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Flex-ability for all

Pursuing socially inclusive demand-side flexibility in Europe

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Figures

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Executive summary

The clearest path to avoiding climate catastrophe while safeguarding affordable and secure energy is to ramp up renewable energy at an unprecedented scale and pace. To integrate these vast new amounts of solar, wind and other variable generation, the electricity system will need to become far more flexible.

Electricity customers have a central role in achieving this. We must create environments in which customers are willing and able to modify the flexible, non-time-specific proportion of their electricity demand in response to system conditions.[1] This demand-side flexibility is vital to integrating renewable generation efficiently and — in Europe's current geopolitical energy context — reducing fossil gas use quickly while ensuring the supply of energy is secure. Flexibility of demand is also key to reducing costs for all, by aligning electricity use with periods of plentiful, low-cost renewable generation and by minimising the network upgrades needed to accommodate peaks in demand.

For schemes, technologies and offers to be genuinely inclusive, they must be accessible to lower-income and vulnerable households while also serving their energy needs.

When the focus shifts from the societal to the individual scale, however, the full promise of flexibility risks being undermined by inequity and exclusion.

Those who can offer the value of their own household's flexibility will stand to gain huge individual benefits. Homes are the greatest source of flexibility potential, with electrification of home heating offering the largest private cost savings of all flexibility sources. Assets and services that enable flexibility provide a passport to the cheapest and greenest energy available at all times.

Lower-income and vulnerable households, however, are routinely shut out of opportunities that could lower their bills, reduce energy poverty and allow them to experience the benefits of the clean energy transition. Most current flexibility-focused policies and innovations do not have these goals in mind. For schemes, technologies and offers to be genuinely inclusive, they must be accessible to lower-income and vulnerable households while also serving their energy needs and fitting with daily priorities and commitments. Figure 1 on the next page provides four principles for designing measures that achieve this.

1 Yule-Bennett, S., & Sunderland, L. (2022). *The joy of flex: Embracing household demand-side flexibility as a power system resource for Europe.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/joy-flex-embracing-household-demand-side-flexibility-power-system-resource-europe/. *The joy of flex* offered a policy action plan for unleashing household flexibility as a system resource, by revealing and capturing flexibility value in markets, removing discrimination against demand-side resources, and ensuring households are willing and able to respond flexibly. This paper, *Flex-ability for all*, builds on the people-centred aspects of this work, with a focus on inclusivity and the experience of low-income and vulnerable households.

Figure 1. Policy principles for inclusive flexibility

Policymakers confronting urgent climate and energy crises have an opportunity to couple the mass deployment of renewable generation, electrification and energy efficiency with the value of flexibility, while prioritising the needs of low-income households.

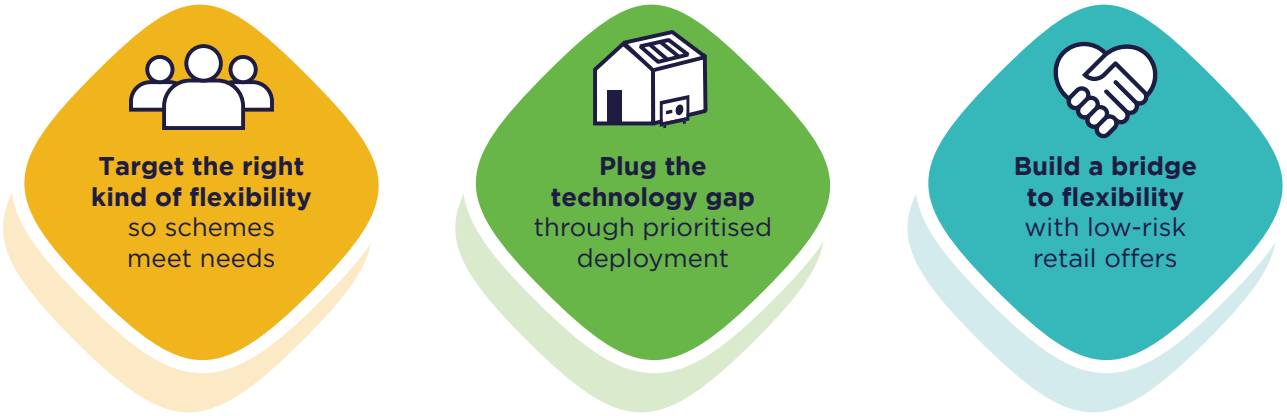
Failing to act to ensure all households are able to realise the value of their flexibility may increase social inequities and energy burdens. Europe's electricity markets are evolving so that *how* and *when* customers use energy will increasingly determine their bills, not just *how much* they use. Those who can shift their energy demand will reap increasing rewards, while the relative cost of being unable to respond flexibly when markets encourage doing so is likely to grow. Households under economic pressure to act flexibly may see no choice but to sacrifice their comfort, convenience or well-being.

Some policy programmes, such as bill subsidies, seek to protect people by simply exempting them from exposure to pricing and other market signals. If households are unable to capitalise on their potential for flexibility, however, they will find it harder to reduce their energy costs, leaving a larger job for publicly funded subsidies.

