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INTRODUCTION

# Exploring energy sufficiency: New challenges and options in times of crisis

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**Abstract** • The war in Ukraine is changing the political landscape at breakneck speed. How should politics and society react to high energy prices and a precarious dependence on fossil fuels imports? Can modern societies get by with much less energy? Energy sufficiency can play an important role in answering these questions. The contributions in this Special topic explore sufficiency as an interdisciplinary research topic for energy modeling, scenarios, and policy.

***Energiesuffizienz erforschen**:*
*Neue Herausforderungen und Chancen in Krisenzeiten*

**Zusammenfassung** • *Der Krieg in der Ukraine verändert die politischen Prämissen in rasender Geschwindigkeit. Wie sollen Politik und Gesellschaft auf hohe Energiekosten und eine fatale Abhängigkeit von fossilen Energieimporten reagieren? Können moderne Gesellschaften mit viel weniger Energie auskommen? Energiesuffizienz kann eine wichtige Rolle bei der Beantwortung dieser Fragen spielen. Die Beiträge in diesem Special topic erforschen Suffizienz als einen interdisziplinären Forschungsgegenstand für Energiemodellierung, -szenarien und -politik.*

**Keywords** • *energy sufficiency, energy descent, co-benefits, energy demand, sufficiency policy*

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## Introduction

Sufficiency as a general sustainability strategy is a well-known concept (Huber 1995; Sachs 1993). However, despite being a frequent subject of debate in science and civil society, it is not well established in the political arena (Best 2022; Zell-Ziegler et al. 2021). In contrast to efficiency and consistency, sufficiency aims for absolute reductions. In particular, the challenge of mitigating climate change means that demand-side policies must be developed with ever greater urgency. Moreover, the current energy crisis, triggered by Putin's war against Ukraine, reveals the structural dependencies of industrialised countries on fossil fuels; consequently, it calls for a rapid reduction in energy use by industry and households (Autor:innengruppe Energiesuffizienz 2022). Scientific evidence of the potential of demand-side policies calls for policy makers to develop sufficiency policies (Skea et al. 2022).

Taking the German transport sector as an example: growth prohibits any progress in terms of emission reductions. In 2009, the stock of cars was 41.3 million; 12 years later this already huge number had increased by 7.2 million to 48.5 million vehicles registered on 01 January 2022 in Germany (KBA 2022). What is worse, not only did the number of cars increase but also their size, weight and power, with an increasing share of new cars being so-called sports utility vehicles (SUVs). The growth in the number of registered cars in Germany is three times the number of registered electric cars in the country. Currently, only 0.6 million battery-electric vehicles and 1.7 million hybrid-electric vehicles are registered in Germany. Sufficiency means reducing the stock of cars: this strategy is acknowledged in all cli-

mate neutrality scenarios in Germany (Lübbers et al. 2022) but it is absent from current German policy. Sufficiency also means reducing the size and power of cars to a suitable level for fulfilling indispensable tasks: electric powered SUVs are simply not sustainable.

Sufficiency is a key policy strategy for enabling the technological transformation of sectors to become climate neutral over the next decades (Wiese et al. 2022 b). Sufficiency can serve as a guiding principle for technological strategies ('sufficiency first' principle: Böcker et al. 2021; Saheb 2021). There is a lot of discussion and research on sufficiency, leading to a growing body of literature and to conceptual complexities. Increasing interest in sufficiency strategy from scientists sharpens the need to define this strategy, which focuses not on technical solutions but on social innovations. In the context of sufficiency strategy, the consumption of resources and nature is not reduced by improving products or production processes, but by satisfying needs through other actions (e.g., travelling by public transport or bicycle instead of in one's own car).



