Energy sufficiency in policy and practice: the question of needs and wants

Tina Fawcett and Sarah Darby
Environmental Change Institute
University of Oxford
South Parks Road
Oxford, OX1 3QY, UK

tina.fawcett@eci.ox.ac.uk, sarah.darby@eci.ox.ac.uk

Abstract

Transformation of energy demand is one of three pillars for action identified in the IPCC's 1.5^{0}C report. To deliver emissions reductions of the scale required, this transformation will need to be radical. While policy approaches of 'energy efficiency first' and 'multiple benefits of energy efficiency' have the potential to increase action and reduce carbon, a more ambitious framing is needed.

Sufficiency, or energy service sufficiency, could be a strong framework to deliver energy services equitably, while respecting planetary boundaries. But the concept of sufficiency cannot be separated from judgements on what is 'enough' or from principles of distributional justice: it steps outside conventional energy policy boundaries.

This paper explores the possibility of distinguishing between needs and wants – a debate with a long history – and considers whether and how such distinctions may be embodied in policies such as rising block and demand-based tariffs, energy labels based on consumption, product bans and building standards to reduce and prevent energy / fuel poverty. The focus is on residential and mobility energy services. Ideas from the literature will be presented and interrogated in the light of European experience and debates on energy sufficiency and fuel poverty, and a model for reaching a national consensus on basic needs will be offered.

Energy policy based around access to sufficient services will involve questioning expectations and norms about what 'enough' means and who gets to decide. Moving to a sufficiency framing will involve challenging social and political debates, and technological advances will not allow us to side-step these. The energy policy community is a good place to start these discussions, because we already have some socio-technical options to offer, along with experience in defining services and standards, which can be developed on the path to much-reduced use of fossil fuel.

Introduction

In October 2018, the Intergovernmental Panel on Climate Change (IPCC) released its report on the impacts of global warming 1.5°C above pre-industrial levels (IPCC, 2018). It made headlines around the world with its vivid warnings of the dangers of increasing climate change, and called for "rapid, far-reaching and unprecedented changes in all aspects of society" to reduce these risks. The report reinforced the vital importance of transformations to energy demand, and also showed that actions on energy demand have significant net co-benefits for nearly all areas of human development and natural ecosystems. Limiting global warming to 1.5°C could go hand in hand with ensuring a more sustainable and equitable society.

While there are many governmental statements in support of taking action on climate change, the evidence is that change is not happening at anything like the rate required. In November, the United Nations Environment Programme released its 'Emissions Gap Report 2018' (UNEP, 2018), which concluded that nations need to 'triple efforts to reach the 2°C target' (which is less demanding than the 1.5°C target in the IPCC report). Supposedly ambitious future scenarios can nonetheless show increasing energy demand. For example, the International Energy Agency's recent, ambitious 'efficient world' scenario to 2040 (IEA, 2018), results in higher global energy demand than today. The UK Government's Clean Growth Strategy (BEIS, 2017b), which has a strong focus on technological innovation, contains insufficient policy to deliver the significant cuts to carbon emissions promised.

The idea that sufficient changes to use of fossil fuel energy can be delivered without changes to the way our societies organise, use and think about energy and its benefits seems increasingly untenable. The recent international Extinction Rebellion movement, which has taken direct action to highlight climate change and species and habitat loss, uses the language of 'climate emergency' to describe the state we are in and calls for radical economic, social and political change. The energy demand research community itself is exploring new ways of thinking. This paper is part of that process. Its aim is to explore the idea of energy sufficiency, to focus on the distinction between needs and wants embodied in this idea, and to present initial thoughts about how this idea could be translated into policy action.

The work presented here builds on conceptual work on energy sufficiency undertaken as part of the ECEEE energy sufficiency project (Darby and Fawcett, 2018). Other papers in the series include one on sufficiency and the rebound effect (Sorrell et al., 2018) and energy sufficiency in products (Toulouse and Attali, 2018). ECEEE has also held a number of workshops across Europe to engage the wider community in debating and building on knowledge. The project aims to bring together current knowledge on sufficiency, develop new thinking and analysis, suggest how sufficiency policy could be developed in Europe, and to act as a resource for the research, policy and NGO communities.

This programme of research and engagement comes out of a history of interest in sufficiency by ECEEE and its members. The first call to consider a new policy paradigm of 'sufficiency in energy services' came at the 2003 Summer Study. The authors pointed to a fundamental 'self-deception' within the energy policy community: the term 'efficiency' was (wrongly) routinely equated with the concepts of 'sufficiency' and 'sustainability' (Wilhite and Norgard, 2003). ECEEE began to take up the challenge of sufficiency. Their response to the 2005 EU Green Paper 'A European strategy for sustainable, competitive and secure energy' suggested that the EU needed to go beyond technical energy efficiency measures and addressing the challenging issue of curbing demand for energy services in a politically acceptable fashion. More recently, a number of papers at Summer Studies have advanced knowledge on sufficiency (Brischke et al., 2015; Darby, 2007; Thomas et al., 2015).

The structure of the paper is as follows. First, we present our definition of energy sufficiency and briefly compare it with other definitions. Then a visual representation of energy service sufficiency is presented. Next we consider the distinction between needs and wants. One particular theory of need is presented, as an example of how needs and wants might be distinguished, followed by counter-arguments. A method for distinguishing needs and wants is presented. Then we consider how the ideas of needs and want fits with existing approach to policy making in energy demand, and how these ideas might be advanced or tested, building on existing policy debates and policy tools. The paper closes with discussion and conclusions.

Defining energy sufficiency

In work for the ECEEE sufficiency project, we developed a definition of energy sufficiency (Darby and Fawcett, 2018). We began with a simple definition:

Sufficiency is an amount of something that is enough for a particular purpose.[1]

From the above, a working definition of energy sufficiency was developed:

> *Energy sufficiency is a state in which people's basic needs for energy services are met equitably and ecological limits are respected.*

The term energy sufficiency is also used to refer to an *organising principle for achieving that state.*

This definition is deliberately high level and conceptual, and inspired by the literature on sufficiency and the good life. It offers a broad framing of the concept of sufficiency, and it is discussed in relation to similarly broad issues: planetary limits, sustainable development goals, equity, timing and scale in our conceptual report.

