Energy Sufficiency Policy: An evolution of energy efficiency policy or radically new approaches?

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Abstract

In the last four decades, energy efficiency increased signifcantly in OECD countries. However, only during the most recent years, total energy consumption started to decrease a little, and much more slowly than energy efficiency potentials would suggest. Energy sufficiency has therefore gained new attention as a way to limit and reduce total energy consumption of a household or a country overall.

The project "Energiesuffizienz" funded by the German ministry for research has examined what energy sufficiency actually is, and what householders, household members but also manufacturers and local authorities could do to make electricity use in the home more sufficient. The focus of this paper is the policy part of the project – the first comprehensive analysis of an energy sufficiency policy.

The objective is to find out how policy can support market actors in using the energy sufficiency options identified. As for energy efficiency policy, it starts with the gathering of potential sufficiency actions and the analysis of the relevant barriers all market actors face, to derive recommendations for which policy instruments need to be combined to an effective policy package, and which other pre-conditions have to be met. Energy efficiency and energy sufficiency should not be seen as opposed to each other but work in the same direction—saving energy. Therefore, some instruments of the energy sufficiency policy package may be the same as for energy efficiency—such as energy taxation, and linear or progressive energy prices. Some may simply adapt technology-specific energy efficiency policy instruments. Examples are progressive appliance efficiency standards, standards based on absolute consumption, or providing energy advice. However, sufficiency may also require radical new approaches particularly to mitigate the drivers of non-sufficiency. They may range from promotion of completely different services for food and clothes cleaning, to instruments for limiting average dwelling floor area per person, or to a cap-and-trade system for the total electricity sales of a supplier to its customers, instead of an energy efficiency obligation. The paper presents these and other elements of an integrated energy sufficiency policy package resulting from this analysis.

Introduction

In the last four decades, energy efficiency increased signifcantly in OECD countries (IEA 2013). However, only during the most recent years, total energy consumption started to decrease a little in some countries including Germany, and much more slowly than energy efficiency potentials would suggest (IEA 2014). Sufficiency (e.g., Sachs 1993) and particularly energy sufficiency (e.g., Wilhite&Norgard 2003; Darby 2007; Calwell 2010) has therefore gained new attention as a way to limit and eventually reduce total energy consumption of a household or a country overall.

The project "Energiesuffizienz (Energy Sufficiency - strategies and instruments for a technical, systemic and cultural transformation towards sustainable restriction of energy demand in the field of construction and everyday life)" funded by the German ministry for research has examined what energy sufficiency actually is, and what householders, household members but also manufacturers and local authorities could do to make electricity use in the home more sufficient.

The focus of this paper is the policy part of the project – the first comprehensive analysis of an energy sufficiency policy. The paper thus complements a second paper for this eceee Summer Study (Brischke et al. 2015), which presents our definition of energy sufficiency in more detail, along with an analysis of energy saving potentials from options for energy sufficiency action by households and manufacturers, design criteria for domestic appliances enabling energy sufficiency, and conclusions for the future development of energy labelling and ecodesign.

The objective of the analysis presented here is to find out how policy can support market actors in using the energy sufficiency options identified. Energy efficiency and energy sufficiency should not be seen as opposed to each other but work in the same direction. Therefore, we assume a priori that it will be possible to develop an integrated energy efficiency and sufficiency policy. In addition to promoting sufficiency, it will also need to include elements to mitigate the drivers of non-sufficiency.

This paper is organised as follows: We begin with a short presentation of our understanding of energy sufficiency at the household level and a location of this paper within a more general approach to energy sufficiency policy. We then briefly touch the first 3 steps (of our 7-step approach) that deal with how to identify, focus, and analyse options for energy sufficiency action in the household, its environment and surrounding infrastructure, with some methodological remarks and a brief example. The paper then continues with a presentation of guiding principles for energy sufficiency governance that are derived from the analysis of the energy sufficiency options as well as from drivers of energy consumption. Next we present the methodology for the development of an energy sufficiency policy in steps 4 to 7 that we are using in the project, followed by an example of such an analysis. As the current status of our results, elements of an integrated energy sufficiency policy package are presented next, but will need complementation from the analysis at the macro level that has not been done yet. Some conclusions and an outlook to future work and research needs conclude the paper. As our project and the policy analysis are still ongoing, both the results on the integrated energy sufficiency policy package and the conclusions are preliminary. However, we hope that further research can already build on the methodology for energy sufficiency policy analysis we outline here, and the methods and procedures we suggest or have used ourselves. Also, this paper focuses on end uses of electricity. Another paper for this eceee Summer Study (Bierwirth et al.) addresses space heating and energy sufficiency.

What is energy sufficiency? The general concept

Energy sufficiency at the household level differs from efficiency in one central aspect: Energy efficiency reduces energy input while keeping the utility/services from energy constant. With energy sufficiency, energy consumption is reduced *while the utility/technical service changes in quantity or quality*. In the "energy sufficiency" project, we understand energy consumption at the household level as the result of a transposition or transformation chain that starts with basic human needs as discussed in literature (e.g., Skidelsky & Skidelsky 2013), which are transformed to more concrete demands, needs (both mostly related to the reliefs that are needed for the care economy) and desires, which in turn are transformed to needed/desired reliefs or utility aspects. The latter are then transformed into the demand of (more or less technical) utility. Finally, products or services provide a technical service, that can meet or not, or even exceed the demand for utility.

How exactly every step of the chain is taken depends on many factors: restrictions within the household (e.g. infrastructural, socio-economic, gender-related), external drivers (e.g. externalisation of work from the wage-labour economy into the unpaid care economy and related gender-hierarchization, peer-group and symbolic consumption trends etc.). Sufficiency may be improved not only by taking *reduced* or *adjusted* transformation steps (according to the really needed levels of reliefs, services), but as well by taking *different* steps, satisfying the demands ands needs in a different way (see Figure 1).

