

Energy sufficiency through social innovation in housing¹

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Abstract

Experience shows that energy savings through energy efficiency measures are partly compensated by income growth, and partly by rebound effects. Therefore to be effective, efficiency measures have to be embedded in a concept of sufficiency which strives for limits and absolute reduction of energy consumption. While the sufficiency concept is not new, it only recently gained attention in the field of housing. This paper provides a basis for broader and more informed debates in policy and research on the potential of sufficiency considerations to contribute to the overall reduction of energy consumption in the residential sector. It recommends shifting the attention from energy consumption of buildings towards a concept of sustainable homes in which e.g. the size of the living area plays a crucial role. A further important aspect is the possibility to fulfil other basic needs like the provision with food, recreation and social contacts in the nearby environment. The paper describes first examples of housing projects guided by sufficiency criteria, depicts the potential roles of different actor groups and points towards some general policy recommendations.

Key words: energy consumption, households, social innovation, sufficiency

Highlights:

Increase of m² living area per person counteracts efficiency gains

Quality living space on reduced size requires innovative provisioning functions

Policy instruments need to expand to sufficiency solutions in addition to efficiency

Creative communication processes help to build trust between stakeholders involved

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1 Introduction

In the last four decades, energy efficiency increased significantly in OECD countries. However, only recently, total energy consumption started to decrease a little, and much more slowly than the realised energy efficiency potentials would suggest. Efficiency improvements are considered to provide reductions in energy use without corresponding inconvenience or loss of amenity. In this perception, efficiency might best be thought of as a measure of *relative* consumption, relative to the life satisfaction gained from consumption. Furthermore, efficiency is usually measured for a specific technical system, and not for broader human behavioural patterns. As a result relative improvements of technical systems dominate the debate, while the distance to target – the issue of concern to environmental policy – is not the decisive criterion in technology development, marketing and labelling.

Efficiency tends to reap the low hanging fruits, but less of them than frequently expected due to rebound effects on the micro- and the macro-level (Greening, Greene et al. 2000 p.63). Since sufficiency provides the means to skim-off the rebounds, we consider it a necessary complement to efficiency strategies, a condition of their effectiveness. As a result, a focus on energy efficiency alone is not enough to reduce the overall energy consumption in line with climate change policy targets. It has to be and accompanied by – in fact embedded in – in a concept of sufficiency (Princen 2005), also referred to as enoughness, which emphasises reductions of resource use in absolute terms (Spangenberg 2014). In the consumption discourse, it is known as strong sustainable consumption (Lorek 2010) and applies to domestic energy consumption as for any other consumption domain (Lorek and Spangenberg 2014). Given the ambitious target of limiting climate change to below 2° and getting as close to 1.5° as possible enshrined in the Paris Accord and ratified by the EU, reducing energy consumption is required in all sectors. While the EU 2020 Energy Strategy has set 20% targets for renewable energy, greenhouse gas reduction, and energy efficiency for 2020, the 2030 Energy Strategy proposes more stringent targets for renewables, energy efficiency, and greenhouse gas reductions for the period 2020-2030 and the 2050 Energy Strategy aims at reducing greenhouse gas

emissions by at least 80%, these figures do not yet fully incorporate the Paris ambitions.

Consequently, Europe and (all) other countries need to look beyond efficiency improvements towards how we can reduce not only energy intensity, but also absolute energy consumption, and to seriously discuss and understand what drives consumption. This is the background against which energy sufficiency has gained new attention as a way to limit and reduce total energy consumption of a household or a country (Steinberger and Roberts 2010, Schneidewind and Zahrnt 2014, Spengler 2016). We need a profound discussion on sufficiency and limits neither neglecting consumer involvement, nor delegating responsibility to them since neither option offers solutions to the sustainability challenges.

This paper deals with sufficiency in housing. Next to nutrition and mobility, housing is one of the three dominating domains of household resource consumption (Lorek and Spangenberg 2001, Spangenberg and Lorek 2002) so it appears as a suitable starting point for a broader sufficiency debate. Instead of focussing on rather marginal aspects of energy saving like 'turn off the light' or 'don't leave your charger in the plug', it focusses on a major driver of energy consumption in housing: the increasing size of floor space per capita. An adequate standard of living, including housing, is a human right included in the Universal Declaration of Human Rights – all the more important is to derive criteria and strategies for what is 'adequate' and how overconsumption can be reduced or avoided.

The paper proceeds as following: section 2 lays out the methodology we followed in gaining our insights. Section 3 describes the need and the possibilities for energy sufficiency at homes, before section 4 presents and discusses alternative concepts of financing more sufficient homes. Section 5 then turns the attention to the role of the various stakeholders in the sufficiency field while section 6 focuses on possible and necessary public policies. In section 7 we open up the field briefly considering how energy sufficiency is applicable for developing economies. Conclusions from our findings as well as an outlook for further research and policy needs can be found in the final section 8.