There is no single agreed definition of energy sufficiency. As Sorrell et al (2018:3) note: "Some authors consider energy sufficiency to be a particular state or outcome defined by a level of energy service consumption that is consistent with both human well-being and environmental limits, while others consider it to be a direction defined by reduction in energy service consumption that also reduces the associated environmental impacts." Our definition clearly fits in the first category. The second type of definition can be characterised as being about 'energy sufficiency actions'. Examples of sufficiency action definitions, include "energy *sufficiency* refers to changes in individual behaviours that lead to lower demand for energy services" (Moser et al., 2015). More detailed definitions have been identified for particular projects. A project which focused on household appliances defined energy sufficiency as a strategy to reduce energy consumption by three strategies: quantitative reduction of sizes, features, usage times of devices etc.; substitution of technical equipment in

[1] http://www.oxfordlearnersdictionaries.com/definition/english/sufficiency

households; adjustment of services delivered to meet user needs (Brischke et al., 2015). Different definitions can be helpful for different purposes, but can also cause confusion. In this paper, sufficiency is used in its broad sense, as per our definition above.

Many of the words and phrases in our definition could be questioned. What are 'basic needs'? Why 'energy services' rather than energy? What do we mean by 'equitably, and what 'ecological limits' do we have in mind? In the remainder of the paper, most focus is on exploring the meanings of 'basic needs' and 'equitably'. We recognise that the focus on energy services, rather than energy itself, adds to the complexity of operationalising a definition of sufficiency. But it is only through focusing on services that we can do some justice to the nature of the global sufficiency challenge.

Visualising sufficient energy services

Our definition of sufficiency mentions both 'ecological limits' and 'basic needs'. The space between these upper and lower boundaries is where sufficient energy services sit. This can be visualised as a doughnut (Figure 1) - following the work of Kate Raworth. She developed a 'doughnut diagram' for Oxfam, a development NGO, which identifies a 'safe and just space for humanity' that lies between a 'social foundation' where basic needs are met, and an 'environmental ceiling'(Raworth, 2012). The social foundation reflects the concept of universal human needs for a variety of goods, services and freedoms (water, income, education, resilience, voice, jobs, energy, social equity, gender equality, health, food), in line with the approach taken in setting the Sustainable Development Goals. Its environmental ceiling is defined in terms of nine planetary boundaries. Raworth's subsequent book 'Doughnut economics' (Raworth, 2017) provides a critique of mainstream economic thinking and has developed new approaches to economic thinking to help deliver the safe and just space for humanity envisaged in the doughnut.

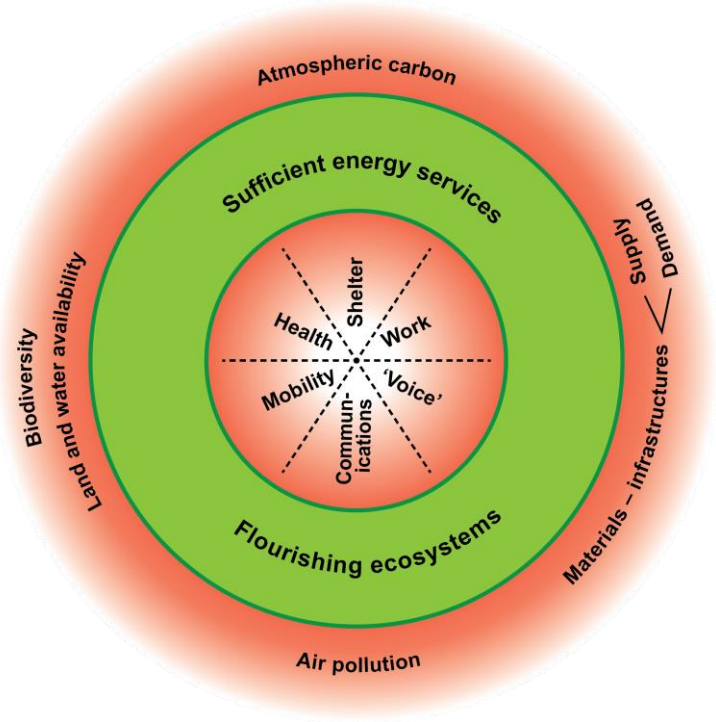

Figure 1: an adaptation of the doughnut for use in thinking about energy sufficiency

In our adaptation of the doughnut model, the external environmental limits relate to

- *sources* of energy for human use and the associated greenhouse gases and pollutants;
- *materials* used in infrastructures of supply and demand (that is, everything from mines and power stations to pipes, wires, buildings, vehicles, roads, machine tools, heating systems and electrical appliances);
- *land and water* used to provide energy services, whether this involves growing biomass, storing water for hydro generation or hosting mines and generating capacity.[2]

[2] The land-and-water-footprint issue relates to the concept of power density – see Smil, V. (2015) *Power Density: a key to understanding energy sources and uses*. MIT Press.

In the inner ring of the energy sufficiency doughnut, the focus is on energy services to meet needs for shelter, health, work, mobility and communication

The doughnut offers a powerful visual representation and incorporates the two principal characteristics of sufficiency as discussed above: the idea of absolute limits (sufficiency as a restraint) and of minimum requirements (sufficiency as satisfaction, or 'enough'). Di Giulio and Fuchs (2014) have taken a similar approach to developing 'sustainable consumption corridors'. Rather than using the language of wants versus needs, they talk about the concept of the good life, minimum and maximum needs, and the maximum natural and social resources individuals are entitled to.

