Energy demand reduction: its importance in meeting climate change targets

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It is just a few short months since the conclusion of COP26, held in Glasgow, UK. There, citizens from all over the world took to the streets in their tens of thousands demanding action on climate change, calling for climate justice. Governments seem to be listening to citizen concerns and to the science; many countries have targets to achieve net zero greenhouse gas emissions by 2050 or sooner. Internationally, COP26 is judged to have made enough progress that the goal of limiting global temperature rise to 2°C, and perhaps even 1.5°C, remains within reach. However, these targets can only be achieved with massive and rapid change to global energy systems, whose use of fossil fuel is the largest source of greenhouse gas emissions. The question is whether governments are looking the right places for the levers for change.

This article argues that they are not - there is too little focus on the role of energy demand reduction in delivering net zero emissions. The transition to net zero will not be solely, or even primarily, about changes to the energy supply side (Eyre and Killip, 2019). Energy experts are agreed that a transition to net zero, particularly a just transition, must go beyond electricity grid decarbonisation, through replacement of fossil fuels by renewables, towards a greater focus on energy demand reduction and on engagement of users in the transition (Nolden et al, 2021).

The key arguments for a greater focus on energy demand reduction are:

1. There is far more scope for energy demand reduction than is commonly understood;
2. Energy demand reduction has many social and economic benefits beyond meeting net zero goals;
3. Without significant energy demand reduction and increased flexibility[1], renewable and low carbon energy cannot meet net zero goals.

Energy systems consist of a range of energy sources, fossil fuel, renewable and low carbon, which via a transformation and transmission infrastructure, and after losses, meet energy demand. Globally, energy demand continues to rise, as do associated carbon dioxide emissions. Although the use of renewable forms of energy is growing rapidly, fossil fuel use also continues to rise, resulting in ever higher carbon emissions. However, this is not inevitable; in some countries and regions different patterns are emerging. In Europe, for example, energy use has been gradually falling since the mid-2000s, as have carbon emissions. This results from a combination of energy demand reduction across all sectors of the economy, primarily via energy efficiency measures, and increased use of renewable and low carbon sources of energy, particularly for electricity generation. Accelerating these changes will be key to meeting net zero targets. They will also help deliver affordable access to modern forms of energy to the billions of people who are currently missing out.

[1] Flexibility - the capacity to use energy in different locations at different times of day or year (via storage or by changing the timing of activity); to switch fuels; to smooth or create peaks in demand or, in the case of mobility, to re-arrange destinations and journeys in ways that reduce energy demand and/or congestion – is also key to the energy transition, but not discussed in detail here.

The common vision for a net zero energy system is one based primarily on renewable sources of energy with a switch towards using decarbonised electricity for heating, industrial process and transport where possible, and indirect use of electricity through an energy carrier such as hydrogen, where not. Making this change will be require the transformation of the whole energy system. The challenges range from the technical – how to ensure reliability in an electricity system powered by renewables? - to the economic – who is going to pay for this transition? – to the social – what role will individuals play in the new energy system? – to the political – how will governments design policy to steer this transition? Many issues are hotly debated, for example the future role of nuclear power or the need for, or feasibility of, carbon dioxide removal (CDR) technologies. Scenarios are used by governments, international organisations and research groups to explore different futures and ways of reaching net zero by 2050.

In all scenarios, the importance of replacing fossil fuels with other energy sources in the transition to net zero is recognised. However, this article argues that far too little research, policy and public attention is paid to energy demand reduction. In scenarios, or futures thinking, energy demand is frequently assumed to be fixed or to rise in line with GDP and population growth. This thinking fails to understand that the demand for the goods and services which energy facilitates (also known as energy service demand) differs from energy demand. People can use far less energy to get the same service. For example, to travel to a cultural event which is beyond walking distance, transport energy use could be reduced by using a smaller car, a more efficient car, car sharing, travelling by public transport, travelling by moped or bicycle. Travel demand could further be reduced by accessing culture closer to home, attending online or attending fewer events. Carbon emissions could be reduced by using electric vehicles. As illustrated by this example, there are many options to reduce the carbon and energy impacts of consumption of goods and services.