Barriers stand in the way of achieving universal access to flexibility, meaning that positive policy action is needed. The barriers low-income and vulnerable households face can include energy-inefficient homes with fewer flexibility-enabling assets (smart meters, controllable electric loads, storage and generation) and no high-speed internet connection. Other barriers can include limited personal agency, particularly for tenants; upfront cost; lack of information and awareness; and mistrust of energy companies. Moreover, technology innovation and adoption favour the more affluent early adopters, meaning that technologies and services are designed with these households in mind. Past models of innovation intend that benefits will filter to others eventually, but this is not certain or quick.

To live the core principles of inclusive flexibility, we need new offers and services that put low-income and vulnerable participants at the centre while boosting technical 'flex-ability' by prioritising them to receive energy efficiency improvements and flexible assets. Policy mechanisms also need to target the kind of flexibility that will deliver the most social value — alongside system value — on an enduring basis, rather than solely focusing on the easiest-to-access flexibility now. Figure 2 on the next page summarises the key policy actions needed to deliver inclusive flexibility.

Figure 2. Policy steps towards inclusive flexibility



Fulfilling the commitment to leave no one behind

The European Green Deal committed Europe in 2019 to a "just and inclusive" transition to a net-zero economy and acknowledged that the risk of energy poverty must be addressed. These aims are supported by the European Pillar of Social Rights action plan, which includes calls to reduce poverty and exclusion and ensure access to essential services like energy.[2]

Legislation to deliver on the Green Deal contains several practical steps, including:

- A Social Climate Fund to mitigate the negative impacts of carbon pricing.[3]
- A Just Transition mechanism to support regions whose economies are harmed by the transition.[4]
- Prioritisation of energy-poor households in national energy efficiency programmes.[5]

Innovation is also turning to social challenges. The focus of the 2023 European Social Innovation Competition was fighting energy poverty.[6] In addition, the EU Affordable Housing Initiative has a strong focus on digital, smart energy-efficient solutions and human-centred business models, to promote social innovation and empowerment.[7]

2 European Commission. (2021). *The European Pillar of Social Rights action plan.* COM(2021) 102 final. https://op.europa.eu/webpub/empl/european-pillar-of-social-rights/en/

3 European Parliament & Council of the European Union. Regulation (EU) 2023/955 of the European Parliament and of the Council of 10 May 2023 establishing a Social Climate Fund and amending Regulation (EU) 2021/1060. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R0955

4 European Commission. (n.d.). *Just Transition Fund.* https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/just-transition-fund_en

5 European Commission. (2023, 25 July). *European Green Deal: Energy Efficiency Directive adopted, helping make the EU 'Fit for 55'* [Press release]. https://energy.ec.europa.eu/news/european-green-deal-energy-efficiency-directive-adopted-helping-make-eu-fit-55-2023-07-25_en

6 European Innovation Council. (n.d.). *The European Social Innovation Competition.* https://eic.ec.europa.eu/eic-prizes/european-social-innovation-competition_en

7 Vanderpoorten, K. (n.d.). *Affordable housing initiative* [Presentation]. European Commission, New European Bauhaus. https://new-european-bauhaus.europa.eu/system/files/2021-11/NEB_infosession_call_AffordableHousingInitiative_demonstrator.pdf

Introduction

The interlocking pressures to reduce fossil gas dependency and minimise energy price escalation, which have monopolised Europe's energy policy attention in recent years, offer valuable insights into the next chapter of the clean energy transition.

First, it is axiomatic that we must not only build low-carbon electricity generation and the grid infrastructure to enable it, but also use these resources smartly, to achieve both system reliability and value for money. Security of energy supply or access to vital energy services 'at any cost' is no security at all. This is particularly true for households on lower incomes or with high energy needs.

Second, delivering the zero-emissions power system necessary to achieve a net-zero economy, while maintaining energy security and affordability, requires access to the entire range of available resources. We must fully utilise not only renewable generation on the supply side but also non-time-specific consumption, storage and on-site generation on the demand side.[8] We must therefore find ways to harness the full potential of this demand-side flexibility.

Third, energy poverty[9] and energy access are no longer marginal policy challenges but mainstream ones. Energy systems and markets exist to serve the energy needs of *all* people. To fulfil this purpose, policymakers must develop strategies that keep overall transition costs under control while remedying the inequitable distribution of benefits, burdens and opportunities present in today's energy system.

Security of energy supply or access to vital energy services 'at any cost' is no security at all, particularly for households with lower incomes or high energy needs.

This paper investigates strategies for reducing energy burdens and improving access to the benefits of a clean energy system for lower-income and vulnerable households[10] through demand-side flexibility. By contemplating Europe's flexibility challenges through a social inclusion lens — incorporating lessons from real-world projects, schemes and energy services — the paper offers recommendations for embedding **inclusive flexibility** in our smart energy future. In this context, inclusive flexibility refers to flexibility-enabling technologies and offers that are not just open to lower-income and vulnerable households but also serve their needs.

8 Broadly, the 'demand side' refers to the places where electricity is consumed, while the 'supply side' refers to the places where electricity is generated and transported to where it is needed.

9 Currently, various national-level definitions exist for energy poverty. An EU-wide legal definition has been introduced in the Energy Efficiency Directive recast at Article 2(52): "'energy poverty' means a household's lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor energy efficiency of homes." European Parliament & Council of the European Union. Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AJOL_2023_231_R_0001&qid=1695186598766

10 In this paper we focus on low-income and vulnerable households. We recognise, however, that people and households are not 'vulnerable' in isolation but in the context of the economic, regulatory and social systems in which they operate, and that vulnerability is highly dependent on context. We focus on income and vulnerability in this paper but recognise that exclusion and lack of agency can result from a range of factors beyond income. A full analysis of inclusion or exclusion for all household situations is outside the scope of this paper.