Needs, wants and sufficiency in theory

A long history of debate

Our definition of energy sufficiency is focused on 'people's basic needs' – with the clear implication that needs are a distinct category from wants. There are complex and long-standing debates as to whether there is a distinction between human needs and wants, and if so, how this can be defined. Some of these debates emerge from philosophical / political / social science traditions, with others arising from the requirements of public policy. For example, policy constantly embodies judgements about how much income is enough for people in different situations. Davis, Hirsch et al. (2015), writing from this applied tradition, summarise the theoretical literature on needs and identify two key areas of debate:

- whether human needs have any universal or objective features;
- what an account of human need should look like, with different approaches to: material and non-material necessities; absolute and relative norms; expert and public/'lay' judgement about what are necessities.

There is a smaller body of work on needs and wants in relation to energy and energy services (e.g. Darby, 2007; Wilhite and Norgard, 2003). But the same types of debate occur, as energy services can deliver both material and non-material requirements (e.g. warmth, cooked food, entertainment) and subject to arguments about appropriate standards (absolute versus relative). Below, we consider one particular theory of need, as an example of how needs and wants might be distinguished. Then we look at the counter-argument for there *not* being a meaningful distinction between needs and wants.

A theory of need

The theory of need introduced here is that developed by Len Doyal and Ian Gough. They theorised that human needs *are* universal, with objective features, and include both material and non-material needs (Doyal and Gough, 1991). This work has recently been developed further (Gough, 2015, 2017). They argue that a sound theory of need provides firm foundations on which to build sustainability targets for public policy. 'Need' refers to a particular category of goals which are held to be universalisable. The contrast with 'wants' – goals that derive from an individual's particular preferences – is central to the argument. The universality of need rests on a belief that if needs are not satisfied then serious harm will result: 'fundamental disablement in the pursuit of one's vision of the good, whatever that vision is' (Gough 2015:1196).

Doyal and Gough (1991) identified two basic needs: physical health and autonomy. They then asserted the universal character of eleven 'intermediate needs' (or needs satisfiers), material and non-material. These were: nutritious food and water; protective housing; a non-hazardous work environment; a non-hazardous physical environment; safe birth control and child-bearing; appropriate health care; security in childhood; significant primary relationships; economic security; physical security; appropriate education. They recognised that the means of satisfying these needs was culturally variable. This approach of identifying universal needs, which may be met differently in different cultures and at different times, is similar to that which underlies the Sustainable Development Goals[3].

Gough proposes that this theory of need provides a better basis for understanding and delivering human well-being within environmental limits, than three alternative approaches: welfare economics and preference satisfaction; hedonic psychology and happiness; and the capability approach developed by Sen (1999). For further discussion of the capability approach, and how it relates to ideas of sufficiency, see Darby and Fawcett (2018).

[3] http://www.undp.org/content/undp/en/home/sustainable-development-goals.html

Needs and wants as indistinguishable

A distinction between wants and needs is integral to our definition of sufficiency, but there are arguments on both theoretical and empirical grounds that no such distinction can be drawn. This section presents brief examples of these arguments, but does not seek to be comprehensive.

Considering theory first, the basis of welfare economics and preference satisfaction is that individuals are the best judges of their interests or preferences / wants (as noted in Gough, 2015). The principle of consumer sovereignty follows from this: that what is produced and consumed should be determined by individuals' private consumption and work preferences. These, of course, vary greatly according to circumstances and inclinations, therefore there can be no valid distinction between wants and needs. This approach fits with mainstream political thinking in many parts of the world and with the neoclassical economic paradigm. However, there are critiques of this position from within economics. The preference satisfaction theory it is based on does not adequately cover, for example, publicly-provided or free goods such as fresh air, cycle lanes or street lights.

Empirical data demonstrate how there has been constant renegotiation of what may be considered as basic needs, usually in the direction of increased consumption of energy and other resources (Wilhite and Lutzenhhiser, 1997). For example, average living space per person (and the energy needed to service it) continues to increase in most developed countries, and the use of refrigeration, cooling and other energy services is increasing rapidly in developing countries (Wilhite, 2016). What was once an expensive service, only accessible to the most privileged people, can become cheap and commonplace within a few decades or less. This does not necessarily show that there can be no distinction between needs and wants, but that goods and services can readily move from one category to another - which leads to questions of the usefulness of this distinction.

Finally, a strong case for a low carbon transition can be made without invoking arguments about needs and wants. For example, Wilhite (2016) lays out a theory of habit, arguing that it can provide a conceptual frame that acknowledges deeply held collective and individual dispositions for high energy consumption and provides insights into how low carbon policy can engage with high energy habits. This theory suggests more infrastructurally-oriented policies for reducing carbon emissions that would, for example, reduce working hours and change the nature of work; make collective transport more convenient and reasonably-priced; increase the sharing of living spaces and products; and reduce the dependency of food systems on refrigeration.

Discussion

There is disagreement as to whether making a distinction between needs and wants is theoretically justified, is empirically possible or is of use in policy making. We have been persuaded by the 'theory of need' approach, and retain the distinction in our definition. In the remainder of the paper, we look at means of distinguishing between wants and needs, and consider whether and how this distinction could be embedded in energy policy.

Needs and wants: empirical distinctions

The development of a Minimum Income Standard (MIS) in the UK seeks to establish what can legitimately be considered a 'need' within a society, by asking the members of that society to make a collective judgement about what to include. Despite arguments against the existence of objective human needs, laypeople instinctively feel that they *do* exist and can be identified (Davis et al., 2015). This MIS is calculated by specifying 'baskets' of goods and services required by different types of household in order to meet minimum needs and to participate in society (Davis et al., 2016; Padley and Hirsch, 2017). The minimum is defined as follows, based on consultation with groups of citizens:

> *A minimum standard of living in the UK today includes, but is more than just, food, clothes and shelter. It is about having what you need in order to have the opportunities and choices necessary to participate in society.* (Padley and Hirsch 2017:3)

This definition has much in common with Doyal and Gough's theory of need, although the language used is different. The MIS is updated annually to reflect social and economic change, although the overall pattern of minimum household requirements has remained relatively stable since 2008 (Davis et al., 2016).

