumption and absolute reductions research and action. *Journal of Cleaner Production*, 132, 298–307. <https://doi.org/10.1016/j.jclepro.2015.02.006>

- Gable, M. (2022, August 3). *French energy sufficiency plan experiences déjà vu*.  
[https://www.lemonde.fr/en/economy/article/2022/08/03/french-energy-sufficiency-experiences-deja-vu\\_5992350\\_19.html](https://www.lemonde.fr/en/economy/article/2022/08/03/french-energy-sufficiency-experiences-deja-vu_5992350_19.html)
- Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration* (1. publ). Univ. of California Press.
- Handley, P. M. (2006). *The king never smiles: A biography of Thailand's Bhumibol Adulyadej*. Yale University Press.
- Huber, J. (2000a). *Industrielle Ökologie. Konsistenz, Effizienz und Suffizienz in zyklusanalytischer Betrachtung*.
- Huber, J. (2000b). Towards industrial ecology: Sustainable development as a concept of ecological modernization. *Journal of Environmental Policy & Planning*, 2(4), 269–285.  
<https://doi.org/10.1080/714038561>
- Huseby, R. (2020). Sufficiency and the Threshold Question. *The Journal of Ethics*, 24(2), 207–223.  
<https://doi.org/10.1007/s10892-020-09321-7>
- Ingleby, M., & Randalls, S. (Eds.). (2019). *Just Enough: The History, Culture and Politics of Sufficiency*. Palgrave Macmillan UK. <https://doi.org/10.1057/978-1-137-56210-4>
- Intergovernmental Panel On Climate Change (Ippcc) (Ed.). (2023). *Climate Change 2022 - Mitigation of Climate Change: Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (1st ed.). Cambridge University Press.  
<https://doi.org/10.1017/9781009157926>
- Irwin, A., & Wynne, B. (Eds.). (2003). *Misunderstanding science? The public reconstruction of science and technology* (1. paperback ed). Cambridge University Press.
- Jonkman, A., & Janssen-Jansen, L. (2018). Identifying Distributive Injustice Through Housing (Mis)Match Analysis: The Case of Social Housing in Amsterdam. *Housing, Theory and Society*, 35(3), 353–377. <https://doi.org/10.1080/14036096.2017.1348392>
- Jungell-Michelsson, J., & Heikkurinen, P. (2022). Sufficiency: A systematic literature review. *Ecological Economics*, 195, 107380. <https://doi.org/10.1016/j.ecolecon.2022.107380>
- Kanschik, P. (2016). Eco-Sufficiency and Distributive Sufficiency – Friends or Foes? *Environmental Values*, 25(5), 553–571. <https://doi.org/10.3197/096327116X14703858759099>
- Latour, B., & Latour, B. (1994). *We have never been modern* (3. print.). Harvard Univ. Press.
- Leahy, P. (2023). *President condemns 'obsession' with economic growth – The Irish Times*. Retrieved March 7, 2024, from  
<https://www.irishtimes.com/politics/2023/04/28/president-condemns-obsession-with-economic-growth/>
- Lynch, M., & Cole, S. (2005). Science and Technology Studies on Trial: Dilemmas of Expertise. *Social Studies of Science*, 35(2), 269–311. <https://doi.org/10.1177/0306312705048715>

- Nees, J. van E., & Waltman, L. (2009). *VOSviewer* (1.6.19 (0)) [Computer software].  
<https://www.vosviewer.com/>
- Niessen, L., & Bocken, N. (2022). *A Sufficiency Business Database as a Tool to Drive Sustainable Business Models* [dataset].  
<https://www.circularx.eu/en/tool/26/business-for-sufficiency-database>
- Princen, T. (2005). *The logic of sufficiency*. MIT Press.
- Princen, T. (2022). Sufficiency and the state: A prospective project. *Frontiers in Sustainability*, 3, 956139. <https://doi.org/10.3389/frsus.2022.956139>
- Promchertchoo, P. (2016). King Bhumibol Adulyadej (1927—2016). *Channel News Asia*.  
<https://www.channelnewsasia.com/asia/king-bhumibol-adulyadej-1927-2016-1038001>
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., De Wit, C. A., 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>
- Roemer, J. E. (2004). Eclectic distributional ethics. *Politics, Philosophy & Economics*, 3(3), 267–281.  
<https://doi.org/10.1177/1470594X04046238>
- Saheb, Y. (2023). *Opening Session- Sufficiency Summit*. Retrieved March 7, 2024, from  
<https://www.sufficiencysummit.com/opening&keynote.html>
- 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>
- Sarewitz, D. (2011). Does climate change knowledge really matter? *WIREs Climate Change*, 2(4), 475–481. <https://doi.org/10.1002/wcc.126>
- Schumacher, E. F. (1975). *Small is beautiful: Economics as if people mattered* (21. [ed]). Harper & Row.
- Shields, L. (2020). Sufficiencyarianism. *Philosophy Compass*, 15(11), 1–10.  
<https://doi.org/10.1111/phc3.12704>
- Skoda, H. (2019). Enough-ness in the Later Middle Ages. In M. Ingleby & S. Randalls (Eds.), *Just Enough* (pp. 29–46). Palgrave Macmillan UK. [https://doi.org/10.1057/978-1-137-56210-4\\_3](https://doi.org/10.1057/978-1-137-56210-4_3)
- 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>
- 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>
- Spengler, L. (2018). *Sufficiency as Policy: Necessity, Possibilities and Limitations*. Nomos Verlagsgesellschaft mbH & Co. KG. <https://doi.org/10.5771/9783845284743>

- Stirling, A. (2019a). How deep is incumbency? A 'configuring fields' approach to redistributing and reorienting power in socio-material change. *Energy Research & Social Science*, 58, 101239. <https://doi.org/10.1016/j.erss.2019.101239>
- Stirling, A. (2019b). Sustainability and the politics of transformations: From control to care in moving beyond modernity. In J. Meadowcroft, D. Banister, E. Holden, O. Langhelle, K. Linnerud, & G. Gilpin (Eds.), *What Next for Sustainable Development?* Edward Elgar Publishing. <https://doi.org/10.4337/9781788975209.00023>
- Stirling, A., & Arora, S. (2021, May 5). Degrowth and the pluriverse: Continued coloniality or intercultural revolution? *Pathways to Sustainability*.
- Thailand human development report*. (1999). United Nations Development Programme.
- VERBI Software. (2023). MAXQDA (24.1.0) [Computer software]. VERBI Software. <https://www.maxqda.com>
- WRF. (2023). *World Resources Forum 2023 – World Resources Forum 2023*. <https://wrf2023.org/>
- Wynne, B. (2006). Public Engagement as a Means of Restoring Public Trust in Science – Hitting the Notes, but Missing the Music? *Public Health Genomics*, 9(3), 211–220. <https://doi.org/10.1159/000092659>
- Wynne, B. (2010). Strange Weather, Again. *Theory, Culture & Society*, 27(2–3), 289–305. <https://doi.org/10.1177/0263276410361499>
- Zell-Ziegler, C., Best, B., Thema, J., Wiese, F., Vogel, B., & Cordroch, L. (2024). *European Sufficiency Policy Database* (Energy Sufficiency Research Group) [dataset]. <https://energysufficiency.de/policy-database/>