2 Methodology

This paper draws on research undertaken for the project on *European Futures for Energy Efficiency* (EUFORIE). In this project we previously identified promising instruments for improving the energy efficiency in households, sourced from eight European country studies (Trotta, Lorek et al. in press). Finland, Germany, Italy and Spain were taken into account as they represent the countries of the EUFORIE consortium and at the same time already cover some of the larger EU countries and provide a sufficient north-south representation. In addition Hungary, Latvia, Romania and the UK were selected to cover the east-west spread within the EU considering adequate representation of the new member countries². The insights from this country analysis into the limits of efficiency underscored the necessity to embed efficiency into sufficiency considerations if substantial energy consumption reductions are to be achieved.

Unfortunately sufficiency issues are hardly found in traditional EU reporting or data bases. The paper therefore is based on intensive literature review in consumer/consumption, ecological economics, sustainability and other journals. In an initial rather general google scholar search we identified over 50 journals relating to energy, sustainability or consumption issues and conducted more detailed research in 17 of them³. While in the majority of journals the term sufficiency does not appear at all, a few publications mentioning it concentrate on self-sufficiency in a sense of voluntary simplicity or for smaller administrative units and municipalities. This however, is not what this paper intends to identify. Instead it develops sufficiency in a broader context also considering national or European administrative or regulatory political framing conditions which support sufficiency thinking and practice beyond individual sacrifice.

²All country reports are available on the EUFORIE website
<http://www.utu.fi/en/units/euforie/Research/deliverables/country-reports/Pages/home.aspx>

³ A detailed list can be found in: [Lorek, Sylvia & Spangenberg, Joachim \(2017\). Stocktaking of social innovation for energy sufficiency. EUFORIE - European Futures for Energy Efficiency. Deliverable 5.3, \[http://www.utu.fi/en/units/euforie/Research/deliverables/Documents/Euforie-D5.3_revised_10012018.pdf\]\(http://www.utu.fi/en/units/euforie/Research/deliverables/Documents/Euforie-D5.3_revised_10012018.pdf\)](#)

Sufficiency considerations in this sense were found in more hidden ways in various articles recognising the limits of efficiency approaches – mainly in energy, environment and housing related journals. The most concrete and developed ideas, however, still seem to be in a project phase and have not made their way to peer reviewed academic journals. Therefore the paper uses exemplary projects, mainly found in a German, Swedish and Swiss context, as additional information sources beyond the academic literature. The selection of the final collection of ideas and instrument presented here were enriched by exchange and interviews with scholars and practitioners working in the fields of e.g. energy efficiency, energy consultancy and ‘beyond GDP’ research and initiatives. 12 semi structured interviews took place in spring 2017 followed by a stakeholder workshop jointly organised by the EUFORIE project and Friends of the Earth, Germany.

3 Energy Sufficiency at homes

The existing trend in housing is a continuously growing floor space per capita. Not all European countries show the same average but at least the same direction. Forecasts for the EU expect a further increase from about 20 m² in 1960 to currently 45 m² per person in the UK or 15m² in post war Germany to 45m² in 2016 (Federal Statistic Office Germany 2017) to over 50 m² per person until 2030 (Deschermeier and Henger 2015). This is high compared to international figures (and independent of the income), with an average of 18 m²/capita in Shanghai, 20 m²/cap in Japan, 30 m²/cap in Singapore - the outlier is the USA with 74 m²/cap (Ho 2015). Reasons for this growth in living area demand include demographic trends and the inadequate housing on offer. In German cities, for example, in 2016, 40-50% of all persons lived in single person households, and about 30% in two person households while 3 to 4 room flats dominate the market. This leads to a situation where the number of 1 person households is in most cities 2 – 3 times as high as the number of 1 - 2 room flats (Nitt-Drießelmann 2016). Cities generally tend to have a lower average space per inhabitant. In Germany Berlin or Hamburg (39m²) are well below the average German 43m² measured on 2011 compared to German regions with mainly rural areas (Federal Statistic Office

Germany 2016). In addition the German statistics show an east-west difference which also characterise the huge variation between western and central and eastern European countries. Nevertheless, also within regions differences are remarkable. The city of Barcelona, for example reports an average of 31.5m²/person with a variation between the 73 administrative divisions of the city ranging from 19.3 to 49.5m²/person (Giampietro M., Pérez-Sánchez L. et al. 2017).