There are two fundamental ways to reduce energy demand. Firstly, through energy efficiency, i.e. providing the same service using less energy and secondly, by reducing the demand for energy services. There is still a huge untapped potential for improving energy efficiency (Rosenow and Eyre, 2018). Energy efficiency, or energy productivity, is more widely recognised as an important focus for governments. The European Union has declared an 'energy efficiency first' principle. This means policy makers should take utmost account of cost-efficient energy efficiency measures in shaping energy policy and making relevant investment decisions. However, many experts would argue that more needs to be done to operationalise this principle. Reducing demand for energy services is a broader idea, which can touch upon ideas of sufficiency and limits to growth and consumption, as well as more modest ideas such as land use planning to reduce the need to travel, or passive architecture which drastically reduces the energy needed for thermal comfort. There is an emerging range of thinking on what 'energy sufficiency' is and how policy could encourage this (Association Négawatt, 2018), but much more research, experimentation and consultation on this and related concepts is needed.

Actions to reduce energy demand have significant net positive co-benefits for nearly all areas of human development and natural ecosystems. This was demonstrated in a landmark report on the impacts of global warming 1.5°C above pre-industrial levels, published in 2018 by the Intergovernmental Panel on Climate Change (IPCC 2018). It showed that limiting global warming to 1.5°C could go hand in hand with ensuring a more sustainable and equitable society. The impacts of three mitigation strategies – energy demand, energy supply and land management – on all other sustainable development goals (SDGs) were calculated in terms of synergies and trade-offs. For energy demand strategies, this modelling showed the positive effects on SDGs are much greater

than the negative effects. Energy demand also out-performed energy supply in terms of its net positive benefits for nearly all SDGs.

Meeting net zero carbon emissions is not the only goal of an energy system. This is particularly obvious given the current crisis in energy markets, with huge price rises for natural gas. In many countries, there is considerable public and political concern about the impact of prices on individual energy users, particularly lower-income households, as well as on businesses - with debate about what governments can or should do to ameliorate the impact of high prices. Recent UK analysis has shown that if the government had not scrapped previous energy efficiency policies, householders would be significantly less exposed to these higher prices, as average energy use would be lower.

A sustainable energy system must deliver three key objectives:

- Energy Security
- Energy Equity (accessibility and affordability)
- Environmental Sustainability of Energy Systems

These goals are characterised as a 'trilemma', but one where the focus is on meeting all three goals, despite potential trade-offs between them. The World Energy Council produces an annual Energy Trilemma Index, which compares national progress in meeting these goals (WEC, 2021). Their evidence demonstrates that achieving high scores in all three objectives is possible given a sustainable mix of policies. Importantly, reducing the demand for energy can meet all three objectives simultaneously. A smaller energy system is more secure and has less impact on the natural environment.

The importance of demand reduction in meeting net zero goals is demonstrated by new scenarios from the UK Centre for Research into Energy Demand Solutions (CREDS), a research centre looking at how reductions in energy demand can support the transition to a net-zero society. CREDS has developed a set of national 'positive low energy futures' (Barrett et al, 2021). This is new modelling and analysis, which has never before been carried out so comprehensively at a national level. The approach was first to develop coherent narratives of plausible futures based on social and technological changes and then turn these into quantified scenarios. Five activities were modelled: food and agriculture, transport, residential buildings, non-domestic buildings and industry/products. The scenarios incorporate social changes that would reduce demand for energy services (e.g. fewer miles travelled), as well as energy efficiency strategies (e.g. better insulated homes).

Four scenarios have been developed showing very different options for UK energy demand to 2050 (Figure 1). These are briefly described:

Ignore demand – baseline scenario, showing energy demand and supply to 2050 based on current known and planned UK policies.

Steer demand – same energy service demand as in 'Ignore' scenario, but incorporating other measures that aim to reduce emissions to net-zero by 2050.