Flexibility: A new watchword for electricity security

Flexibility, in the context of an electricity system, means the ability to adjust to the variability of generation, consumption patterns and grid availability across relevant market time frames.[11] The International Energy Agency calls flexibility a "new watchword for electricity security."[12] Historically, system flexibility has been provided by ramping up coal, fossil gas and hydroelectric generation.

Demand-side flexibility will be vital in a decarbonised energy system — alongside supply-side batteries, dispatchable renewable generation and low-carbon gases — to ensure reliability.

The EU Smart Grids Task Force describes demand-side flexibility as the ability of users to deviate from their usual electricity usage patterns in response to price signals or market incentives. Demand-side flexibility consists of load, demand-side generation and demand-side storage.[13]

Over half of system flexibility worldwide will need to come from demand-side flexibility and batteries by 2050, to achieve net-zero carbon emissions.[14]

Shutterstock/AlyoshinE

11 European Commission. (2023, 14 March). *Proposal for a regulation of the European Parliament and of the Council amending Regulations (EU) 2019/943 and (EU) 2019/942 as well as Directives (EU) 2018/2001 and (EU) 2019/944 to improve the Union's electricity market design.* COM(2023) 148 final, Article 2(80). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0148&qid=1679410882233

12 International Energy Agency. (2022). *World energy outlook 2022,* p. 60. https://www.iea.org/reports/world-energy-outlook-2022

13 Küpper, G., Hadush, S. Y., Jakema, A., & Staschus, K. (2020). *ASSET study on regulatory priorities for enabling demand side flexibility,* p. 16. European Commission. https://op.europa.eu/en/publication-detail/-/publication/38fbccf2-35de-11eb-b27b-01aa75ed71a1/language-en

14 International Energy Agency, 2022, p. 140.

PART 1:

Why prioritise inclusive flexibility?

Given the range of significant and urgent risks posed by the cost-of-living and energy crises, ensuring that all households are able to benefit through flexible energy use might seem rather niche and technical. A strong case can be made, however, for prioritising inclusive flexibility now.

Getting it right from the outset

Upholding social inclusion as a vision for Europe at this stage in the energy transition makes strategic sense. Household flexibility is a relative newcomer to the mainstream energy markets conversation, and the need to ensure a just and inclusive energy transition is also rising on the agenda. There is a limited time window to cement inclusive principles into the foundations of national household electrification strategies and market-based flexibility incentives. Prioritising the lowest-income households in these aspects of the transition will increase the likelihood that principles and approaches to inclusive flexibility are mirrored in other areas of energy policy.[15]

Rapid decarbonisation and electrification of energy generation and demand will characterise the next decades. In Europe, the need to replace Russian gas has created an additional layer of urgency around this transformation. It will be possible only with an immense expansion of demand-side flexibility capability.

Upholding social inclusion as a vision for Europe at this stage in the energy transition makes strategic sense.

The 2023 revision of the Renewable Energy Directive[16] increases the binding EU renewable energy target for 2030 to 42.5%, almost doubling the share compared with 2020.[17] Achieving this will require an unprecedented effort to electrify energy demand and deploy flexible assets to Europe's buildings. In parallel, more policy focus is turning to tools to activate demand-side flexibility. The Clean Energy for All Europeans package agreed in 2019 has recently been enhanced by the electricity market design proposals published in 2023. The proposals contain additional measures intended to ensure that wholesale and retail electricity markets incentivise and enable flexibility.[18] Member States will face important choices over how to incorporate the finalised measures into national regulatory regimes.

15 See, for example, Sunderland, L., & Gibb, D. (2022). *Taking the burn out of heating for low-income households.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/taking-burn-out-of-heating-low-income-households/

16 Council of the European Union. (2023, 9 October). *Renewable energy: Council adopts new rules* [Press release]. https://www.consilium.europa.eu/en/press/press-releases/2023/10/09/renewable-energy-council-adopts-new-rules/

17 Share of renewable energy sources in consumption in 2021 was 21%. The EU's binding renewable energy target in 2020 was 20%. For 2030, the target was 32% before the latest revision of the Renewable Energy Directive. European Parliament & Council of the European Union. Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202302413

18 Relevant EU electricity market design proposals include: national flexibility assessments; reform of network company incentives to encourage procurement of flexibility; reduced minimum bid sizes (from 500 kW to 100 kW) for demand-side flexibility providers in wholesale markets and grid services; and new energy-sharing provisions. In addition, retail customers will be entitled to enter into multiple electricity supply contracts, facilitated by submetering, enabling them to choose dynamic offers for highly flexible loads (such as heat pumps with storage) while serving other energy needs through different retail offers. European Commission. (n.d.). *Electricity market design.* https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en

Seizing this timely opportunity to uphold inclusivity as a policy priority for demand-side flexibility provides a clear focus point for innovators, policymakers, local authorities and utilities to ensure that the benefits of flexible energy use are open to all. Conversely, tolerating the exclusion of already burdened, disadvantaged or marginalised groups at this critical juncture risks undermining the social contract (and therefore the political mandate) for energy decarbonisation.[19]

The price of missing out

The evolution of EU and national energy market design is raising the financial stakes for electricity customers, meaning that business as usual is not compatible with the commitment to a just and equitable transition.