Obviously, other things being equal, more floor space needs more energy for space heating and cooling, ventilation, and lighting (except for the marginal number of zero energy buildings). It also allows the households to operate more and/or bigger appliances, all of which increase energy consumption. Whether this is an indication of people's willingness to consume (Røpke 1999) or if they are locked in (Sanne 2002) is an ongoing debate. Furthermore, continuously increasing flat and housing sizes tend to contribute to land conversion, a major driver of biodiversity loss, and more construction-related material flows. Furthermore, keeping energy consumption low requires additional house isolation to reduce the heat loss effects, and thus lower energy consumption comes with a trade-off in form of higher material resource consumption. In any case, without instruments limiting average dwelling floor area per person it is hardly imaginable how an absolute reduction in household energy demand could be achieved. Thus such instruments will have to be an important part of any energy sufficiency policy package as they address one important driver of energy consumption and non-sufficiency (Thomas, Brischke et al. 2015).

Even in efficient buildings running on renewable energy and equipped with best class appliances a moderately sufficient lifestyle can result in an additional reduction of 45% of greenhouse gas emissions (Pfäffli 2012). In her study arriving at this result Pfäffli highlights three main measures of successful sufficiency gains (1) reducing the per capita living area (calculation basis from 60m² to 40m²), (2) a moderate change in user behaviour in the use phase of household electric and electronics and (3) a change in the mobility modal split. To achieve this, constructors, building managers and tenants all have their role to play (Pfäffli 2012). Thus sufficiency concepts may become the best – perhaps only - chance to ensure that climate targets can still be reached.

A helpful perspective to overcome the tension between upscaling norms and factual needs and to recognise the surplus of the sufficiency approach regarding domestic energy consumption is offered by Ellsworth-Krebs and colleagues (Ellsworth-Krebs, Reid et al. 2015). They recommend looking from a perspective of 'home' and not purely the 'house'. As the house approach is based on a traditional development prioritising engineering, technology and techno-economic thinking its dominant focus is on thermal comfort around a suggested optimal temperature of 21°C (Fanger 1970). Ellsworth-Krebs and colleagues instead point towards the home approach which looks beyond the physical/material object and call for alternative discourse which recognises that comfort is constructed and cannot be objectively defined. The intervention strategy they therefore suggest emphasises more the social end than the technical means in this socio-technical line. This starts with recognising that occupant satisfaction is a rather complex social and societal issue and cannot be defined e.g. by a standardized room temperature. Instead it might increase with occupants' ability to sufficiently control the indoor environment, a frequent issue in the context of air conditioning versus individual airing. The home approach encourages the occupant to be active and central to shaping energy demand. This also helps to avoid overestimations of technical solutions (Date and Chandrasekharan 2017).

In addition the home approach also delivers its potential when considering aspects beyond the house. Energy effects of homes include more than just the own flat but the neighbourhood (Knüsel 2013) and how to ensure a good and comfortable life therein. Questions to raise for the promotion of sufficient lifestyles in such an understanding tackle the fulfilment of basic needs: Do people have easy access to (public) mobility options? Is recreation possible nearby? Especially the inclusion of mobility aspects is necessary for the sufficiency consideration of housing as mobility is the second determinant of household resource consumption (after housing and with nutrition). Other questions refer to social needs: Is the provisioning of daily needs nearby possible? Are there places to meet people? Can I receive guests? etc. Positive answers to such questions are needed for communities of

peers to change their consumption behaviour; a transition a single household can hardly achieve alone (Shove, Pantzar et al. 2012).

Thus concepts for sufficient living necessarily consider the location of the homes. Most projects striving for sufficient living conditions are found in urban areas (Vattenfall 2014, Mårtensson 2016, Gröner Forschungen und Entwicklungen GmbH 2017) not on the country side where property prices are much lower. They are often located in inner cities where the reduction of transport plays a crucial role (see the questions related to city planning in the previous paragraph). Fuhrhop for example found out that energy use is avoided when grocery shops are at reach either by foot or bicycle, when public transport is reachable within 500 m from the house and/or car sharing facilities are offered in similar distance; he also reactivates decade-old suggestions, now as examples for sufficiency enhancing solutions, to remove respectively newly build walls or even stairs between apartments where one of the owner or tenant needs less space while the other need more (Fuhrhop 2014).