Shift demand – a low energy demand scenario with changes that reduce demand for energy across the whole economy using proven technologies and under current social/political norms. Net-zero is achieved with high investment in zero carbon supply and a range of carbon dioxide removal (CDR) technologies.

Transform demand – a low energy demand scenario that includes transformative change in technologies, social practices and behaviour, infrastructure and institutions. It is intended to generate significant co-benefits in health, local environment, affordable warmth and work-life

balance. Energy demand falls by 52%. Net-zero is achieved with lower supply side investment and without engineered CDR.

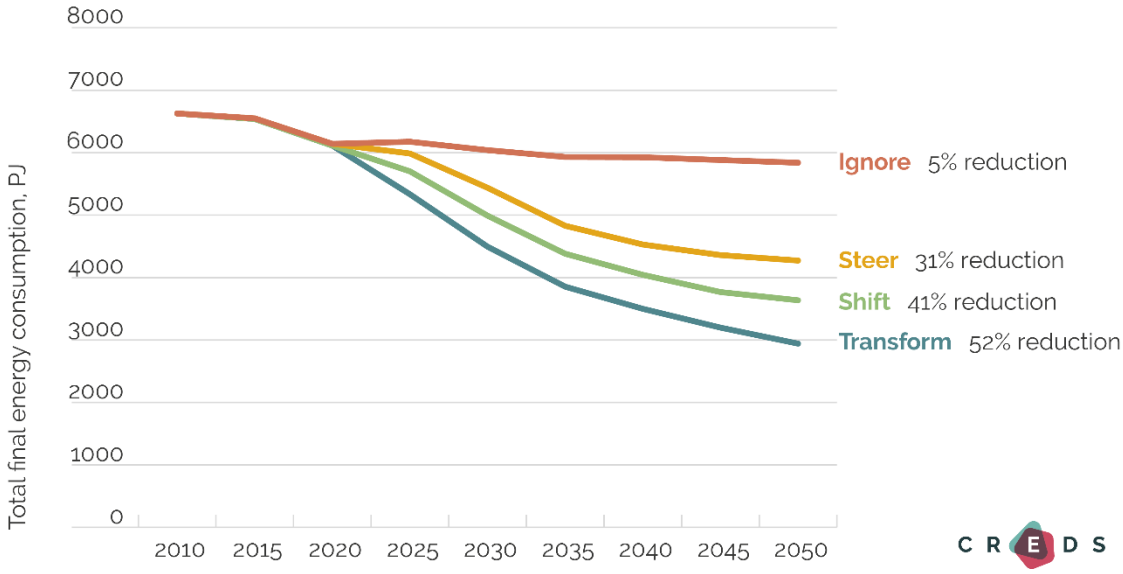

Figure 1: Total final energy consumption in the UK to 2050 under various scenarios

Only the Shift and Transform scenarios meet the UK's net zero by 2050 goal. Importantly, the Transform scenario can be delivered at lower cost and reduces the risks and costs associated with relying on untested, undeveloped technical solutions in energy supply and engineered carbon dioxide removal. The CREDS work concluded that a low energy demand strategy could be at the heart of a fair, affordable and healthy route to net-zero.

There is no doubt that government choices about energy policy, and other policy areas which influence energy demand, are critical. In their 2021 scenarios exercise, the International Energy Agency state: "decisions made by governments are the main differentiating factor explaining the variations in outcomes across our scenarios" (IEA, 2021). Government policies made the difference between scenarios which met the net zero goals globally, and those which did not.

In conclusion, the transition to net zero will require huge change at all scales in the socio-technical systems which supply our energy. This challenge cannot be met simply by changes to energy supply; significant reductions in energy demand and increased flexibility are also needed. Reductions in energy demand can be met in part by increased energy efficiency and switching to less energy intensive means of getting the service desired. However, there are also more difficult decisions to be made about limiting access to some types of energy service to ensure we meet carbon reduction targets. Governments and other policy actors need to pay more attention to these options, to investigate them in more detail, and to start conversations with the public about synergies and trade-offs on the path to net zero.

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