Sufficiency actions can therefore intervene not only along the life-cycle of a given product, but at different points and can follow different approaches (see as well Brischke et al. 2015 and Figure 1):

1. Reduction: a quantitative reduction in a) needed reliefs (e.g. household work/care economy production through use of technology) or in utility aspects (e.g. having lighting for reading, or a TV) or in b) the technical services demanded to provide the reliefs or utility (e.g. number and light output of luminaires).

2. Substitution: a different transformation of basic needs into needed reliefs/utility aspects and consequently demanded technical services. This may include a substitution along the whole transmission chain or only at one of the latter transformation steps, and means a substitution of current actions/routines by others, e.g. partly replacing residential clothes-washing by e.g. external services or more frequent airing of clothes.
3. Adjustment: a) an adjustment of the technical service demanded to the actually needed reliefs or desired utility aspects (e.g. appliance size, switching off an appliance when not used, adjusting refrigerator or room temperatures to actual needs, apartment sizes to number of inhabitants etc.) or b) an adjustment of the technical service supplied by energy-using products to the technical service actually demanded by the user, avoiding non-demanded energy waste (e.g. standby functions, internet connectivity).

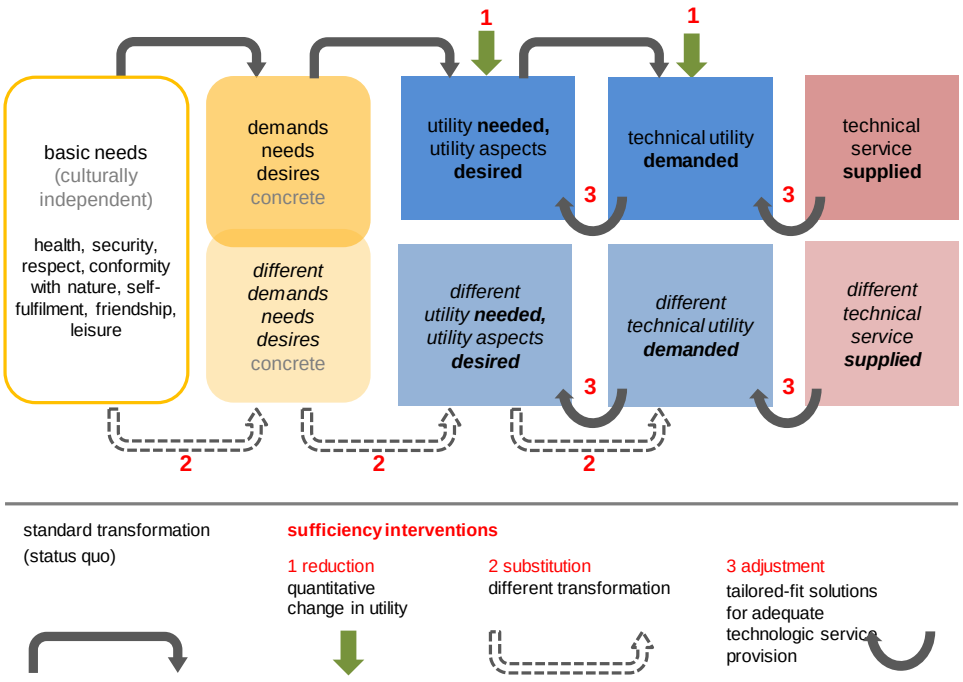

Figure 1: Chain from basic needs to final energy consumption and sufficiency intervention points

Very importantly, when looking for realisation possibilities of higher energy sufficiency levels in the household, the object of analysis is therefore not a single energy-using product. Rather, the starting point is an area of basic needs, constituting a domain of demands, needs and desires that transposes to a demand of technical services and consequent energy consumption. Sufficiency actions within that domain may take one or more of the three different sufficiency approaches presented above.

Fostering sufficiency or mitigating non-sufficiency?

The transformation chain at the household (meso) or individual (micro) level presented above is not the single-most important unit of analysis. Applying Coleman's (1994) "foundations of social theory" to our field of analysis, households (at the meso level) and individuals (at the micro level) face restrictions and are embedded in social, economic, legal (etc) structures that provide the framework for sufficiency actions, within which they act in a principally rational way (cf. also Shove 2003).

Restrictions in turn are partly structured by macro drivers (e.g. resulting from capitalist production logics such as rapid innovation cycles at short product lifetimes, demand induction by advertisement or pressure on the gender-hierarchical care economy). Actions at the micro level that are conditional on restrictions and themselves partly influenced by macro drivers (cultural practices) then aggregate to emergent more or less energy-sufficient phenomena that can be observed in a society (at the macro level). As non-sufficiency "phenomena" we understand in Germany (and most "western" societies) e.g. ever-increasing housing floor area per person, TV screen diameters, or more generally, rising/stagnating energy demand in spite of vast efficiency gains mostly as an indirect consequence of different drivers for non-sufficiency.

These interrelations constitute a complex cause-effect chain that is not fully understood yet and needs much further investigation. Figure 1 depicts an application of Coleman's (1994) macro-micro-scheme to the field of energy sufficiency.