4 Alternative concepts of financing more sufficient homes

4.1 Investing into social housing projects

Models of ownership for housing can strongly influence flexibility for the concept of homes. For instance, in the EU the population share which moved within the last 5 years was about 5% for house owners, 25% for house owners with mortgages/credit, 26% for tenants with reduced rent, and 44% for regular tenants (Eurostat 2016). Compared to classical ownership cooperative houses are an interesting model which often allows easier change of flat size and structure and thus can be adopted to changing demands, regardless if the increase or shrinking of space (Steffen 2014). Today, too many elderly people are living in former family flats, much too large for their demands and hard to maintain, as such flexibility is missing and moving would imply higher cost per m² and loss of the established social environment, even if the smaller flats required were available. Although the challenge has been known since decades and the necessary technological means are available, neither modern architecture nor the institutional setting has been adapted to deal with it. One

approach to enable sufficient, community enhancing living is the solidarity-based economy and crowd funding of sufficient numbers of 1-2 room flats and houses. The German *Mietshäuser Syndikat* (*apartment-house syndicate*) can serve as one example here. It provides support for self-organised housing projects. It invests in houses for such projects so that they can be taken off the real estate market (Miethäuser Syndikat 2016). Another possibility are local investment funds restricted to citizens of the municipality (Kaltenbrunner 2014). Especially the flexible use of shared space and facilities for further respectively additional rent offer an interesting potential to reduce concerns of investors into sufficiency motivated houses. And so do the reversible structure which allow necessary corrections with small effort (Steffen and Fuchs 2015).

4.2 Public incentives

House owners in various countries are supported through public loans. A funding criterion, e.g. in Germany, is the energy consumption of the flat/building measured per m². But comparable low energy consumption per m² can easily sum up to a high energy use in total, in particular if the cheap loans encourage planning for a larger living area. Therefore the more useful relation in a sufficiency context is energy consumption/person (Brischke and Spengler 2011, Hagbert 2016). A shift to such a measurement criterion would gain importance if the support with public loans were not based on the objects as such but on the number of users. Even more, next to public credits for energy efficiency renovation (in Germany KfW financing and other national, state and local schemes) a similar or superior stream of funding could be offered when sufficiency criteria are met (Steffen 2013). This would increase the incentives for compact dwelling and thus not only reduce energy consumption but reduce the need for further soil sealing.

To make moving more appealing for people living in flats or houses too large for their actual needs, besides providing the necessary smaller flats, is a full or partly reduction of real estate transfer tax which could be applied in cases where the new flat/house is at least a defined percentage smaller than the old home (Kopatz 2014, Thomas, Brischke et al. 2015). In general sufficiency aspects would benefit from a switch in the system of real estate and/or land tax (Löhr 2008, Kaltenbrunner 2014).

For example, land located in central urban areas has the disadvantage, in comparison with peripheral areas that owners are much more hesitant to sell. As property tax currently provides almost no stimulation to the market, there are strong financial arguments (as well as environmental considerations) to reform the system of property tax with the aim of reducing costs (Schiller, Gutsche et al. 2009). In countries that don't raise acquisition taxes but higher property taxes, the latter could be waived for some time. Bonus payments to older couples who sell their houses in favour of bigger families might be possible as well. Similar incentives for rented dwellings need some further consideration as well (Thomas, Brischke et al. 2015).

Financial support could also be gained through increasing flexibility on the local level when setting limits for dwelling allowances. For people living on social welfare public authority might justify paying higher dwelling allowance for energetically refurbished flats because they will benefit – or even be overcompensated – by the reduced costs for energy bills.

4.3 Non-market arrangements

Plausibly, for behavioural change to happen, opportunity and desirability of doing so must coincide. However, what makes such social innovations desirable, and which kind of opportunity must be given for change to materialise is still disputed. Such opportunities arise when people create combinations between new and existing elements, such as with newly acquired competences or new technology or equipment (e.g. disappearance of the coal oven for heating and the emergence of the wood pellet oven (Gram-Hanssen 2008, Gram-Hanssen 2010); in these processes, elements shape each other (e.g. maintenance of a coal oven requires different competences than a wood pellet oven) as practices related to household energy consumption – including indoor climate regulation, standby consumption and computer use – are interlinked. Changing unsustainable practices can be fostered through creating conditions under which desirable bundles of practices can be developed and disseminated (Gram-Hanssen 2011). For example, providing the possibility of using home offices might encourage people to work more at home and travel less (Spurling and McMeekin 2015), with impacts on both transport and home heating energy consumption, thus changing the way “things are

normally done” within the household.). Heiskanen and colleagues found five categories of ways to engage households and analysed the relevant contextual conditions: *“needs-based tailored support; pioneering practices; challenge, competition, game; learning by doing; peer-to-peer learning.”*

(Heiskanen, Laakso et al. 2018). Although these categories are somewhat overlapping and non-exhaustive, they refer to commonly used interventions aiming to influence energy use in real-world settings.