The trajectory is set for energy and network charges to become more granular according to time and location, reflecting system conditions such as the ratio of supply to demand and the amount of available grid capacity.

Stronger market signals in favour of flexibility are critical to incentivise the right clean energy investments and galvanise the massive amount of demand-side flexibility required to decarbonise the energy, transport and heat sectors without significantly ramping up network costs and paying for seldom-used backup generation.[20] It is in our collective interests that these unnecessary system costs are avoided altogether, rather than just swallowed and socialised across customers.

At the household level, the upshot is that how and when energy is used will increasingly determine energy bills, rather than just how much. The rewards available to those able to adapt consumption patterns in response to system conditions will continue to grow. At the same time, the relative cost to a household of being unable to respond flexibly is likely to become more severe.[21]

The need for enduring, inclusive solutions

Traditional regulatory strategies for protecting households from energy price risks include regulated retail tariffs (including social tariffs) and direct fuel cost support, the latter of which ultimately ends up in the pockets of energy companies, not households. Safeguarding low-income and vulnerable households from high and volatile prices remains essential to prevent harm.

Energy bill support will not by itself be sufficient, however, to protect these households from the longer-term harm of missing out on the financial and nonfinancial benefits of clean, electrified energy and emerging marketplaces for flexibility. A truly inclusive approach requires opening up access to life-improving technologies and services, while ensuring that households' basic energy needs are met. Completely detaching certain households from incentives to use energy flexibly could perpetuate their exclusion from the smart energy transition. Instead, the aim should be to equip people with tools to respond to new value offerings, and to design those offerings in ways that are safe and beneficial to them. When it comes to energy use, households have often been asked to trade the valuable qualities of ease, predictability and transparency without the guarantee of lower bills.

Energy efficiency and building weatherisation policies are increasingly seeking to empower households by reducing demand and increasing comfort permanently, while protecting them from price volatility. Contemplating demand-side flexibility and energy poverty challenges together, and incorporating lessons and insights from the buildings sector, focuses the policy spotlight on solutions that both protect *and* empower households on an enduring basis.

19 Roberts, S., Bridgeman, T., Broman, D., Hodges, N., & Sage, C. (2020, September). *Smart and fair? Exploring social justice in the future energy system* (Phase One report), p. 7. Centre for Sustainable Energy. https://www.cse.org.uk/resource/smart-fair/

20 To unblock the value pipeline and expand flexibility markets, it will be necessary to confront obstacles to wholesale energy market efficiency and competition. These obstacles include fossil generation subsidies, incumbent market power and counterproductive charging methodologies. For related policy recommendations, see Yule-Bennett & Sunderland, 2022, and Regulatory Assistance Project. (n.d.). *Power system blueprint.* https://blueprint.raponline.org

21 Roberts et al., 2020.

Getting energy uses ready to go flexible

The European Union is in the process of introducing a range of measures to increase the deployment of demand-side renewable resources and the electrification of end uses.

Heat: The RePowerEU communication calls for the EU to double its deployment rate of heat pumps, which means installing 10 million heat pumps over five years, beginning in 2022.[22] The draft Energy Performance of Buildings Directive (EPBD) proposes that heating and cooling be fossil-free by 2040; to support this, subsidies for fossil fuel boilers will be phased out from 2027.[23] Additionally, the European Commission has proposed that sales of 'stand-alone' (nonhybrid) fossil fuel boilers could be effectively banned by September 2029 through changes to the Ecodesign Regulation.[24]

Solar: The EU Solar Strategy set out the aim to install solar photovoltaic panels on roofs of all commercial and public buildings from 2027 and on all new residential buildings from 2029.[25] Introduction of regulations in the EPBD is under negotiation.

Transport: The 2020 EU Sustainable and Smart Mobility Strategy pledged to replace 30 million cars with zero-emissions vehicles on the road by 2030.[26] In support, the new Alternative Fuels Infrastructure Regulation sets mandatory deployment targets for public smart electric vehicle charging,[27] and the draft EPBD proposes to expand charging infrastructure in existing public and private buildings.

Digitalisation: The European Commission's 2022 Action Plan for Digitalising the Energy System aims to ensure that the green and digital transitions go hand in hand. The plan outlines actions to help consumers increase control over their energy use through new digital tools and services, including the establishment of a governance framework for a common European energy data space.[28]

22 European Commission. (2022a, 18 May). *REPowerEU plan.* COM(2022) 230 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN

23 European Commission. (2021, 15 December). *Proposal for a directive of the European Parliament and of the Council on the energy performance of buildings (recast).* COM(2021) 802 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0802&qid=1641802763889

24 European Commission, 2022a.

25 European Commission. (2022b, 18 May). *EU solar energy strategy.* COM(2022) 221. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A221%3AFIN

26 European Commission. (2020). *Sustainable and smart mobility strategy.* COM(2020) 789 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789

27 European Parliament & Council of the European Union. Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2023.234.01.0001.01.ENG&toc=OJ%3AL%3A2023%3A234%3ATOC

28 European Commission. (2022, 18 October). *Commission sets out actions to digitalise the energy sector to improve efficiency and renewables integration* [Press release]. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6228

PART 2:

Home is where the smart is

In past decades, addressing the energy system's flexibility needs meant reducing overall peak demand to 'keep the lights on' in times of emergency. To achieve this, not everyone on the grid needed to adjust their energy use. A reduction in demand by industrial customers — including through the use of on-site diesel generators — combined with standby centralised fossil fuel generation did the job. By contrast, to efficiently manage our low-carbon, electrified future, it must become second nature to enable and mobilise clean, flexible energy use wherever possible.