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## Different concepts of sufficiency

Sufficiency is a condition and a strategy: as a condition or state it is defined in relation to climate and ecological boundaries, and as a strategy it is a reflection of needs and changes in social practices (Sorrell et al. 2020). Researchers emphasise that sufficiency also relates to a minimum standard of needs satisfaction or well-being (Bierwirth and Thomas 2019; Spengler 2016). In contrast to efficiency and consistency, sufficiency means achieving resource savings and social justice through social innovation; that is, through changes in behaviour or resource use. Energy sufficiency is a relatively new term and scientific literature has not yet achieved a consensus on its definition. Most commonly, energy sufficiency "is the strategy of achieving absolute reductions of the amount of energy-based services consumed" (Zell-Ziegler et al. 2021, p. 2). Furthermore, it refers to a situation "where everyone has access to the energy services they truly need, not just want, whilst the impacts of the energy system do not exceed environmental limits" (Gynther 2021, p. 1).

Although sufficiency is conceptualised as individual downshifting by some (Paech 2020), the scientific community widely acknowledges that this does not represent the wider potential of sufficiency (Dengler and Schmelzer 2021; Kalt and Lage 2019; Kopatz 2016; Schneidewind and Zahrnt 2014; Spangenberg and Lorek 2019). Sufficiency policy – which is, like other policy fields, an instrument mix – addresses the structural generation of energy demands as an essential component of sustainability transitions. It should be included more thoroughly in modeling, scenarios and policy for energy, transport, buildings, industry and agri-food (Wiese et al. 2022 b; Zell-Ziegler et al. 2021; Zell-Ziegler and Förster 2018). Many sufficiency policies are present in non-energy sectors such as agri-food or production/consumption, including for example the extension of warranty periods, repairability, and climate-friendly menus in public canteens.

The articles in this volume show that definitions of sufficiency also differ according to whether sufficiency is self-initiated or third party-initiated. Voluntary sufficiency practices (based on a reflection of needs) and policies enabling these actions may differ from sufficiency practices due to changed framework conditions (e.g., policy measures); and they are, of course, fundamentally different from energy poverty. For the design of a sufficiency-oriented policy mix, policy signals must be clear: for example, in terms of price instruments that push back unsustainable practices over the course of time. However, the policy design must also prioritise equity: if social aspects and distributive justice are not considered, demand-side policies that neglect lower-income households or reduce their living standards are likely to provoke a backlash, protest or even a crisis.

## Potential benefits of sufficiency

In the following, we summarise the potential contributions that sufficiency can make in terms of respecting planetary boundaries, resilience, well-being, justice and freedom. The benefits of sufficiency described briefly in the following are further elaborated by Wiese et al. (2022 a).

### Sufficiency appears crucial for avoiding the transgression of planetary boundaries

Worsening socio-ecological crises, such as climate change and biodiversity loss, demonstrate the urgent need to develop ways of living and doing business that respect planetary boundaries and secure everybody's needs. The responsibility for developing such approaches lies primarily (but not solely) in the global north (Brand et al. 2021; Rockström et al. 2009). Given the most


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recent IPCC estimations, industrialised countries must become climate neutral well before 2050 and achieve negative emissions (i.e., remove more green house gas (GHG) than they emit) in the second half of the 21st century. However, this may only be possible through geo-engineering or carbon capture and storage; both these technologies are highly uncertain and are broadly untested. Therefore, applying sufficiency strategies in addition to efficiency improvements and fully closed natural cycles (i.e., consistency strategy) not only increases the likelihood of remaining below 1.5° Celsius to 2° Celsius warming, but also decreases the dependence on risky technologies.

In addition to mitigating climate change, there are other boundaries – like land-system change and biosphere integrity – that need to be preserved. Some technological greenhouse gas abatement solutions face serious limitations because substantial amounts of energy and resources are needed to provide them. For example, the import of synthetic fuels and hydrogen require land area, resources and substantial amount of energy in the exporting countries along with substantial development of respective transport infrastructure Sufficiency actions increase the solution space and the scope for other abatement actions which can, for example, reduce land-use pressures and the need for energy and resource imports.