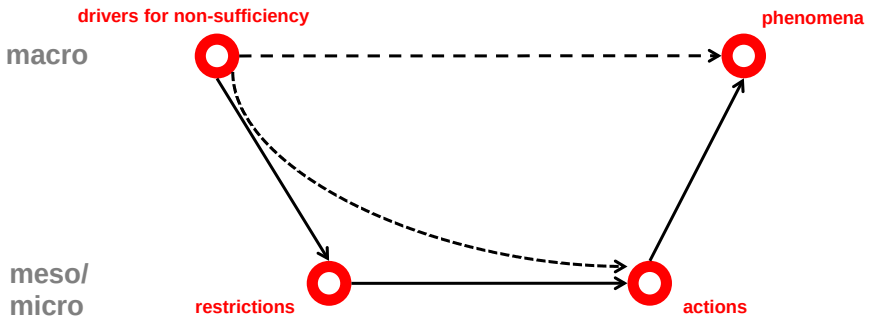

Figure 1: Causal chain in Coleman's macro-micro-scheme

In principle, policies may intervene both at the macro and at the micro level. In the field of sustainability transition, much work has been done on socio-technical "niches" (as which sufficiency actions can be regarded), on how they develop and how such development can be supported by policy, e.g. by providing protected spaces (e.g. Smith and Raven 2012). However, the recent literature looked more at processes "weakening [the] reproduction of core regime elements", which is necessary for creating "windows of opportunity", within which niches can be mainstreamed and lead to a transition of the old regime (Turnheim and Geels 2013).

As a consequence, and building on Schumpeter's (1942/1993) concept of creative destruction and on the recent concept of regime destabilisation (Turnheim and Geels 2012), Kivimaa and Kern (2015) propose that policy packages towards sustainability need to combine both those aimed at creating niche-innovations and building effective innovation systems around them and those aimed at destabilising currently dominant regimes.

For the specific case of energy sufficiency, which constitutes a socio-technical niche that is especially complex due to the above-described macro-micro interlinkages, we follow Kivimaa and Kern's suggestion but specify that it is particularly certain drivers shaping current meso/micro restrictions which are constituent of the current ("old") regime. An effective sufficiency policy should consequently address both issues: the ultimate causes for the phenomena – i.e. the drivers for non-sufficiency (destabilising the current regime), but should also approach households and individuals at the meso/micro level (create and support the niche).

Within this project, both policy approaches will be explored and developed, but work on the macro level has not commenced yet. Therefore, this paper focuses on the meso and micro level – and on the restrictions that are partly defined by the macro drivers, actions that are taken and possible policy interventions to support sufficiency actions. However, some of the policies presented later may be seen as also addressing the drivers.

Defining the scope: steps 1 to 3

For developing an energy sufficiency policy, we need to analyse which options for energy sufficiency action in the household exist in principle. This requires a methodology we present in the following steps, along with its application for the example of clothing hygiene.

Step 1 Scope: defining the unit of analysis (domain)

In a first step, the unit of analysis has to be defined where higher levels of energy sufficiency shall be reached. Other than with energy efficiency that targets single energy-using products (e.g. washing machines or personal computers), for sufficiency this involves a domain of needs and desires (e.g. clothes hygiene or information/ communication).

Table 1 lists the basic needs (mostly areas of care economy production) that the multidisciplinary project team identified based on its knowledge of the project's focus sector, which is electricity in the household sector, and how they translate to different demands, needs and desires (care economy domains).

Table 1: Basic needs and translation to demands, needs, desires (domains)

basic needs / area of care conomy production	demands, needs, desires / care economy domain
adequate food provision	storage, cooling, freezing food preparation
adequate provision of cleanliness/ hygiene	clothing hygiene/washing clothes drying dish-washing housekeeping personal hygiene
adequate lighting	lighting
adequate room climate	heating/cooling (air conditioning) ventilation
leisure/ entertainment/ information/ communication	leisure/ entertainment/ information/ communication

Example: As care economy and gender issues are relevant especially in the caring areas within the household, we decided to choose one of the respective domains (see Table 1) for this exemplary policy case. Most of the demands, needs and desires within the care economy domains vary widely across different households. We decided to choose a domain with a lower variance for this first application of the developed methodology. The domain considered to have the lowest variance was clothing hygiene, as this is a demand that needs to be met by all households.

Step 2 Status quo: analysing current energy consumption hot-spots

Within the respective domain of analysis, the currently existing hot-spots of energy consumption have to be identified, in order to search for potential innovations in the next step. This is important in terms of effectiveness: if sufficiency is to produce significant energy consumption reductions, the points of matter have to be addressed instead of services that are less relevant in terms of energy consumption.

Example of clothing hygiene: With clothes-washing, this step is not complex. The energy-consuming event is washing in the washing machine. However, energy consumption may vary strongly with a) the frequency of washing b) the way of usage (well-filled, temperature, spinning) and c) the type of machine (auto-selection of programme, efficiency class).

Step 3 Potential innovations: collecting potential sufficiency actions

In a third step, the potential sufficiency actions, which may contribute to realising a lower energy consumption, are collected. In our analysis, we used literature search, team brainstorming sessions, and open innovation workshops (Brischke et al. 2015). The guiding question hereby is how demands, needs, desires can be satisified with smaller units, less intensive use or by using different ways of needs fulfilment with lower energy consumption (e.g. external services or entirely differing approaches).

For coming up with an encompassing list of potential sufficiency actions, the three sufficiency strategies presented above (reduction, substitution, adjustment) guided the collection of potential sufficiency innovations.

Example of clothing hygiene: In the third step, the potential sufficiency actions are collected that may contribute to realising a lower energy consumption in the washing domain. We distinguished actions that may serve for down-sizing (until eliminating) washing equipment in the household and other actions that may serve for saving energy through changes in equipment use and sorted them by the three sufficiency approaches presented above (reduction, substitution, adjustment). Table 3 in the policy analysis lists the possible actions identified, so we do not replicate them here. They include both actions in the household such as wearing clothes longer, airing or refreshing instead of washing, washing at full loads only, reducing wash temperatures and spin speeds, and washing by hand instead of with the machine, and actions that need external infrastructures and services, such as communal laundry facilities in multifamily houses, laundries in the quarter, or even laundry services with pick-up and delivery at the home, in combination with an innovative ‘refreshing cabinet’ replacing the washing machine in the home.