House power as a system resource

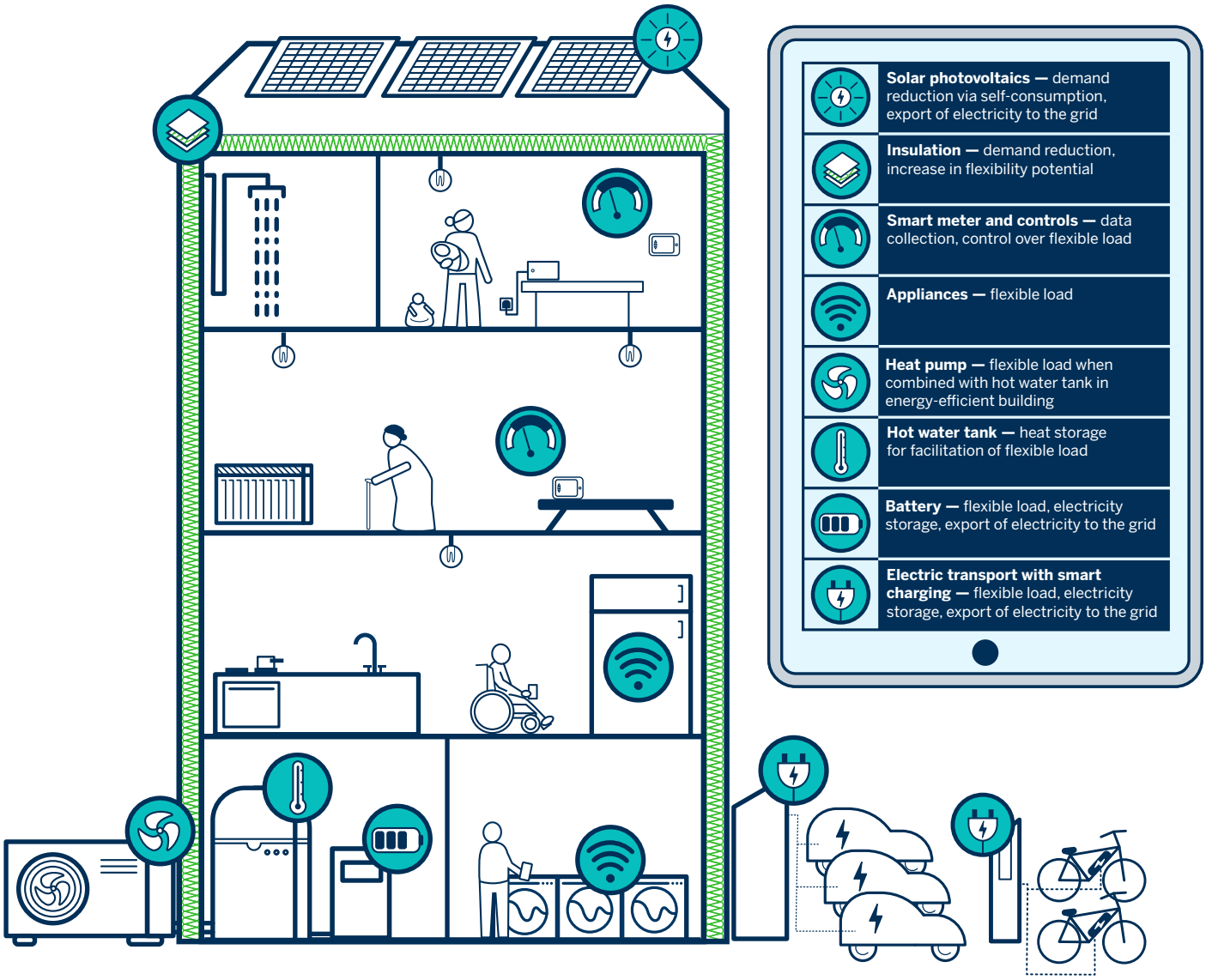
Households are set to play a critical role in delivering the benefits of energy savings and carbon emissions reductions, becoming the greatest source of untapped flexibility potential by 2030, according to European Commission projections.[29]

Households are set to play a critical role in delivering energy savings and carbon emissions reductions, becoming the greatest source of untapped flexibility potential.

Flexible assets are technologies that make this scale of benefits possible, by supersizing demand-side flexibility potential (see Figure 3 on the next page). They include controllable electric loads such as heat pumps and non-time-critical household appliances; storage such as batteries, including those in electric vehicles, and thermal storage in the form of building fabric energy efficiency; and on-site generation such as rooftop solar panels. Flexible assets can be designed and used in a way that allows households to use energy at times that don't coincide with when they draw power from the grid, so they can buy electricity when it's cheapest without sacrificing comfort or convenience.