A final example may be given how sufficiency thinking can be rooted in social innovations motivated in completely different settings: The ‘homeshare’ concept – initiated in the early 1990s already – intends to enable two unrelated people to share their lives for their mutual benefit. Homesharers provide support and companionship to a householder in exchange for free or low-cost accommodation (Sánchez, García et al. 2011). According to ‘homeshare international’ the concept is established in actually 15 countries, among them Spain which hosted the 5th World homeshare congress in Madrid 2017 (Solidarios 2017) and the UK where the homesharing development since 2015 were supported by the Lloyds Bank Foundation and the Big Lottery Fund with £2 million. Here in over 150 local homesharing schemes and organisations more than 10.000 persons are involved (SharedLivesPlus 2017). In some countries homeshare initiatives can be found most in university cities enabling cheap accommodation for students and allow to stay in their homes. In Germany various cities offer room for students not for money but for hours spent on helping the elderly landlord. As a rule of thumb the ‘rent’ in such arrangements is one hour of help per month per m² (Steffen 2014). In Germany 36 university cities (9% of the 400 in total) offer support for bringing together people in search for room and those in search for help (Hagmann 2010). In Cologne, e.g. the program is annually evaluated and the reports testify that 98% of the homesharing partnerships are recognised as satisfactory (or very satisfactory) by both partners (Zank 2017). The homeshare concept should not be confused with home-sharing in Airbnb-like businesses. It is targeted to long(er) lasting partnership to share living space and thus helps to reduce m² living area at least for the tenant/owner of the shared home.

5 Engaging with stakeholders

To achieve sufficiency in homes needs a broad variety of different considerations and will need engagement of a many different stakeholders. What ties the bits and pieces together is the aspect of social innovation. In all groups of actors innovators are already developing ideas which could contribute to the sufficiency transition once they are up-scaled from niche projects to become elements of the prevailing regime; the frictions of the overall societal landscape due to environmental and other challenges poses an opportunity for this (Kemp, Weaver et al. 2018).

5.1 The design role of planners and architects

Designers including architects have the potential to play a crucial role in communicating sufficiency as well as paving the way through practical leadership. The literature on design for sustainability is rich on examples and concepts in this regard (see e.g. Spangenberg, Fuad-Luke et al. 2010, Date and Chandrasekharan 2017). So far architecture's contribution to 'a good life' is mainly perceived in the sense of providing more space (Zarghami, Fatourehchi et al. 2017). However, the self-understanding of architects starts to change from 'as much as possible builders' towards 'space problem solvers' (Steffen 2014). This holds true for the home in sense of the house as well as of the neighbourhood. In the current era of corporate-led urban development and the commercialisation of public space, critical architects, urbanists and citizen groups are exploring strategies and ways to democratise the city, but are bound by the preferences of their clients. Within these groups there is marked interest in creating and safeguarding urban commons – spaces not primarily defined by their formal ownership but by how citizens use them (Bradley 2015).

Architects and planners can develop a vital function for the advancement and integration of sustainability practices in societies. They are capable of communicating and presenting the pro and contra of sufficiency solutions through working with clients, customers and other relevant disciplines such as engineers or economists. Therefore it is necessary to expand the scope of design education and practice beyond style and fashion, economic issues (mainstream design) and

environmental concerns (Ecodesign) to include social and institutional issues whenever possible (Spangenberg, Fuad-Luke et al. 2010).

Sustainable design for sufficiency-optimised homes is based on co-creation, co-design and synergistic learning – standard solutions and one-size-fits-all designs will not be sufficient. Social innovation practiced and promoted more and more by designers is only possible through mutual learning, team working, inter- and trans-disciplinary thinking and practice. Reciprocity, teaching and learning through participation involving stakeholders, form the foundation of sustainable solutions in general and especially sufficiency solutions. Planners and architects in such processes would become facilitators rather than the creators of sufficiency solutions – a challenge to design's collaboration and communication capabilities (Spangenberg 2013).

Vital for the process is to recognise the interrelatedness of the different levels and aspects of the housing related problem and processes and to define and analyse them from multiple perspectives. Awareness is an important step in this context for providing consumer satisfaction with a minimum of negative environmental impacts and a positive balance of social effects. Special skills related to eco-efficient and sufficient production and resource use allow becoming familiar with technological advancement, dematerialisation, zero carbon considerations, new and sustainable materials, and, waste considerations. Of equal importance is the integration of service provision by designing homes in a context of Product-Service-Systems (PSS) and maximising user satisfaction by appropriate material/dematerialised option (Blincoe, Fuad-Luke et al. 2009, Spangenberg, Fuad-Luke et al. 2010).

5.2 Housing companies and cooperatives

Examples show that communal or private cooperatives as well as private companies already develop interesting approaches towards sufficient homes. Especially non-profit cooperatives are devoted to support the common good through their statutes already. Gessler and colleagues report from Switzerland that subsidized flats thorough their occupancy regulations are requiring a specific number of tenants per m² (Gessler, Gugerli et al. 2013). This holds true for existing flats and also limits the tendency to ever larger individual space in new build homes. In this sense, also the GAG

Immobilien AG Köln for example, an incorporated housing company owned by the city of Cologne, has decided to retreat from the stock market after 60 years of being listed, to escape the obligation to maximise profit, invest in social housing and be able to build smaller again (ib 2016 & personal communication).