The assessment of minimum standards for household energy use in the MIS relies heavily on expert rather than lay judgement. Energy use is taken to be a function of dwelling size and it is assumed that typical housing will have gas central heating with a radiator in each room. A fuel expert calculates energy requirements for cooking, lighting, heating etc. based on typical room dimensions and insulation levels for the kinds of housing relevant for each of a number of household types and sizes (Davis, Hirsch et al. 2015:54).

The MIS is important in showing that it is possible, through careful participatory research, to reach social consensus on what minimum needs are in a given time and place, and that this consensus may be stable, at least over the short to medium term. It is also important in recognising a social dimension to standard of living. This

offers some prospect of operationalising the concept of sufficiency. But the process by which it is decided also shows the significance of context: it has been derived for a single country, with a single legislature. This fits with the philosophy of Individually Determined National Contributions under the UNFCCC, brought in at the time of the 2015 Paris conference: each nation is, in effect, determining how it will achieve sufficiency.

Approaches to policy change

Outlining the challenges

What would adopting sufficiency as one of the guiding principles of energy policy mean? To think about this idea, we use the UK as an example of an industrial/post-industrial economy. First, government would need to set the level of sufficient energy services, by using a methodology like the Minimum Income Standard. It would also need to know the level of these which would be delivered within planetary boundaries. Figure 2 is a simple diagram of total energy services plotted against the proportion of the population whose energy needs are met. It shows the balance of energy service needs and wants, and how moving from current consumption to sufficient energy services would reduce the space available for meeting energy service wants. The suggestion, based on the prevalence of fuel poverty (BEIS, 2017a; Scottish Government, 2018) and those who are unable to access adequate mobility services (Sustrans, 2012), is that up to a fifth of the population currently do not have their energy service needs met. Other than that, it is not to scale. The arrows show the direction of change needed.

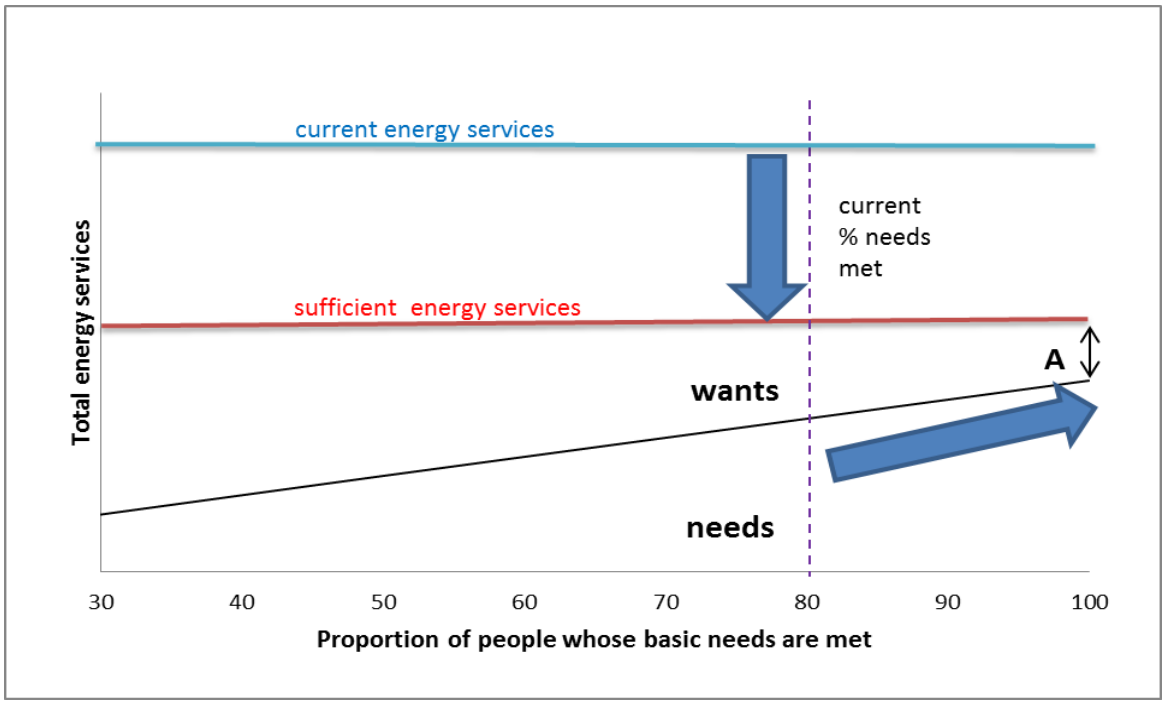

Figure 2: Illustration of energy services, want and needs (not to scale!)

From the diagram, one of the key unknowns is how big A is - i.e., if all energy service needs were met, how much additional energy service would be permitted within the national 'budget'? Indeed, it is unclear if A is a positive number - whether all needs can be met within ecological limits (making reasonable assumptions about low carbon technologies / energy sources / infrastructures of supply etc). Under conditions of sufficiency, this diagram should be in one dimension, as 100% of needs would be met, and the key questions are what space (if any) is left for wants, and how should this space be shared.

Energy policy would then face a number of new challenges, including to:

1. establish what sufficient energy services are and ensure the sufficient energy services 'cap' is not exceeded;
2. ensure all are able to meet their energy service needs through a combination of individual and public provision of infrastructure, heat/cooling and power;
3. manage the transition from current energy services to the new, lower, sufficient energy services, in a way which is socially acceptable.

The first challenge is fundamental. The Minimum Income Standard method can be a starting point. However, as noted earlier, basing a definition on energy services creates problems of measurement. The second challenge is

closely linked to issues of energy or fuel poverty - something which is of increasingly of concern, and is being incorporated in more EU and national level policy. The third challenge is a version of the central challenge for any energy policy responding to the climate change imperative. Even if we agree on limits to wants, and what constitutes needs, there will be different views on how the remaining space for 'wants' should be managed.