29 European Commission. (2016). *Evaluation report covering the evaluation of the EU's regulatory framework for electricity market design and consumer protection in the fields of electricity and gas; Evaluation of the EU rules on measures to safeguard security of electricity supply and infrastructure investment (Directive 2005/89).* SWD(2016) 412 final, Part 2, graph 2 [Commission staff working document]. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=SWD:2016:412:FIN

Figure 3. Flexible assets in homes



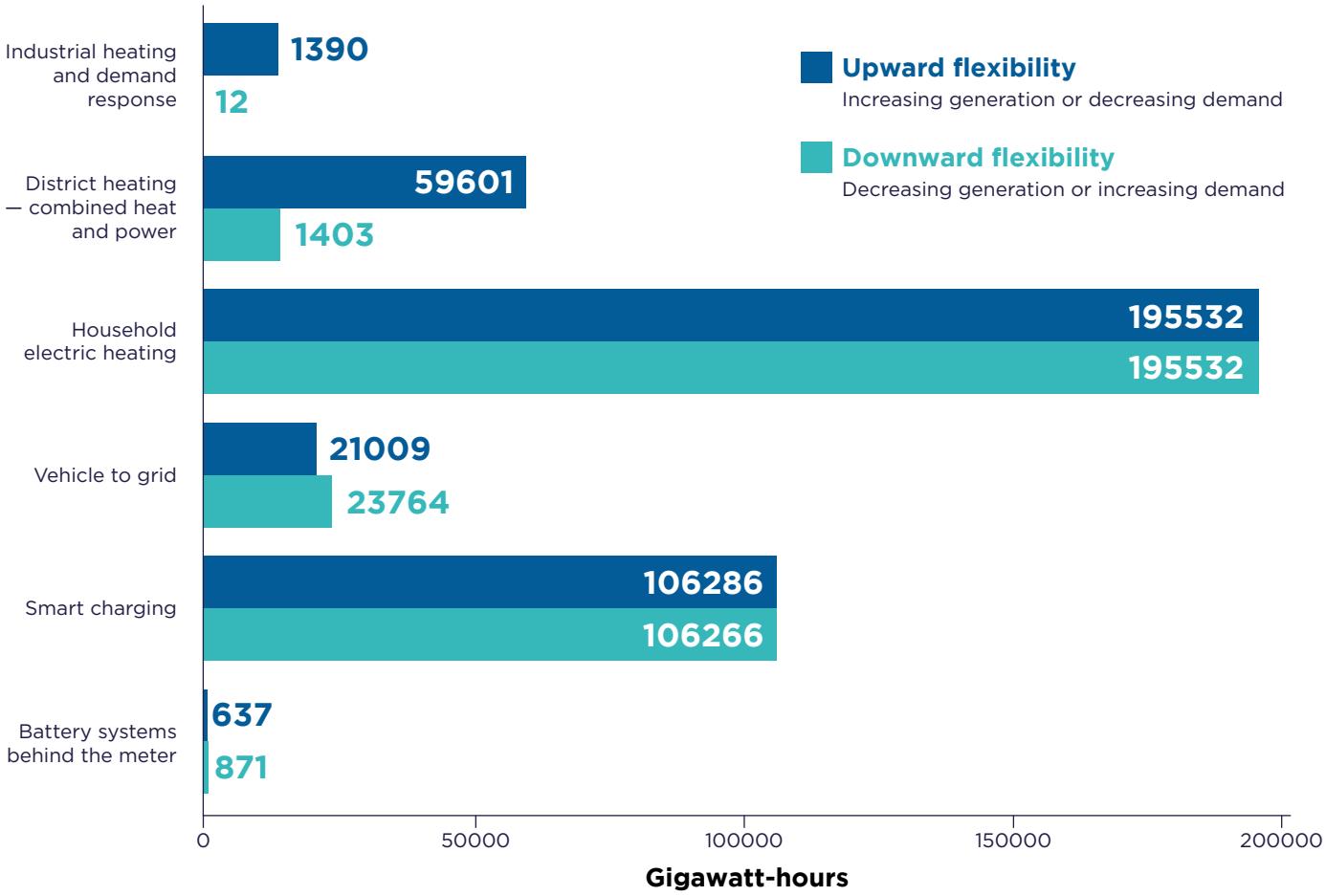
The significance of households as a flexibility resource is underlined by the findings of a recent study by smartEn and DNV.[30] Based on modelling, the study estimated that the largest contributor of activated flexibility[31] in the EU electric system in 2030 will be residential electric heating, followed by smart charging of electric vehicles. Figure 4 on the next page shows the total activated flexibility estimated per technology.[32]

30 smartEn & DNV. (2022). *2030 demand-side flexibility: Quantification of benefits in the EU.* https://smarten.eu/demand-side-flexibility-quantification-of-benefits-in-the-eu/

31 'Activated flexibility' means flexibility activated by economic signals and available to the system, rather than just technical potential flexibility. The upward and downward activated flexibility that the study calculated correspond to about 10% and 8% of the projected total demand, respectively.

32 smartEn & DNV, 2022.

Figure 4. Projected sources of activated demand-side flexibility in 2030



Note: In this figure, the category of industrial heating represents both electric and combined heat and power. Calculations are based on a 2030 electricity wholesale market simulation.

Data source: smartEn & DNV. (2022). *2030 demand-side flexibility: Quantification of benefits in the EU*

What's in it for households?

Scaling up household flexibility will open up a new world of financial and nonfinancial benefits.