Methodology for ex-ante analysis of appropriate energy sufficiency policy packages: steps 4 to 7

Market forces alone are unlikely to bring about the energy savings that energy sufficiency options can enable. Just as for energy efficiency, we can assume that for sufficiency options that concern modifications in appliance design, buildings, or the housing market may need well-designed packages of polices and measures, which interact and reinforce each other in such a policy package (Thomas et al. 2013): Value chains in the building and appliances sectors are complex. Many different actors – investors, end-users but also building developers, equipment or appliance manufacturers, designers, trade, and builders – have to work together for an optimal outcome. A well-designed package of policies and measures is, therefore, needed to assist the various actors in overcoming their specific barriers and strengthening their incentives. The overarching objectives for the policy package on energy sufficiency are to:

- make it possible (in case there are restrictions)
- make it as easy and attractive as possible
- eventually, make it the standard.

Every policy or measure has its own function in the package, its advantages, target groups and specific operational mechanisms. Each is tailored to overcome one or a few certain market barriers and to strengthen the actor-specific incentives, but none can address all of these barriers and incentives. Therefore, the impact of well-combined policies is often larger than the sum of the individual expected impact (IEA 2005).

Energy sufficiency, however, also has a number of options that require action by householders or household members to reduce the size or features of equipment they buy, concern its use, or even substitute equipment purchase or use by new or traditional services. Such action often concerns the transformation of demands, needs, or desires into the reliefs needed or the aspects of utility desired, or transforming such reliefs or utility into the technical service requested (cf. Figure 3). Making these actions happen will therefore often require policy to overcome restrictions in the household or its environment, to enable sufficiency action (through framework conditions, infrastructures, service offers), and to enable informed decisions. This, hence, requires much more than just individuals "changing behaviours". The question here is, which policies and measures are needed to make these actions happen. And although the 'value chains' for these actions may differ a lot from those in energy efficiency analysis of appliances and buildings marktes, answering this question will also require the analysis of barriers and incentives, but more than for energy efficiency also acceptabilities of actions, drivers of energy consumption, and framework conditions that shape action in purchasing and using equipment. Particularly, the necessities of the caring economy and the imperative of not putting inappropriate burdens on those who do the cooking, washing, and cleaning, but rather to ease their tasks while trying to promote energy sufficiency have to be considered.

The process of analysis leading to the final development of an integrated sufficiency policy package is graphically presented in Figure 3.

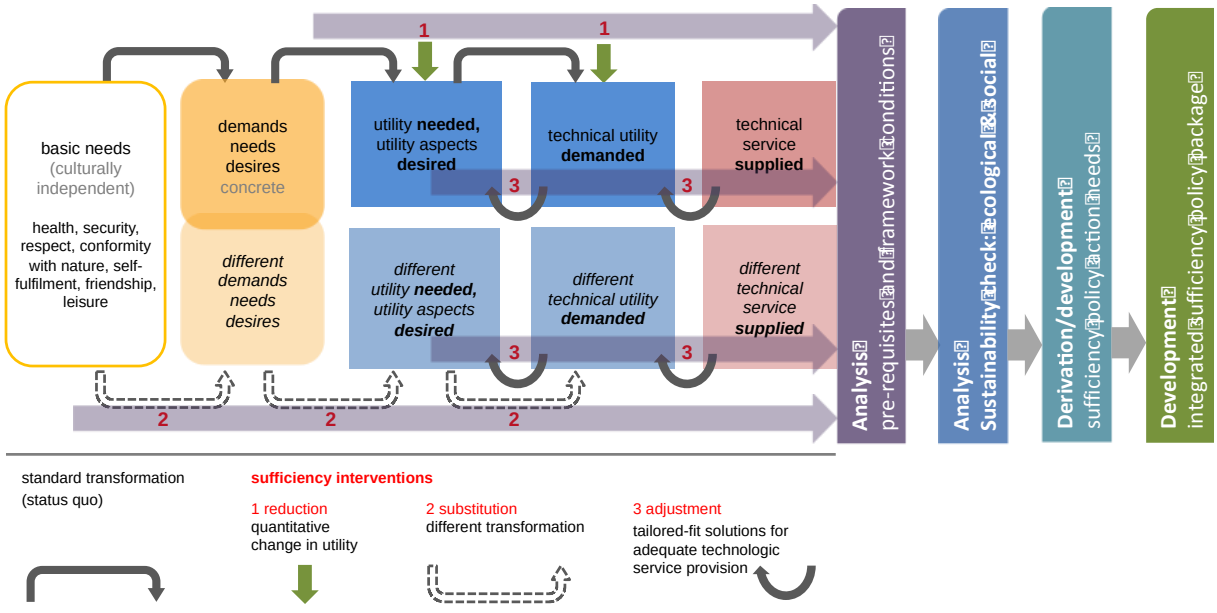

Figure 2: standard transformation chain of the determinants of household energy consumption and methodological approach towards developing integrated energy sufficiency policy packages

Energy sufficiency policy is a new field. There is some policy experience we present later, but we are not aware of any integrated comprehensive policy packages being implemented. Therefore, we can't yet follow the advisable two-step approach of combining (1) an actor-centred theoretical analysis, as we are performing it here, with (2) an empirical proof, for which Figure 4 presents an overview.