Needs and wants in current energy policy

Policy on residential energy demand does not typically use the language of needs and wants, it focuses largely on energy efficiency and adoption of lower carbon or renewable energy sources, with some policy around changing behaviour. However, given national policies around affordable warmth and energy / fuel poverty, it is apparent that governments have adopted the idea that some energy services are needs, which society should ensure everyone has access to. Once some levels of energy service have been defined as needs (e.g. affordable warmth), does this mean everything else can be considered a want?

There are ongoing disputes in energy policy which could be interpreted as being arguments about what level of consumption is a necessity . The 'gilets jaunes' protests in France were sparked in part by a rejection of proposed increased in taxation of motor fuel (Willshire, 2018). The increase in taxation was put forward as an environmental policy measure. The stated logic of the protests was that car travel is a necessity, particularly for people living rurally, and thus increasing fuel taxes was fundamentally unfair. Similar arguments have been used in other countries in protests and debates on taxation of fuels - although fuel prices are just one component of the cost of motoring, and one element of environmental taxation (Fawcett, 2010). Clearly, whether car travel is perceived as necessary, depends in part on the availability of public transport alternatives. In the MIS work, in recent years a car has been included in the necessary basket of goods for families with children for the first time, as the focus groups thought bus systems were no longer good enough to allow children to participate in normal social life without access to a car (Davies et al, 2015). Arguably, transport has an insatiable 'further and faster' character, making it particularly difficult topic when discussing the distinction between wants and needs. The embryonic movement for slow living may be one counter to this (e.g. Parkins, 2004; Fullagar et al., 2012).

A focus on wants

Policies to reduce energy service 'wants' and consequent energy consumption, could focus on reducing average consumption of energy, or could specifically target high consumption (or both, of course). High consumption could be defined in terms of household consumption, or the consumption of particular products / homes / services, or all of these. Deciding which approach to take would require better understanding than we currently have on the distribution of energy consumption, particularly if we want to avoid penalising vulnerable high consumers (who exist in significant numbers (Preston et al., 2013). This would be a different focus for energy policy, and there are many issues to research.

Beyond individuals

Energy systems are characterised by demand, supply and infrastructures of demand and supply such as buildings, transport networks and fuel pipelines. These infrastructures are out of the direct control of individuals and can have enormous influence on consumption patterns. For example, someone living in a concrete-and-glass apartment in a tropical country might reasonably consider air-conditioning to be a need, while a neighbour in a vernacular home would not do so; a worker obliged to live in the countryside, without good public transport, because of the high price of city housing might reasonably think that owning and using a private car is a need, whereas her colleague at work who lives in the city would be able to travel to work easily without a car. This social as well as individual nature of resource consumption, characterised as 'social loading' by Wilhite and Luzenhiser (1997), poses a major challenge to designing policy which separate needs from wants.

Building on existing policy

Although sufficiency is an idea recently introduced into energy policy debates, it has a considerable overlap with reducing energy consumption or energy conservation. It connects with a number of existing debates about the design of energy markets and individual policy instruments. Examples of these debates, and their link with sufficiency is given below. For more detailed discussion of product policy and sufficiency, see Toulouse and Attali (2018).

<u>Designing energy markets: pricing structures for household energy</u>

The design of pricing structures for household energy connects to both the limits and equity aspects of energy sufficiency. How household energy charges are structured determines whether people pay more or less per kWh and/or per kW as consumption and instantaneous electricity demand rises (or falls). Two options which work in opposite directions are standing charges and rising block tariffs. There is a strong logic behind having a standing charge. This fixed cost within the energy bill ensures that all users share the cost of transmission, distribution,

metering and billing infrastructure equally and then pay for their consumption separately. The lower household consumption, the higher percentage standing charges are of the total bill, and the higher the effective price per kWh. There have been long-running debates about removing standing charges from energy bills (Pyrko and Darby, 2011)., although to little effect thus far in the UK(Warren, 2012). Regulatory approaches favour this type of 'cost-reflective' pricing and national regulators typically act against cross-subsidies between groups of customers (Baker and White, 2008).

By contrast, rising block tariffs are designed so that costs per kWh rise as consumption rises. They are one of several options which might deliver more sustainable tariff structures, in terms of economic, environmental and social objectives (Baker and White, 2008). Rising block tariffs exist in a number of countries, for example one of these has been introduced in Spain as part of Article 7 policies (Ricardo-AEA, 2015). In South Africa, a 'poverty tariff' has been instituted that allows for 50kWh per month of free electricity (Winkler, 2007), This is available only to customers who agree to the installation of prepayment meters (Makonese et al., 2012).

Another sufficiency-related approach to electricity pricing links cost to the demand capacity of the customer: a 'demand charge' is a component of the tariff, so that customers pay more for the privilege of being able to operate several large appliances at once. For many years, for example, roughly 90% of Italian residential customers paid a tariff that capped instantaneous demand at 3kW. This type of arrangement is inherently equitable (although customers with electric heating would need special provision) and helps to keep peak load within manageable limits. The interests of the utility and the state can therefore be a powerful factor in defining sufficiency, at the aggregate if not the individual level (Hayden, 2013).

Currently, the main focus on tariff development is in time-of-use pricing, due to concerns about peak electricity demand and the integration of renewables into electricity supply. Dynamic, time-of-use pricing does not inevitably disadvantage poorer customers (Faruqui et al., 2010), but distributional impacts need careful attention. Customers vary considerably in terms of the energy-using activities they normally carry out at peak times and in the extent to which they can shift them. The association of flexibility with income is not straightforward: for example, a single working parent with young children is likely to have less flexible demand than a pensioner with similar income and housing.