Financial benefits

Drawing upon all of Europe's available sources of flexibility would offer staggering energy system cost savings. The smartEn and DNV study concluded that in 2030, over €300 billion in annual system benefits are achievable across the EU. The quantified benefits include savings on wholesale energy prices, generation capacity costs, investment needs for grid infrastructure, system balancing costs and carbon emissions.[33] Such collective **indirect flexibility benefits** minimise the cost of decarbonisation and energy security for everyone, whether they are directly engaged in flexible actions or not.

Households which provide flexibility by adapting their demand to system conditions can enjoy an additional layer of rewards: **direct flexibility benefits.** There are two main ways in which electricity customers may receive direct benefits. They may be paid for providing demand-side flexibility to system operators via suppliers or third-party aggregators, or they may receive savings or rebates on their electricity bill. Bill savings are available through a dynamic energy retail tariff or another form of flexible retail offer; these retail routes are particularly well suited to households.

33 smartEn & DNV, 2022.

Efficiency: The original flexible asset

Energy efficiency and flexibility work best together. Efficient buildings can maintain a desired inside temperature for longer without requiring further heat input, providing both cost savings and healthy living conditions without damp and mould. When fabric energy efficiency measures are combined with other flexible assets — such as rooftop solar, batteries or heat pumps with storage tanks — occupants can choose to use electricity for heating from the grid when prices are low and avoid it when prices are high, without sacrificing comfort, well-being or convenience.

In turn, home technologies managed via smart controls offer enhanced visibility into and control over energy use (helping to avoid both under- and overconsumption) and energy bills, even in volatile wholesale market conditions.

The smartEn and DNV study found that the highest direct financial savings could be achieved from household electric space heating, with the highest savings potential per kWh to the household and the greatest potential cost reduction across the EU of €71 billion in 2030, across all categories of buildings. These savings were calculated excluding energy efficiency improvements and the capital investments to enable the flexibility. Efficiency improvements to a building's fabric would further enhance the flexibility potential. Cost-benefit assessments for building retrofits commonly overlook the value to be gained from increasing the structure's flexibility capability.

In addition, while the study looked at technologies independently, the greatest household savings can be achieved through blending different flexible assets — for example, by combining a heat pump with a home battery and rooftop solar (see Figure 9 on Page 30 describing winning flexibility combinations).

Nonfinancial benefits

In addition to bringing financial gains, making homes efficient and more capable of flexible energy use enhances occupants' health, comfort, security and agency. Flexible assets and flexibility benefits can also be combined or shared to strengthen social cohesion and community.

During extreme weather and power outages, flexible buildings offer a vital safety cushion, enabling occupants to meet their energy needs for longer. This increases the likelihood of maintaining habitable conditions until the event is over. Battery storage — including electric vehicle batteries — and on-site generation provide backup power sources, enabling appliances such as refrigerators and medical equipment to continue to run for a period without grid power.

The value of flexible assets lies both in the flexibility itself and in their function as a gateway to emerging smart energy systems and associated markets.[34] While flexibility offers householders significantly more autonomy from the wider electricity grid,[35] the most promising value of flexibility lies in better connection and integration *with* the grid, not independence from it. The advantages of this connection go beyond the financial benefits it can bring.

34 Smith, A., Torres Contreras, G. A., Brisbois, M., Lacey-Barnacle, M., & Sovacool, B. (2023, June). Inclusive innovation in just transitions: The case of smart local energy systems in the UK. *Environmental Innovation and Societal Transitions, 47*, Article 100719. https://doi.org/10.1016/j.eist.2023.100719

35 For example, the Ford F-150 electric pickup truck is marketed as a backup power supply during an outage. Ford has partnered with solar battery storage and energy services provider Sunrun in the United States to maximise both household autonomy from the grid and the e-truck's potential as a home energy management tool. See, for example, Bellen, R. (2021, 19 May). *Ford F-150 Lightning electric pickup truck can power your home in an outage.* TechCrunch. https://techcrunch.com/2021/05/19/ford-f-150-lightning-electric-pickup-truck-can-power-your-home-in-an-outage/

In the smart energy market of the future, millions of assets across millions of households, communicating continuously with each other and with the grid, will empower householders to effortlessly access the cheapest and greenest electricity available. At the same time, residents will benefit from home technologies that use datasets and artificial intelligence to understand, anticipate and serve their energy and lifestyle needs. Smart, flexible systems also offer new ways for energy users to support one another. For example:

- Residents of a multi-occupancy building can work together to keep everyone safe during a polar vortex by using a combination of flexible assets shared across different energy-efficient apartments.
- During the same weather event, a system operator can call upon demand-side flexibility to prevent total system shutdown. The operator can prioritise keeping power flowing to vulnerable households and hospitals and ensure time-limited rolling blackouts for all households rather than leaving some homes without power for long periods.
- An energy community[36] can raise revenues by offering grid services via a third-party aggregator, reducing bills and generating income to invest back into community facilities.

Empowering households with flexibility capability mutually benefits bill-payers, system operators and overall decarbonisation. Despite this, direct flexibility rewards remain out of reach for most households.

iStock.com/kate_sept2004

36 A broad definition, based on various EU legislation, is a legal entity gathering households, local authorities or small businesses and providing energy services for environmental, economic or social benefits to its members. The services may include local renewable generation.