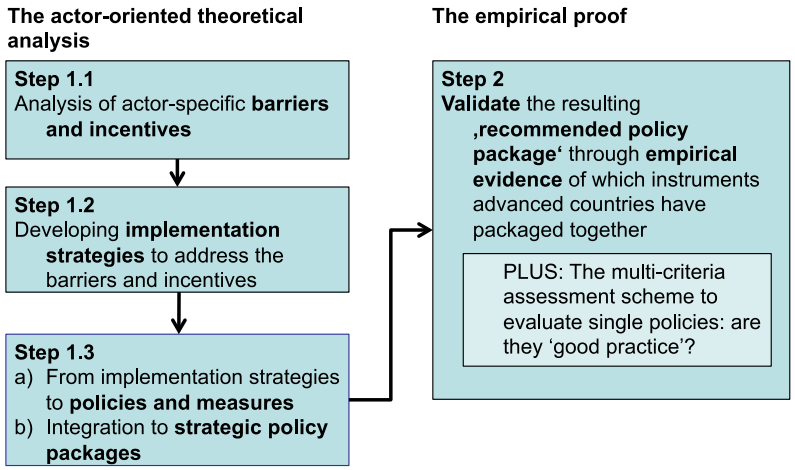

Figure 4: The two-step combination of theoretical and empirical evidence in analysis for recommended strategic energy efficiency and sufficiency policy packages (source: bigEE, Thomas et al. 2013)

The methodological approach we use and recommend on the theoretical side is based on and seeking to extend and refine the theory-based policy evaluation approach, which goes back to experiences with energy efficiency policy evaluation in the USA (e.g., Blumstein et al. 2000) and was applied and developed further more recently within the EU project AID-EE (cf. www.aid-ee.org and Ecofys et al. 2006). Originally, the theory-based approach was developed for *ex-post* evaluation of existing policies. It aims at understanding how policies work and the factors of success or failure by defining for each step of implementation a theory on the implementation mechanism or strategy of the step and indicators to measure success of the step and the instrument overall. It can be used both for process evaluation and for theoretically explaining the reasons for the impact achieved – success or failure. The AID-EE project has pointed out that this can also be used to examine *ex ante* whether policies are expected to be successful, and therefore guide policy design. In the bigEE project, we developed this further to analyse, which implementation strategies and policies need to be combined to a package to achieve success in realising energy efficiency (Thomas et al. 2013). We are now expanding this to energy sufficiency policy analysis. As said above, however, this needs to be complemented by an analysis of policies addressing directly the drivers of non-sufficiency.

Starting from the options identifed in steps 1 to 3 presented above, the first two steps in this policy analysis concern which of these actually save energy and are socially acceptable to the householder and the household members, especially do not put too high a burden on the person(s) in charge of the care economy in the household.

Step 4 Barriers to implementation: analysing pre-requisites and framework conditions

Every single potential sufficiency action from step 3 has to be analysed in detail as to the framework conditions in which it may be carried out, with respect to pre-requisites that have to be met before the action can be realised by the household and its members and with respect to the interest in action they have. This step is essential, as the implementation barriers have to be identified that need to be addressed by policy if the action shall be enabled. Because the areas of food provision and cleanliness/hygiene involve the care economy (production of within-household services), the respective pressures on this economic sector are of special importance. As the care economy is in most households not yet gender-balanced, gender issues are vital. We divided the above issues in a series of separate issues that can be analysed for every single possible sufficiency action. In our project, we started with desktop research on all types of basic need. Qualitative in-depth interviews with 12 persons for clothes washing and TV use, and a focus group on gender issues provided some empirical insight. A

broad survey of up to 1,000 persons will be able to test a number of these potential actions for clothes washing and TV use in the summer of 2015.

Table 2: Issues for up-front analysis of potential sufficiency actions

	analysis issue	description
pre-conditions for option realisation	care-economy/ individuals	e.g. time constraints (time-consuming intensity and fit to care-organisational logic of option), acceptability by caring and cared-for individuals
	infrastructures	infrastructures necessary for realisation: e.g. within household/ dwelling, local care and service infrastructure/ institutions (public/commercial), transport infrastructure (public/commercial)
	policy	necessary political framework and policies for implementation
Effects of non-fulfilment of pre-conditions	type of intervention into care-economy production logic	Estimation of effect on work-load: more, none, less
	degree of relief in care-economy workload	Estimation of degree of relief ++ (strong relief) to -- (strong additional workload)
	vulnerable population	identification of population sections that may be especially vulnerable to the realisation of the respective sufficency action

Example of clothing hygiene: Wearing clothes longer and airing instead of washing may be at odds with norms demanding clothes washed daily. Washing at full loads only may require possession of too many clothes for one-person households. Reducing wash temperatures may be difficult for heavy-duty households (families, workers etc.) or allergy sufferers. Reducing spin speeds will require adequate drying space for wetter clothes and is applicable only in summer, when clothes can be dried outside/without room heating. Washing by hand instead of with the machine means a lot of work. Actions that employ external infrastructures and services will of course have the existence and provision of these as a precondition. This concerns the options of communal laundry facilities in multifamily houses, laundries in the quarter, or laundry services with pick-up and delivery at the home, in combination with an additional refreshing cabinet in the home.

Step 5 Sustainability: Excluding options with negative net effects on ecology and care economy

This step is for ensuring that only sustainable sufficiency actions are being targeted. Two sustainability dimensions matter here: the environmental (i.e. ensuring a positive net effect on the environment) and the social dimension (i.e. ensuring that no significant externalisation of additional work required to save energy into the care economy takes place and that actions are acceptable by caring and cared-for persons).

A negative environmental effect is probably possible only for sufficiency actions that follow the substitution approach, i.e. replacing current routines, actions, appliances by alternative ways of satisfying the needs. If the action follows the reduction or adjustment approach, the environmental effect will certainly be positive. A positive net effect within the substitution approach may be straightforward (e.g. when replacing a refrigerator by an already existing cool cellar storage) and if so does not require further investigation. However, in many cases, substitution actions and their net energy effect may be more complex and require a more detailed analysis as to their total energy savings within the household and additional energy consumption within and outside the household (e.g. when replacing a domestic service production such as washing or food preparation by external services). This kind of analysis is not trivial and requires substantive efforts we are not able to take during this project, but is necessary if respective options shall be entered into the list of available sustainable options.

A negative effect on the care economy concerns especially the options falling into the areas of that economy. In step 4, actions have been analysed with respect to their pre-conditions. In this step, all options for which the pre-conditions cannot be met (for physical, political or other reasons) need to be eliminated from the list.