Designing policy around consumption or efficiency?: Product standards and labels

Policy on products could be designed around either absolute consumption or efficiency. There is concern that the current efficiency basis for most policy instruments, especially minimum standards and energy labels, could be less effective than an alternative consumption (or sufficiency) framing. Energy labels are the most visible component of EU energy efficiency policy. From their introduction on cold appliances in 1995 they have gone on to be applied to most significant household appliances, cars and homes themselves. For homes and appliances, these labels are efficiency labels. For some appliances, particularly cold appliances and washing machines, the efficiency standards are easier to reach in larger models, for technical reasons. As a result, there has been concern that a market shift to higher efficiency might, perversely, lead to higher consumption. For cars, a different approach has been taken in the UK implementation of EU legislation, with labels on energy efficiency and carbon emissions per km being absolute values, rather than related to engine size, vehicle weight or other size characteristics of the car.

For appliances, it appears an efficiency label has generally been effective in supporting reductions in consumption. This is shown by EU sales data for cold appliances (refrigerators, freezers and fridge-freezers), washing machines and tumble driers illustrates (Michel et al., 2015). For cold appliances, 2004-2014, the average declared energy consumption has been reduced by 25%, with size increasing by just 3%. Washing machines have become much more efficient, but the impact on energy consumption is less clear. The average declared energy consumption of tumble driers sold decreased both in France (by 28%) and Portugal (38%) between 2004 and 2014 (figures not supplied for EU as a whole). Fortunately the fears of efficiency labels having a perverse effect in terms of consumption have largely been unrealised. For vehicles, the picture is less positive. There have been widely reported scandals related to the accuracy of emissions testing, particularly related to particulates and air pollution, but also to carbon emissions per km (Brand, 2016). Where efficiency has been tied to vehicle weight, there have been hidden incentives to escalate the size of vehicles in order to claim relatively high efficiency: this has been counter-productive in terms of sufficiency and energy consumption.

Limiting personal consumption

There are very few, if any, cases of products being banned due to energy consumption. There is no upper size of home which can built, supercar which can be designed or fridge-freezer purchased. EU product policy has

effectively banned the least energy efficient products, and this has led to significant energy savings. While this policy approach has delivered very important reductions in energy use, it has not challenged unlimited consumption. However, there are some examples of government policy which does seek to influence consumption - the case of the size of homes is considered briefly next.

Governments tend to have views on how much residential space per person is acceptable. They may have both minimum and maximum standards for space per person / household – although the maximum typically only applies where housing costs are paid for or subsidised by the state. The ideas of both 'under occupation' and 'over-crowding' are common in the housing and social welfare literature, and government statistics. Two UK public policy decisions have tended to reduce residential space. Firstly, minimum space standards for new dwellings have been removed from planning policy. Secondly, the amount of space that tenants in social housing are entitled to has been reduced, with a 'bedroom tax' imposed. Neither of these changes were related to energy policy or sufficiency concerns, although both are likely to reduce the amount of space occupied by parts of the population. In housing which is already the smallest in Europe, this raises welfare concerns (Morgan and Cruikshank, 2014).

In the absence of passive house standards, or zero carbon heating fuels, the amount of space occupied per household or per person is important when thinking about sufficiency, because of the link between space and energy needed for heating. Ideas about reducing space per person have been explored in the sufficiency literature (e.g. Thomas et al., 2018). As indicated above, dwelling size intersects with many other aspects of life - and a lack of space may prevent people from meeting social needs. Two lessons arise from this - the first is that non-energy policy can be very important in determining energy use. Secondly, when designing energy sufficiency policy, energy outcomes are not the only consideration. The overall purpose of a focus on sufficiency - incorporating justice, human welfare and environmental limits - must be central to the design of individual instruments or policy packages.

Discussion

This paper set out to describe the definition of energy service sufficiency developed as part of the wider ECEEE project, and to interrogate further the distinction between needs and wants, which is one of its fundamental characteristics. If the idea of sufficiency, and sufficient energy services in particular, is to be persuasive and useful, it needs both a clear intellectual and theoretical framework, and to be capable of being translated into a set of policies.

The challenge of sufficiency

Sufficiency is a difficult idea. The question is, what makes it difficult? The inside ring of the doughnut is very similar to the globally agreed Sustainable Development Goals. The upper boundary, at least for greenhouse gas emissions, also reflects a global agreement. Why so difficult, given that we are reflecting global agreements on minimum needs and maximum limits? First, these are strikingly different in nature. The outer boundary comes from a scientific consensus on atmospheric physics, geochemical flows and so forth. The inner boundary is far more contentious: judgements on what is sufficient are place- and time-sensitive and also influenced by history, by infrastructures and cultural norms. But the distributional issue, the acknowledgement of needs and allocation of resources between people, is arguably the most difficult single issue. The ideas of limits conflicts with economic growth imperatives and with much classical economy theory. The change from a focus on energy efficiency, which is a means of achieving a range of energy goals, to talking about the 'ends' – what human beings need, and how to provide that within a safe natural environment – is a quantum shift.

Energy efficiency has been able to fit with standard economic assumptions and a variety of political outlooks (Mallaburn and Eyre, 2014), but it's not clear that sufficiency will do this, as it operates from a distinctly different starting point. Sufficiency forces the issue of climate change and environmental degradation to the centre of our politics. As an aspiration, it may be acceptable, but it is likely be resisted when the concrete consequences of such an approach are elaborated. It could also be risky for energy policy specialists and those proposing it, as they may be marginalised and ignored. On a more positive note, introducing energy sufficiency as a central concern of energy policy could be a route to having difficult conversations in a constructive way.

Testing the idea of sufficiency

Work on the Minimum Income Standard shows there is a workable method for distinguishing needs and wants at national level, and that consensus can be reached and be periodically updated to take account of social change. It enables and records public discussion that produces not just lists of agreed necessities but a set of rationales that tell us why certain items are included and others are not. Such discussions could themselves be

seen as part of a process of creating and maintaining a sufficiency-based society. For the ten years over which this definition has been reviewed in the UK, perceived needs did not increase significantly and some decreased. However, this has been a period of low economic growth and 'austerity' (low investment in public services), and over longer time scales we might expect the minimum needs identified to increase. In Doyal and Gough's language, it is the 'intermediate needs' here which are changing, the ways in which people meet their fundamental need of pursuing the good life / participating in society.