To maintain tenant relationships, housing association, at least large ones, are in a good position to offer an exchange programme for apartments, e.g. for widowed seniors. Besides the knowledge if and where adequate flats are available they also have the possibility to adequately consider the price and ensure that the rental agreement for the new flat is less expensive than the old one (Thomas, Brischke et al. 2015). Another incentive would be to practically help with moving through offering packing and transport service (Fuhrhop 2014). Similar opportunities are missing for swapping houses between individual owners, and may run into legal problems if swaps are considered mutual sales, establishing tax payment duties.

Real estate companies can influence mobility patterns, e.g. through providing bicycle facilities or privileged parking space for car sharing (Gessler, Gugerli et al. 2013). Finally, in case of letting furnished or partly furnished flats, they can equip them with not only more efficient but also smaller appliances to help reducing energy consumption and living space demands (Pfäffli 2012).

5.3 Middle actors

Next to designers, planners and the housing companies some crafts professions (e.g. builders, heating installers, plumbers and electricians) play a rather practical role in shaping sufficient or insufficient behaviour. Literature perceives them as intermediaries or 'middle-actors' (Parag and Janda 2014, Wade, Hitchings et al. 2016). Builders e.g. are crucial to mediating between consumers and technology, to enabling the physical changes needed, to spread the message of sufficiency behaviour and finally to train the home users how to adopt behaviour to meet carbon-reduction targets. They can improve customer capacity by providing them with efficient infrastructure and explaining to them the importance of their handling to ensure a sufficient use of them (Parag and Janda 2014).

An observed hindrance for fully exploiting these potential is that some professionals are either contractually connected to one supplier, or might choose those products more familiar to them, instead of offering a range of options. Whilst this limited selection of devices might be linked to brand loyalties, another reason is that for such products they no longer need to consult manuals and user guides, thus better cultivate their status as experts and complete income generating tasks in shorter time, enhancing profitability. Thus economic gains and the preservation of an expert identity can contribute that e.g. heating installers can be reluctant to accept different and better solutions (Wade, Hitchings et al. 2016) as it would mean a longer process before they have learned about other products and can train their staff and their clients. On the other hand, many installation firms take part in regular training, and some companies like Vaillant have set up competence centres where selected partners receive advanced training and are familiarised with the latest technologies. Their problem is clients who are looking for the cheapest offer, not the best solution. Simplifying and streamlining financial incentives and administrative regulations would be able to mobilise a significant potential for reducing energy consumption.

5.4 Municipalities

Municipalities are the administrative units closest to provision of homes to their citizens; many energy saving initiatives have been initiated locally, by municipalities, often in co-operation with local citizens' initiatives. Thus municipalities are in a key role to consider sufficiency issues properly, in various ways depending on their legal competencies and financial strength. As they have some, but limited access to hard policy instruments, municipalities prefer to rely on leading by example and providing a fertile ground for local action – not at least by supporting initiatives of other stakeholders (Bangens and Nilsson 2015). They also can function as role models and promote sufficiency through education and communication campaigns (Jenny, Grütter et al. 2014).

One area for communities of great importance is to support dwelling exchange and, as a condition, to take care that enough flats of reduced size – and of lower price – are offered. An information instrument requiring limited efforts is a local internet based platform for dwelling exchange.

However, as a voluntary approach, it will not be contentious but its effectiveness might be limited. Larger impact might come from an obligation to report vacancies to the authorities and/or a public register; introducing it falls into the capacities of local authorities in some – but not in all – countries.

Rebuilding community-owned buildings, or initiating and stimulating such processes for privately owned ones may help to create the smaller flats required by students, and single person households with a sufficiency-oriented or frugal life style. Thomas and colleagues provide examples from some large German cities: in Frankfurt, for example, after years of vacancy a huge office building with 14 floors had been rebuilt and divided in almost 100 apartments (Thomas, Brischke et al. 2015).

Sufficiency consultancy is as well an instrument worth considering; municipalities would be a trustable host of such institutions. Beyond a purely digital platform sufficiency consultancy could bring together elderly people interested to move to smaller homes with families or people interested in shared apartments. Well organised, such a sufficiency centre (in very large cities even various centres for the different quarters) would have the best chance to ensure people can stay at least in their neighbourhood when they move (Fuhrhop 2014).