This leaves as a result a list of sustainable sufficiency action options that may be targeted by policies.

Example of clothing hygiene: Based on the heavy workload it requires (high additional burden on the care economy), we take manual washing off the list for reasons of social unacceptability. Although further analysis is needed as to the circumstances under which communal laundry facilities in multifamily houses, laundries in the quarter, or laundry services with pick-up and delivery at the home, in combination with a refreshing cabinet in the home that replaces the washing machine will actually save energy and/or caring economy workload, we keep these in the analysis, but with a caveat.

Step 6 Policy approaches, part 1: Deriving policy action needs for the sustainable options

Based on steps 1-5, every single potential energy sufficiency action that may help rising sufficiency levels in the domain at stake has to be checked with respect of its need for political action in order to make its realisation possible and actually happen. A first starting point is the up-front scan of necessary basic political framework conditions within step 4.

For the realisability of single energy sufficiency actions, it is most crucial that all barriers and preconditions are addressed. A good policy thus has to respond to any issues arising from the analysis in step 4 including gender issues and the identification and solution of possible vulnerabilities within parts of the population. To these ends, adequate policies need to be developed. Therefore the toolboxes of existing policies can be used, e.g. of energy and energy efficiency policies. However, as shown above, energy sufficiency is very distinct in several respects and will probably require the development or derivation of new policy approaches. So while we are starting with a desktop analysis of potentially adequate policy instruments based on experiences from the energy efficiency field, we hope to test the effectiveness and acceptance of some policy approaches in the survey foreseen.

Example of clothes hygiene: For our example, possible sufficiency actions resulting from steps 1-6 are presented in Table 3. We differentiate between actions that serve for downsizing equipment and actions that target a different use of technical appliances in the washing hygiene field. As several actions serve both ends, they appear twice in Table 3.

Table 3: Energy sufficiency options, policy needs and derived energy sufficiency policy instruments for clothing hygiene

action	sufficiency approach	barriers or preconditions	main policy needs	adequate policy instruments
actions for downsizing equipment				
longer usage period of clothing	reduction, adjustment	norms of fresh clothing	support change in norms: longer usage periods for many clothes possible	information/publicity campaigns, energy sufficiency advice
wash only full drums	adjustment	habits, sufficient amount of clothes, storage	enable change in habits, inform about energy savings (if clothes and storage already exist), ensure availability of smaller washing machines	information/publicity campaigns, advice; change EU energy label for washing machines to reward low absolute energy consumption per wash (instead of per kg of load), requirements for appliance design for loading feedback
community facilities	substitution	existence of such facilities; fear of social control/ problems with intimacy	support: financial, targeting building owners for providing space, ensure close-by facilities, replication support for integrated solutions	financial incentive programme, investment in public laundries; information/publicity campaigns and advice, legal framework for local availability
laundry	substitution	existence of nearby such facilities; fear of social control/ problems with intimacy	ensure locally/reliably available private/public facilities (locality), ensure financial access of low-income households	financial incentive programme, public investment, including laundry cost in social benefits; information/publicity campaigns and advice assuring potential users of hygiene
laundry service and refreshing cabinet	substitution	availability of service	ensure reliably available private/public service, ensure pos. env. effect, ensure financial access of low-income households	public investment, including cost in social benefits; information/publicity campaigns and advice assuring potential users of hygiene; financial incentive programme for market introduction of refreshing cabinets?
actions changing utilisation				
longer usage period	(see above)	(see above)	(see above)	(see above)
more airing	reduction, substitution	norms of fresh clothing	support change in norms: longer usage periods for many clothes possible	information/publicity campaigns, energy sufficiency advice
wash only full drums	(see above)	(see above)	(see above)	(see above)
reduce	reduction,	habits, fear of insufficient	enable change in habits, inform about new	information/publicity campaigns, advice; support R&D on new detergents,

temperature	adjustment	hygiene	detergents and routines to ensure hygiene	analysis in their use, and routines to ensure hygiene
reduce spinning speed	reduction, adjustment	adequate drying space for wetter clothes	encourage/ allow outdoor drying; support: financial, targeting building owners for providing space	possibly change housing regulations or norms; requirements or financial support for providing space in new build, especially of social housing
reducing detergent quantity	adjustment	easily visible scale in the cup	inform and build confidence	information/publicity campaigns, energy sufficiency advice

The policies that can be derived from this approach build on the existing restrictions within households and try to eliminate them in an ”end-of-the-pipe” manner. However, this approach does not allow for an investigation into the drivers, the reasons how restrictions came about and how they may be addressed more systematically. Therefore, this meso/micro-approach for developing sufficiency policies can only play a complementary role in the more encompassing approach presented in the section on the drivers of non-sufficiency above which is still to be done within this project. However, as the investigation into the drivers and their consequent effects on restrictions at the lower levels is not sufficiently developed yet, this section only presents the policy conclusions resulting from the analysis of energy sufficiency action at the meso/micro level. .

Step 7 Policy approaches, part 2: Bundling policies into an integrated strategy

Finally, the array of policies identified as supportive to the implementation of the single sufficiency options within the domain at stake have to be combined into an encompassing and integrated policy package addressing all domain issues in an adequate way.

Example of clothing hygiene: From Table 3, we conclude that the options we encountered useful to foster energy sufficiency action for the domain of clothing hygiene will need a combination of information/publicity campaigns, personalised energy sufficiency advice, change in the EU energy label, possibly changes in housing regulations or norms, and financial incentive programmes and/or public investment for communal laundry facilities in multifamily houses, laundries in the quarter, or laundry services and refreshing cabinets in the home. However, as stated above, these policies will have to be complemented by policies resulting from the driver analysis that has not been started yet within this project.