In any event, we can expect the ways needs are met to change over time. There seem to be two imperatives here. One is to assess need realistically in macro/aggregate terms of sufficiency – in terms of the outer ring of the doughnut. The other is to have effective systems in place for assessing and meeting basic needs within each legislature.

Missing scales in the sufficiency literature

The discussion around needs and wants in this article has been framed around individuals, and the energy services considered have been those in the residential sector and personal travel. This is not surprising as the idea of 'inner ring' sufficiency arises from thinking about individual lives, and it is a consumption rather than production side perspective. However, sufficiency ideas need also to be applied to communities and organisations at a variety of scales. How can the idea of sufficient energy services be translated into organisational and business activities and public life? What level do we set sufficiency at, and at what level do we embed it in policy? For example, how could we decide how much energy a university chemistry department needs? Would that ever be an answerable question?

Reconsidering our definition

While recognising the needs/wants debate is complex, we took the position that distinguishing needs and wants by social consensus has been shown to be possible; such consensus can be a useful input to policy. A definition which uses the concept of energy services is more difficult to operationalise, and more thought and research into this is required.

Making a distinction between needs and wants is not the only basis for a serious response to climate change and other environmental limits. Policy responses to high levels of consumption can sidestep a 'needs and wants' framing, focussing more single-mindedly on environmental goals and the achievement of these in ways that are socially just. Yet in practice, debate and negotiation about environmental goals almost inevitably raise questions of equity, needs and wants. The early arrival of 'grandfathering' as a contentious issue in the Kyoto negotiations illustrates this. Even if, in principle, it is not necessary to think in terms of needs and wants, they are hard to avoid in politics. Disagreements on this issue are certainly worth considering further. However, they need not stand in the way of action to take European consumption patterns in a new direction.

Conclusions

Sufficiency can be used as an organising principle for living within ecological limits. Putting it into practice is a huge task and we have only begun to outline some of the aspects of this. While recognising that sufficiency will always be contentious, we see it as an important concept to feed into policy at a time when so much is at stake for climate, biosphere and human welfare. It means facing up to the need for substantially different ways of life, which will still have to emerge from existing materials, institutions, ideas and processes.

A central issue in making the necessary changes will be the debate over what needs, including energy services, are basic and non-negotiable. We have argued that, boundaries between needs and wants do exist de facto in the minds of people everywhere. They are constantly negotiated as societies develop and it is therefore vital to have processes for carrying out this negotiation in an open way and with reference to ecological limits.

Limits to consumption are much harder to agree than limits to (in)efficiency, which involve judgements about technologies and cost, rather than how much is enough. To make progress with exploring consumption limits, a better understanding of patterns of household energy consumption, variability between households, links to income, access to infrastructure and the relationship between resources and energy services will be important. Defining over-consuming products may be less difficult, but has generally been avoided to date, with standards, labels and performance requirements being set in terms of efficiency.

This work on sufficiency is still in its early stages. However, we believe it usefully opens up conversations around needs and wants, about ensuring enough energy services for all, and what those might be, while responding to the calls from scientific, civil society and political leaders for rapid change to protect the natural environment on which we all depend.

Acknowledgements

The authors gratefully acknowledge funding from ECEEE, the KR Foundation and the Engineering and Physical Sciences Research Council via the UK Energy Research Centre, grant EP/L024756/1.

References

Baker, W., White, V., 2008. Towards sustainable energy tariffs: A report to the National Consumer Council by the Centre for Sustainable Energy. Centre for Sustainable Energy, Bristol.

BEIS, 2017a. Annual fuel poverty statistics report 2017 (2015 data). Department of Business, Energy and Industrial Strategy, London.

BEIS, 2017b. The clean growth strategy: Leading the way to a low carbon future. Department for Business, Energy and Industrial Strategy, Available: https://www.gov.uk/government/publications/clean-growth-strategy [Accessed Oct 2017].

Brand, C., 2016. Beyond 'Dieselgate': Implications of unaccounted and future air pollutant emissions and energy use for cars in the United Kingdom. Energy Policy 97, 1-12.

Brischke, L., Lehmann, F., Leuser, L., Thomas, S., Baedeker, C., 2015. Energy sufficiency in private households enabled by adequate appliances, ECEEE Summer Study, Pres'que Ile de Giens, France.

Darby, S., 2007. Enough is as good as a feast – sufficiency as policy, ECEEE Summer Study, France.

Darby, S., Fawcett, T., 2018. Energy sufficiency: an introduction. Concept paper for ECEEE. ECEEE, Available: https://www.energysufficiency.org/libraryresources/library/items/energy-sufficiency-an-introduction/ [Accessed Nov 2018].

Davis, A., Hill, K., Hirsch, D., Padley, M., 2016. A minimum income standard for the UK in 2016. Joseph Rowntree Foundation, York.

Davis, A., Hirsch, D., Padley, M., Marshall, L., 2015. How much is enough? Reaching social consensus on minimum household needs. Centre for Research in Social Policy, Loughborough University, Loughborough.

Di Giulio, A., Fuchs, D., 2014. Sustainable consumption corridors: concept, objections and responses. GAIA 23, 184-193.

Doyal, L., Gough, I., 1991. A theory of human need. Palgrave Macmillan, New York.

Faruqui, A., Sergici, S. and Palmer, J., 2010. *The impact of dynamic pricing on low income customers.* Institue for Electric Efficiency White Paper

Fawcett, T., 2010. Personal carbon taxation: its role in climate policy, British Institute of Energy Economists 2010, Oxford.