5.5 Residents

In case of larger scale processes for sufficiency of homes, beyond individual decisions, one of the main messages which can be derived from sufficiency research is the need to include the (future) inhabitants of homes to be newly built or redesigned in due time, i.e. before the planning and design processes have reached a state when significant adaptations are no longer possible. Acceptance also for unconventional concepts, even for inconvenience during the process of refurbishing (Bierwirth 2015) have a much higher chance to be carried out smoothly when those effected are involved in the development process. Creative and structured communication processes help building trust between planners, designers and architects on one hand and the inhabitants (not individually but as collective) on the other. The prominent role of the former group was pointed out in 4.1 already.

In a moderated process

- the different interests and the different needs of the participants have to be discussed and defined
- the advantages and disadvantages of more sufficient solutions have to be openly presented and discussed
- various alternative options have to be presented, by different experts, how the needs expressed could be taken into account and how solutions to individual situations are to be derived
- pro and contra arguments of sufficiency solutions need to be openly considered and final solutions agreed upon commonly.

(Steffen and Fuchs 2015)

6 Public policies

Last but not least public policies are of vital importance to create the framework conditions for sufficiency thinking and acting, let alone for sufficiency oriented action by public authorities themselves. They can, in addition to a wide variety of other measures partly already taken, target energy consumption directly by restricting the space on which – residential – energy is consumed. Beyond that, sufficiency policy frameworks need to create an environment in which products as well as infrastructures can flourish which needs much less energy and other resources.

6.1 Energy related policies

Clear and direct price signals are one element in this context. Progressive tariffs are one interesting approach here. As examples from Italy and California show, they seem to function well in a liberalized electricity market. However, they are not easily introduced - social and energy related political interests seemed to be important functional conditions for the launch and implementation of progressive tariffs in the electricity sector (Dehmel 2011). A free social minimum energy supply paid for by progressive prices for high-end users could be a cost-neutral option to overcome legitimate social concerns.

A further step could already intervene in the design phase. For instance, developing the EU Ecodesign Directive a bit further and building on the Japanese Front Runner Programme, energy using products might be developed under the requirements of progressive efficiency improvements – else they would not be licensed to be marketed. If such a concept were implemented, larger TV sets for instance would have to be more efficient in relation to screen size than smaller ones (Brischke and Spengler 2011).

6.2 Targeting living space

Optimising energy consumption per capita is supporting sufficiency approaches more effectively than defining eligibility to diverse benefits based on energy use per m² of flat area, per family, per building, per flat, etc. This insight could be applied to public loans and subsidies as well as in legally binding regulations (in Germany e.g. the Energy Saving Ordinance) or certification schemes (e.g. those developed by the Germany Sustainable Building Council) (Steffen and Fuchs 2015, Mårtensson 2016).

Policy may support sufficiency approaches e.g. through public architectural competitions or requiring that any such competitions should include guidelines and requirements for less living space per person (Thomas, Brischke et al. 2015). One obstacle to deal with regarding smaller or even compact housing is the strict building regulations and the requirements of accessibility (Mårtensson 2016), another in countries like Germany or Austria the architects' payment code determining payment based on the built volume. Another case where state regulation may be required is changing the building codes to require flat size adaptability for all residential buildings.

6.3 Limit new soil sealing

An interesting opportunity is to reconsider urban respectively sub urban development plans (Sachverständigenrat für Umweltfragen 2016). In countries with centralised land use planning, the most radical approach would be allowing the building of new houses only to cities with a growing number of inhabitants (if the current demand is satisfied; this would also curb the speculation with flats and houses in high-price areas like London). Under such a rule of no net increase, erecting new

buildings would still be possible in municipalities with constant or shrinking population but only under the condition that an area of similar size was de-sealed. Such a moratorium would not only benefit biodiversity conservation and contribute to reaching the Aichi targets operationalising the Convention for Biological Diversity and the intentions of the UN SDGs, they could also generate a new wave of architectural and planning creativity to improve the available building stock, not at least catering to the changing demand for housing opportunities. Such a regulation would potentially be the most powerful, but certainly a very contentious instrument (Kopatz 2014, Kopatz 2016) and not available in all countries. A less strict approach are tradable permits for soil sealing. From 2012 to 2017 the German Federal Environment Agency experimented with such a concept. The policy target of a maximum of soil sealing of 30ha/day as enshrined in the National Sustainable Development Strategy was taken as the upper limit for Germany. Free certificates were given to participating cities. The criterion for the allowances was the number of inhabitants of a city (UBA 2016). In case of new building plans, the corresponding certificates then had to be filed by the planning authorities. As required, they might buy or sell contingents of certificates. This would satisfy the needs of growing cities but also give an incentive to all municipal authorities to limit new building of dwellings (Thomas, Brischke et al. 2015).

The experiment fruitfully strengthened the development of the inner cities. Spaces between buildings or other unused space was activated in a way that they fully compensated the space avoided at the edge of the cities (UBA 2016). An accompanying study on legal issues showed that the permit solution could be integrated in communal building planning rather easily, at least within the German planning system. Accompanying measures helpful on the way would be further planning obligations to steer and restrict settlement area and the further development of monitoring requirements (Bovet 2017).