Elements of an integrated energy sufficiency policy package

Energy efficiency and energy sufficiency should not be seen as opposed to each other but work in the same direction. The ultimate goal is to reduce energy consumption in absolute terms, at least in Germany. More specifically, the German government set the target to reduce electricity consumption by 10 % until 2020 and by 25 % until 2050, compared to the 2008 value (BMWi 2012).

Therefore, some instruments of the energy sufficiency policy package may be the same as for energy efficiency—such as energy taxation, and linear or progressive energy prices. Some may simply adapt technology-specific energy efficiency policy instruments. Examples are progressive appliance efficiency standards, standards based on absolute consumption, or providing energy advice. However, sufficiency may also require radical new approaches, often linked either to substitution routes strongly different from the curent technology and practice, or to addressing the drivers of non-sufficiency. They may hence range from promotion of completely different services for food and clothes cleaning, to instruments for limiting average dwelling floor area per person, or to a cap-and-trade system for the total electricity sales of a supplier to its customers, instead of an energy efficiency obligation. In the following subchapters, we expand on a number of these policy instruments.

Energy pricing instruments

Energy taxation is an instrument to internalise external costs of energy supply into energy prices. It thereby increases the energy prices and hence the economic motivation to save energy. This motivation supports both energy efficiency and energy sufficiency alike. Some have observed that energy taxation and the signal for energy sufficiency it sends can also be a measure to counterbalance the rebound effect from energy efficiency action and policy. However, energy taxation alone will not be sufficient to overcome barriers that are not related to the energy price and will therefore not realise anywhere near the full potential, for both energy efficiency and sufficiency.

The same holds true for linear or progressive energy prices. They both improve the price signal for saving energy, including through energy sufficiency. However, currently the energy policy debate is rather for more

fixed price elements to cover network and reserve costs also for those who self-generate with solar PV, hence even more degressive energy prices. Maybe energy sufficiency can provide an argument against such trends.

Sufficiency-oriented product policy

For appliance energy labels and standards, a sufficiency-oriented product policy implies a move from specific to absolute metrics (e.g. kWh/cycle not kWh/kg/cycle) and from linear to progressive requirements. In our example of clothing hygiene, the current EU energy label has energy efficiency defined in relation to a baseline calculated in terms of kWh/kg/cycle, i.e. per kg of full load capacity of the washing machine. Even though an intercept value was introduced, it probably still is easier for manufacturers to achieve the highest efficiency label classes A+++ and A++ with larger machines, so this is a clear signal to increase capacity. This may well have been a driving force behind the observation that currently clothes washers with 6, 7, or 8 kg of capacity dominate the market, while 20 years ago, 5 kg of capacity was most common (Ecofys 2014). This trend is a barrier to energy sufficiency, which would call for smaller appliances. Defining the energy efficiency baseline in kWh/cycle may be able to revert this trend and hence support energy sufficiency in the purchasing decisions of EU households.

Similar changes may be required for other types of appliances. Brischke et al. 2015, paper 7-294 in these proceedings, present more detailed conclusions for the future development of energy labelling and ecodesign.

Energy sufficiency advice

As for energy efficiency, lack of information and motivation can be an important barrier to implement energy sufficiency actions in the purchase and use of appliances or the alternatives. Personalised energy sufficiency advice can be much more effective than general publicity and information campaigns in making people aware of their own options and in convincing them of advantages or that e.g. perceived health risks are not a problem. For cost and effectiveness reasons, such advice should be integrated with advice on energy efficiency options.

In our example of clothing hygiene, advice would particularly concern actions such as wearing clothes longer, airing instead of washing, washing at full loads only, and reducing wash temperatures and spin speeds. It could also relate to actions that need external infrastructures and services if these were available in the building or neighbourhood, such as communal laundry facilities in multifamily houses, laundries in the quarter, or laundry services in combination with an additional refreshing cabinet in the home, and to financial incentive programmes for any of these.

Promotion of energy-sufficient services

In some cases, energy-sufficient services can be substitutes for appliances we use today in the home. Their market breakthrough may require promotion through public awareness, information, and motivation programmes, but their establishment may also need financial incentive programmes and/or public investment, at least for some initial demonstration facilities and businesses.

In our example of clothing hygiene: To the extent that communal laundry facilities in multifamily houses, laundries in the quarter, or laundry services and refreshing cabinets in the home will actually save energy, financial incentive programmes and/or public investment for such infrastructures and services could be justified. In addition, public awareness, information, and motivation programmes for households to use these alternatives to an own washing machine could be essential to support them.

Instruments for limiting average dwelling floor area per person

For many end uses of electricity in the home, demand depends on dwelling floor area per person, e.g. lighting, refrigeration and freezing, or TVs. More room space, which is mostly available to higher-income households allows for more and bigger appliances—also easier to purchase for the wealthier. Therefore, instruments for limiting average dwelling floor area per person will be an important part of the energy sufficiency policy package. They will address one important driver of energy consumption and non-sufficiency.

An information instrument requiring limited effort are platforms for dwelling exchange. As a voluntary approach, it will not be contentious but its effectiveness is also expected to be limited. In addition to such pure information approaches it is possible to create incentives, i.e. financial incentives or the removal of economic barriers: It might be possible, for example, to waive tax for the acquisition of real estate, which is a barrier to changing owner-occupied dwellings, if purchase of and move to a smaller apartment and the sale of the bigger apartment or house is made. 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 more thought, and we are still looking for a solution. An obligation to report vacancies to the authorities and or a public register may be an

idea. Government support to attractive dwelling forms may be helpful too. If, for example, older people leave their houses they will look for barrier-free apartments. If the apartment is small and the children come for a visit, it will be necessary to have guest rooms. In cities with shortage of dwelling floor space, such approaches are already applied today. A housing association in Munich, for instance, has created so-called flexible apartments. These are comparably small, but are completed by rooms for joint use. In the cellar there is a playing room, guest rooms are available, and the artist studio may also be used for birthday parties. Besides, the housing association offers an exchange programme for apartments, e.g. for the widowed senior, for whom it's otherwise not worth moving to a smaller flat, because with a new rental agreement the flat would often be as expensive as the old one (Stroh 2011). Policy may support such approaches e.g. through public architectural competitions or requiring that any such competitions should include guidelines and requirements for less living space per person.