### Sufficiency mitigates the unintended side effects of other sustainability strategies

Currently, the dominant strategies for mitigating climate change are the shift towards renewable energies and efficiency improvements. While efficiency and consistency strategies are indispensable, they both have drawbacks. Efficiency improvements may reduce energy demand per service unit but, at the same time, they can generate various rebound effects which counteract part (or all) of the savings potential (Santarius 2016; Sorrell 2009). If, however, individuals simultaneously pursue sufficiency (i.e., a strategy of voluntary downshifting and reflection on one's own needs), the application of efficient technologies is less likely to generate rebound effects.

Likewise, with regard to consistency strategies. Studies suggest that a shift towards renewable energies may lead to consumers – and prosumers with their own photovoltaic installations who enjoy low electricity prices – thinking that their level of energy consumption does not matter anymore (i.e., 'the sun is always shining'). This could actually increase their demand (Galvin et al. 2021). However, if sufficiency is pursued in combination with a shift towards renewables, overall demand should not increase.

It should be noted that there is discussion in the literature about the possibility of sufficiency strategies also generating rebound effects. Parts of that discussion, however, confuse sufficiency with other kinds of absolute reduction in demand (Sorrell et al. 2020). For instance, if sufficiency is practiced due to external incentives (e.g., high energy prices or top-down directives), consumers may feel that their needs are not being met. It remains a matter of definition whether such situations should be categorised under the umbrella of sufficiency (see our definition above). If sufficiency is practiced on the basis of voluntary downshifting and reflection on one's own needs, rebound effects are unlikely. However, there could be a micro-macro discrepancy (Santarius 2016): sufficiency-oriented practices by some consumer groups or countries could reduce energy prices globally and consequently lead to an increase in demand by other groups or in other countries (Alcott 2008).

### Sufficiency fosters sovereignty and resilience

Beyond contributing to climate and energy goals, sufficiency has the potential to increase the resilience of socio-economic systems. Knowing how to influence or change energy demand and social practices is important in situations in which demand reduction is imposed by external circumstances (Autor:innengruppe Energiesuffizienz 2022; Barth et al. 2022). For instance, sufficiency can support a policy strategy aimed at becoming less dependent and vulnerable in times of geopolitical uncertainty. This is evident in the current public debate about the war in Ukraine: it is claimed that sufficiency measures (e.g., turning down the heating or using public transport) could reduce the finances available to the Russians for their war effort and, at the same time, could help to stabilise the overall economy for as long as dependence on Russian oil and gas persists. Some even consider that sufficiency measures could make a direct contribution to peace. For instance, Italy's prime minister Mario Draghi suggested that "the question is between peace and having (…) air conditioning in summer" (AFP/The Local 2022).

More generally, using all the available strategies (beyond simply focusing on technological solutions) supports the energy transition by reducing energy demand and promoting energy sufficiency policies (Best and Hanke 2013). A combination of energy sufficiency with strategies for energy efficiency and renewable energies enhances the diversity of options and the flexibility of policy action (for sufficiency potentials in the housing sector, see Cordroch et al. 2021). A sufficiency perspective in the energy system means not exploiting potential supply levels to a maximum – thus increasing resilience by reducing the threat of supply shortfalls.

### Sufficiency increases health and well-being

Sufficiency can lead to many positive effects, often called multiple or co-benefits. These include positive effects on individual health (reduced stress/burnout), increased autonomy/liberty (Paech 2012), better personal finances (through spending less money), and having more time for family, friends and oneself. Hook et al. (2021) analyse 23 empirical studies on the connection between voluntary simplicity and well-being and confirm a consistent positive relationship. Based on expert judgement and a literature review, Creutzig et al. (2021) conclude that 79 % of 306 demand-side options have positive effects on well-being. The evidence of the positive impacts of compact-city designs, active travel modes, diet shifts, etc. on human well-being is ro-



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bust. However, beyond the individual level, there is little evidence of effects in social dimensions such as political stability and social cohesion.