6.4 Inducing sufficiency in a circular economy

Finally, the sufficiency aspect in and for homes is also a so far neglected, important aspect on the way to a circular economy. Whereas to date developing settlement areas seems to be a one way

process, closing the circle could be fostered through ‘take back’ obligations for buildings. This would force constructors e.g. to develop and carry out plans how to deconstruct buildings after their use time and how to re-naturalise, as far as possible, the sealed area. A comparable instrument is established already long out through history in the German mining law where mining areas have to be re-naturalised after the active period (thus past mining areas in Germany and the UK look strikingly different). Financial and technological planning for the ‘take back’ then would have to be established with the building permission (BMUB 2016). Also open source approaches could help in a circular economy as they would transparently show construction principles and materials used and thus support more sustainable solutions (Petschow and Peuckert 2016, Zimmermann 2016).

7 Energy sufficiency in a global context

The majority of research and practice carried out around energy sufficiency is taking place in countries like Germany and Switzerland – as the major source of examples in this paper – or France where even a national sufficiency network exists. All those countries are rather advanced in the uptake of efficiency measures and tend to reach its limits. Other countries – even within the EU – are more characterised by a high overcrowding rate of living area, the lack of bath, shower, indoor flushing toilet in the dwelling and a not comfortable warmth during winter time like Latvia or Romania. Here the sufficiency potential is rather low and would require efficiency measures first (Bierwirth 2018).

Taking up co-sufficiency in the global South, however, has to consider complex reality. Significant differences exist in consumption levels between and within these countries – far beyond the German-Romanian difference, for example. For quite some economies in the global South the main challenge is to *lift up* its citizens to a sufficient level of consumption. Nevertheless, movements like the “environmentalism of the poor” are already prioritisation goals such as livelihoods and well-being instead of prioritising the economic growth path as the basic policy orientation. Mathai in this context points out, that following a sufficiency path ‘...*raises the fundamental consideration of whether successfully addressing the environmental crisis requires the dissolution of nationalisms,*

more fluid national identities, and greater solidarity among people across boundaries”, because up to now the most geopolitically powerful countries have built economic and political systems to produce and eventually consume more and more (Mathai 2018).

8 Conclusion and outlook

Given the Planetary Boundaries and the necessity to remain in the safe operating space for humankind (Rockström, Steffen et al. 2009), and the new responsibilities of humankind in the Anthropocene (Crutzen 2006), we have to acknowledge that the rules of the game have changed. As affluent countries have put the hunger of millennia behind it, the unlimited freedom of choice for everybody, the absolute consumer sovereignty is no longer a viable (read: a sustainable) option: society must ruthlessly restrict the free choice of (some) individuals to safeguard the quality of life for all, in a healthy environment. Only political regulatory framing will be able to induce a limit in energy, resource and space consumption per person (Steffen and Fuchs 2015). To construct larger and larger apartments, however energy-efficient they may be, is increasingly recognised to be not particularly sustainable. Nevertheless, the desire for living in smaller homes is not (yet) very widespread, not even among proponents of sustainable housing projects (Mårtensson 2016). To change this, politics and policies should recognise sufficiency as a field of action instead of referring to individual decisions and lifestyles as today (Bierwirth and Thomas 2015). A supportive institutionally framework starting with progressive energy tariffs, via a switch in funding criteria for public loans from a m² to a per capita basis towards a revision of building renovation and construction requirements allowing for compact housing and flexible flat size.

Reducing the size of individual living space while upgrading its quality and life satisfaction provisioning function so far is a challenging task for design and architecture – not least because architects’ payment in many countries is based on the built volume. From a tenants perspective however, smaller individual flats in combination with shared facilities such as laundry rooms or guest rooms on short additional rent and user-friendly smart technologies make both environmental and economic sense (Gröner Forschungen und Entwicklungen GmbH 2017). Indeed, the driving force for

lower floor space claims is often economic: because land prices are high and people want to live in cities where currently prices go through the roof in many countries, people either have to commute long distances at relatively high cost, or pay a fortune for a few square meters in urban centres. Quite some examples under development or carried out already show that downsizing is gaining popularity. A further motivation for engaging in such projects – be it as individual, as planner, as house owner, or as municipality – is to learn more about the consequences of building smaller while obtaining sufficient, even improved quality of accommodation from such small areas. In turn, the attention such projects receive contribute to raising awareness of the underlying intention of sufficiency. Creative and structured communication processes can further help to build trust between planners, designers and architects, municipalities and politics, all other actors and the inhabitants (Bierwirth 2015), and this to overcome planning rigidities and bureaucratic obstacles.

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