Another possibility to limit the building of new houses is the re-use of already existing buildings. In Münster, for instance, a car park has been rebuilt. Now there are stores and apartments. Besides, in many cities a large number of office space is empty without further use. A rebuilding may help to create urgently required flats. In Frankfurt, for example, after years of standing empty a huge office building with 14 floors has completely been rebuilt and divided in almost 100 apartments. This would offer an enormous potential: All over Frankfurt there are nearly 2 mn square meters of empty office space, which, arithmetically, is the floor area required for almost 27,000 flats of 75 square metres each. In Munich, there are 1.8 mn square metres and Hamburg can offer 1.2 mn square metres of empty office space. Particular funding programmes may help to use this potential.

However, a centralized Cap for new living space would make such incentive and conversion programmes even more attractive: Cities e.g. in Germany are in competition to each other. They are also competing for inhabitants. Interesting new building projects in the housing market are created to attract young families. Each additional taxpayer will increase the income of the city. Thus, it is difficult for the cities to restrict any new build activities: they fear the advantage for neighbour cities possibly resulting therefrom. This problem may only be solved by establishing a common target for the floor space consumption applicable to all German cities.

A more radical approach for such a regulation might be to allow the building of new houses only to cities with a growing number of inhabitants. Such a regulation would potentially be the most powerful, but certainly a very contentious instrument. Another basic approach is to control the building of new houses by a trading system for floor certificates. For that purpose, a quantitative nation-wide target for maximum living space will be determined (Cap), certified and distributed to the local planning authorities through a certain distribution process. In case of new building plans, the corresponding certificates have then to be filed by the planning authorities. As required, they may 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 build of dwellings.

Electricity sales caps and trade

Another innovative instrument was proposed by the German Advisory Council on the Environment (Sachverständigenrat für Umweltfragen, SRU) in 2011. It is a cap-and-trade scheme for the electricity sales of all suppliers in the country. Its basic way of functioning is as follows:

In the beginning, certificates are produced for the total amount of allowed electricity sales in the starting year and allocated to suppliers based on their number and type of customers. This total amount of certificates will be reduced in subsequent years, following a pre-determined path. Suppliers will have to hand in the exact amount of certificates matching their sales each year. If a supplier meets its target, i.e., the number of certificates allocated is the same as its electricity sales in kWh, there is no need for further action. If the customers saved more energy than targeted, the supplier may sell surplus certificates or bank them. If a supplier cannot motivate its customers to realise enough savings, it needs to purchase the missing certificates from other suppliers with a surplus. This trading element can therefore create flexibility and improve economic efficiency.

This scheme provides a strong incentive for suppliers to support their customers in reducing their electricity consumption through energy efficiency, energy sufficiency, or fuel switching. They have complete freedom as to the ways and services they use to support their customers in reducing their electricity consumption. This is, hence, a policy addressing another important driver of energy consumption and non-sufficiency: the incentive that energy companies have had to increase energy sales. However, a number of details need to be clarified, and its consequences better analysed before such a scheme could be started. The "Energiesuffizienz" project will be the first to delve into such more detailed analysis.

Conclusions and outlook

What did we learn from our analysis of guiding principles, methodologies, concrete policies and measures, and a comprehensive policy package for energy sufficiency so far? On the one hand, energy sufficiency actions and the policy support they need are more different from energy efficiency than we thought at the outset of the work: With sufficiency actions, utility aspects are reduced or change qualitatively; and because of substitution options, the analytical approach cannot follow a single product type (as with efficiency) but has to follow rather a field of needs/care economy domains. On the other hand, the seven principle methodological steps of analysing the options for action, appropriate policies and measures, and the resulting policy package are quite similar overall to the steps of energy efficiency policy analysis, whereas the substance of analysis in each step will naturally differ, and sometimes a lot. For instance, the step 4 of analysing pre-requisites and framework conditions has to deal with all the gendered aspects of the care economy and more generally with norms and social practices determining the demand for technical services, which are not as relevant for energy efficiency, because the latter does not imply a change in the demand for technical services.

As some services and practices to be devleoped as well as some instruments in the policy package are quite new, policy experimenting may be needed to create good practice case studies before broad implementation. Based on interviews with local energy policy actors and stakeholders,[1] we found some guiding principles regarding policy processes:

- Give appropriate consideration to multilevel governance.
- Integrate local to global approaches.
- For highly innovative services or measures: Do not address everybody from the start but
    - create or secure room for those who are motivated to play, make experiences, and learn;
    - develop and support „islands“ with pioneers, who create different new models and can become multipliers.

At the time of writing this paper, our analysis of energy sufficiency policies for supporting the most important actions is far from complete. Especially, the restrictions within households/individuals require further analysis as to their provenience and addressability, and upcoming project work will focus on the drivers at the macro level, how they relate to restrictions at the meso/micro level and how drivers can be addressed by policy. For some of the options for energy sufficiency action and some policy proposals, their effectiveness and acceptance will also be tested in a survey this summer. Work will continue throughout 2015, and the final report of the project “Energiesuffizienz” will provide a more comprehensive picture of the policies and measures and a comprehensive, integrated package for energy sufficiency and efficiency policy than we are able to provide at this point of the research. However, we hope the methodological approach for policy analysis outlined here and the ideas on elements of an integrated policy package for energy sufficiency may be useful for other researchers in the field.

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[1] More detailed information on the interview outcomes with local stakeholders forthcoming on the project website www.energiesuffizienz.de

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