### Sufficiency is fast and cost-effective

Technologies and infrastructure for climate protection require investment, ramping-up, research and development. However, meeting carbon emissions targets implies a steep GHG reduction pathway, which makes the speed and cost of mitigation options crucial. Sufficiency often requires no investment or special infrastructure (or very little), which means it can be implemented rapidly. Modeling shows that demand-side options are often the most cost-effective in terms of costs per GHG reductions (Zozmann et al. 2021). Moreover, simply stopping measures that counteract sufficiency (such as fossil fuel subsidies or the expansion of airports etc.) can happen quickly under certain conditions and can free up funds that are urgently needed for investment in the energy transition.

The IEA tracks the progress of many climate mitigation technologies (IEA 2021) and has concluded that the deployment of renewable energies is not happening fast enough to meet the goals. In the wake of the current geopolitical crisis, the IEA has proposed many fast sufficiency options in its '10-Point Plans' to reduce the EU's reliance on Russian gas and oil (IEA 2022 a; 2022 b). Other sufficiency policies are long-term projects that require investment, new and/or modified infrastructure and also shifts in mindset. Changing urban settlement planning cannot happen fast, although policy goals can facilitate first small steps.



### Sufficiency enhances justice and freedom

Sufficiency policy is prone to failing if it increases societal inequalities. At the same, however, sufficiency can play a key role in improving environmental and social justice. Consider a rapid reduction in emissions today. It would relief the burden of climate protection for future generations. Sufficiency would also lead to a reduction in energy demand from those who use too much ('overconsumption'). Consequently, sufficiency policy must aim to reduce the consumption levels of affluent people and societies (Burke 2020). It could even support an increase in demand from those who live on demand levels below what is considered a decent living (Darby and Fawcett 2018; Raworth 2017).

Moreover, sufficiency can promote justice not only in terms of distribution, but also in terms of the recognition of basic human rights. For instance, it can increase access to energy for the underprivileged by introducing measures that reduce energy consumption and decrease energy prices (Barth et al. 2022). Economic institutions and policy makers should to create mechanisms for social redistribution when internalising the costs of energy consumption and environmental pollution (Held 2018).

## New research on energy sufficiency

Sufficiency policy and research has gained increasing levels of attention over recent years. This is the first and introductory article of a set of new publications on energy sufficiency in a Special topic in TATuP – Journal for Technology Assessment in Theory and Practice. The articles in this issue will explain in greater detail how energy sufficiency is a policy option for solving multiple crises. They will also deliver more detailed explanations about the multiple co-benefits of sufficiency: for instance, how it contributes to greater social justice. Calls for energy sufficiency policy are increasing, but so far political institutions and actors have shown little interest. In an effort to overcome the political inertia, this Special topic also includes an interview with the mayor of the city of Wuppertal).

The following challenges and contributions made by sufficiency are explored in this Special topic. First of all, in terms of the differences between sufficiency concepts and definitions, several articles contribute to widening the various perspectives and understandings of sufficiency. In their article, 'Prosuming–energy sufficiency and rebound effects', Nesrine Ouanes et al. conceptualise sufficiency at household level and analyse inter-

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actions between energy self-sufficiency, load shift, demand reduction and energy flows from the grid. The same problem is addressed by Jonathan Coignard et al. in their article, 'Are more solar panels always better?', which introduces a new parameter (natural self-sufficiency). Several articles focus on modeling and scenarios: Patrick Zimmermann quantifies the energy sufficiency potentials for buildings in his article, 'Transition pathways for the European building sector', showing that a combination of sufficiency, efficiency and consistency has the highest potential across different impact categories. The contribution made by Carina Zell-Ziegler and Johannes Thema, 'Impact chains for energy sufficiency policies', conceptualises the inclusion of sufficiency measures into demand side-models and provides a deep dive into the co-benefits of energy sufficiency measures using a novel form of graphic representation. Jonas Lage and Marie Graef also consider co-benefits in their article, 'Co-Benefits als


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Katalysatoren für Suffizienzpolitik'; their analysis provides an overview of the co-benefits from sufficiency that citizens can expect. In the article, 'Wie neu ist Energiesuffizienz?', Nicole Hesse and Christian Zumbrägel present a historical analysis of changes in energy practices, tracking historical cases of energy savings and demonstrating the importance of multidisciplinary energy research.

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