Fullagar, S., Wilson, E. and Markwell, K., 2012. Starting slow: thinking through slow mobilities and experiences. In *Slow Tourism: experiences and mobilities,*eds. Fullagar, Markwell and Wilson, Channel View Publication

Gough, I., 2015. Climate change and sustainable welfare: the centrality of human needs. Cambridge Journal of Economics 39, 1191-1214.

Gough, I., 2017. Heat, greed and human need. Edward Elgar Publishing, Cheltenham, UK.

Hayden, A. , 2013. Enough of that already: sufficiency-based challenges to high-carbon consumption in Canada. *Environmental Politics* 23 (1), 97-114

IEA, 2018. Energy efficiency 2018: Analysis and outlooks to 2040. International Energy Agency, Available: https://webstore.iea.org/market-report-series-energy-efficiency-2018.

IPCC, 2018. Global Warming of 1.5 °C. Intergovernmental Panel On Climate Change, Available: http://www.ipcc.ch/report/sr15/ [Accessed November 2018].

Lin, B. and Jiang, Z., 2012. Designation and influence of household increasing block electricity tariffs in China. *Energy Policy* 42, 162-173

Makonese, T., Kimemia, D.K., Annegarn, H.J., 2012. Assessment of free basic electricity and pre-aid meters in South Africa. Proceedings, 2012 Domestic Use of Energy Conference, Cape Town, South Africa

Mallaburn, P.S., Eyre, N., 2014. Lessons from energy efficiency policy and programmes in the UK from 1973 to 2013. Energy Efficiency 7, 23-41.

Michel, A., Attali, S., Bush, E., 2015. Energy efficiency of white goods in Europe: monitoring the market with sales data. Topten.eu, Available: http://www.topten.eu/uploads/File/WhiteGoods_in_Europe_June15.pdf [accessed 29/2/16].

Morgan, M., Cruikshank, H., 2014. Quantifying the extent of space shortages: English dwellings. Building Research and Information 42(6), 710-724

Moser, C., Rösch, A., Stauffacher, M., 2015. Exploring Societal Preferences for Energy Sufficiency Measures in Switzerland. Frontiers in Energy Research 3.

Padley, M., Hirsch, D., 2017. A minimum income standard for the UK in 2017. Joseph Rowntree Foundation, York.

Parkins, W., 2004. Out of time: fast subjects and slow living. *Time and Society* 13 (2/3), 363-382

Preston, I., White, V., Thumim, J., Bridgeman, R., Brand, C., 2013. Distribution of carbon emissions in the UK: implications for domestic energy policy. Joseph Rowntree Foundation, York.

Pyrko J and Darby S (2011) Conditions of behavioural changes towards efficient energy use - a comparative study between Sweden and the United Kingdom. *Energy Efficiency* 4 (3), 223-236

Raworth, K., 2012. A safe and just space for humanity: Can we live within the doughnut? Oxfam, Oxford.

Raworth, K., 2017. Doughnut economics: Seven ways to think like a 21st-Century economist. Random House Business Books, London.

Ricardo-AEA, 2015. Study evaluating the national policy measures and methodologies to implement Article 7 of the Energy Efficiency Directive. Study produced for DG ENER , Available at https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report%20on%20Article%207%20EED.pdf [Accessed 22/2/16].

Scottish Government, 2018. Draft fuel poverty strategy for Scotland 2018. Scottish Government, Available: https://www.gov.scot/publications/draft-fuel-poverty-scotland-2018/ [Accessed Jan 2019].

Sen, A., 1999. Development as freedom. Oxford University Press, New York.

Sorrell, S., Gatersleben, B., Druckman, A., 2018. Energy sufficiency and rebound effects: Concept paper. ECEEE, https://www.energysufficiency.org/libraryresources/library/items/energy-sufficiency-and-rebound-effects-concept-paper/.

Sustrans, 2012. Locked out: Transport poverty in England. Sustrans, Available: https://www.sustrans.org.uk/sites/default/files/images/files/migrated-pdfs/Transport%20Poverty%20England%20FINAL%20web.pdf [accessed Jan 2019].

Thomas, S., Brischke, L., Thema, J., Kopatz, M., 2015. Energy sufficiency policy: An evolution of energy efficiency policy or radically new approaches?, ECEEE Summer Study, Pres'que Ile de Giens, France.

Thomas, S., Thema, J., Brischke, L., Leuser, L., Kopatz, M., Spitzner, M., 2018. Energy sufficiency policy for residential electricity use and per-capita dwelling size. Energy Efficiency.

Toulouse, E., Attali, S., 2018. Energy sufficiency in products: Concept paper. ECEEE, https://www.energysufficiency.org/libraryresources/library/items/energy-sufficiency-in-products-concept-paper/. [Accessed Jan 2019]

UNEP, 2018. Emissions gap report 2018. United Nations Environment Programme, http://www.unenvironment.org/emissionsgap [Accessed December 2018].

Warren, A., 2012. Turn the system round to make the profligate pay, http://www.ukace.org/2012/10/turn-the-system-round-to-make-the-profligate-pay/.

Wilhite, H., 2016. The political economy of low carbon transformation: Breaking the habits of capitalism. Routledge, Abingdon, Oxfordshire.

Wilhite, H., Lutzenhhiser, L., 1997. Social loading and sustainable consumption, Proceedings of the European Council for an Energy Efficient Economy, Summer Study 1997. Danish Energy Agency.

Wilhite, H., Norgard, J.S., 2003. A case for self-deception in energy policy, Proceedings of the European Council for an Energy Efficient Economy, Summer Study 2003, France.

Willshire, K., 2018. 'Gilets jaunes' protesters threaten to bring France to a standstill, The Guardian, https://www.theguardian.com/world/2018/nov/16/gilet-jaunes-yellow-jackets-protesters-france-standstill.

Winkler, H., 2007. Energy Policies for Sustainable Development in South Africa. *Energy for Sustainable Development* 11 (1), 26-34