Rise of the prosumer and energy citizen

New decentralised energy marketplace models include energy communities, cooperatives and peer-to-peer trading platforms, where households (including prosumers, who both produce and consume energy) can match directly with renewable generators or each other to buy and sell electricity. Participating households may also provide flexibility services to electricity system operators, usually via aggregators.

For participants in energy communities and cooperatives, benefits over and above individual household participation in flexibility include a dedicated focus on social cohesion and community, the ability to crowdfund flexible assets, and opportunities to enhance flexibility capability by pooling different assets in different locations.[37] Citizen-led services also offer the advantage of being trusted intermediaries, which is particularly important for engaging low-income and vulnerable groups in smart energy services.[38]

EU energy policy promotes citizen co-owned energy resources as a means of increasing people's control over their energy through renewable energy sales, self-consumption, efficiency and flexibility.[39]

The presence of an energy community in a market, location or policy package does not, however, guarantee access to flexibility services for lower-income and vulnerable households. Members of energy cooperatives on average tend to be more affluent, although some cooperatives do either provide subsidised membership to low-income households or use surplus generation or profits to fund support schemes.[40] Challenges associated with making flexibility inclusive persist at the community level and prevent lower-income and vulnerable households from participating.[41] Therefore, citizen-led models can be an excellent source of innovation on the social-energy nexus but are not a panacea for inclusive flexibility.

iStock.com/kate_sept2004

37 Claeys, B. (2021). *Energy communities with grid benefits: A quest for a blueprint.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/energy-communities-with-grid-benefits-a-quest-for-a-blueprint

38 Smith et al., 2023.

39 DellaValle, N., & Czako, V. (2022, July). Empowering energy citizenship among the energy poor. *Energy Research & Social Science, 89,* Article 102654. https://doi.org/10.1016/j.erss.2022.102654. See also Claeys, 2021.

40 See, for example, Community Energy for Energy Solidarity. (n.d.). *The project.* https://www.energysolidarity.eu/project/

41 Knox, S., Hannon, M., Stewart, F., & Ford, R. (2022, January). The (in)justices of smart local energy systems: A systematic review, integrated framework, and future research agenda. *Energy Research & Social Science, 83,* Article 102333. https://www.sciencedirect.com/science/article/abs/pii/S2214629621004254

PART 3:

Who risks missing out?

For those most heavily burdened by their energy bills and living in the worst-quality housing, increased energy efficiency and the addition of flexible assets hold the potential for life-changing benefits.

If managed well, timing household energy use to minimise cost could become a valuable money-saving strategy, reducing the pressure to use as little energy as possible. Low-income and vulnerable households are, however, seldom the first in line to gain these advantages.

Barriers to participation

Although all users on a system benefit from the significant collective gains derived from system flexibility, more affluent groups are far more likely than others to enjoy the additional layer of value obtained from direct flexibility participation. In 2023, electric vehicles, heat pumps and smart appliances — the key flexible assets at the household level — are more expensive to purchase than the fossil-fuelled or 'dumb' alternatives and are therefore 'luxury' choices.[42] At the same time, lower-income and vulnerable residents are more likely to live in homes that are inherently less capable of flexible energy use, with poorer insulation and older appliances.[43]

Timing household energy use to minimise cost could become a valuable money-saving strategy, reducing the pressure to use as little energy as possible.

Not only are flexible assets concentrated in certain demographic groups, but lifestyles and household schedules make some groups more or less able to take the benefits of moving energy use manually. For example, a retired couple's ability to run household appliances at different times of the day may make them more able to access flexibility benefits than a single working parent. Research on the distributional effects of time-varying electricity tariffs suggests that households' patterns of energy demand are affected by factors beyond income. Additional factors include age, location (in addition to temperature differences, cities tend to have later evening peaks in electricity demand), culture (for instance, some countries traditionally enjoy a hot meal at lunchtime, others in the evening) and working hours. The presence of children in the home significantly reduces the ability to access flexibility benefits, in the absence of flexible assets.[44]

42 See, for example, Sunderland & Gibb, 2022.

43 Households with children, on a low income, of large size, renting social or private housing, or living in the countryside, a village or a small town are more likely to experience poor energy efficiency. Dubois, H., & Nivakoski, S. (2023). *Unaffordable and inadequate housing in Europe.* Eurofound. https://www.eurofound.europa.eu/publications/report/2023/unaffordable-and-inadequate-housing-in-europe

44 Yunusov, T., & Torriti, J. (2021, September). Distributional effects of time of use tariffs based on electricity demand and time use. *Energy Policy, 156.* https://doi.org/10.1016/j.enpol.2021.112412

A plethora of barriers combine to keep low-income and vulnerable households from benefitting from flexible retail offers. Two well-recognised barriers to more flexible energy use are lack of agency for tenants and lack of upfront capital for homeowners to make energy efficiency improvements to the fabric of their home or upgrade to smart appliances. Other factors that contribute to flexibility capability include:

- Access to a high-speed home internet connection and a smart meter.[45]
- Awareness and understanding of flexible retail offers.
- Digital literacy.
- The ability and willingness to absorb price risk.
- The freedom to switch from an incumbent supplier (which may also be hampered by debt).
- Trust in energy service providers.[46] Trust barriers have also been exacerbated by the energy crisis and supplier responses to it.[47]

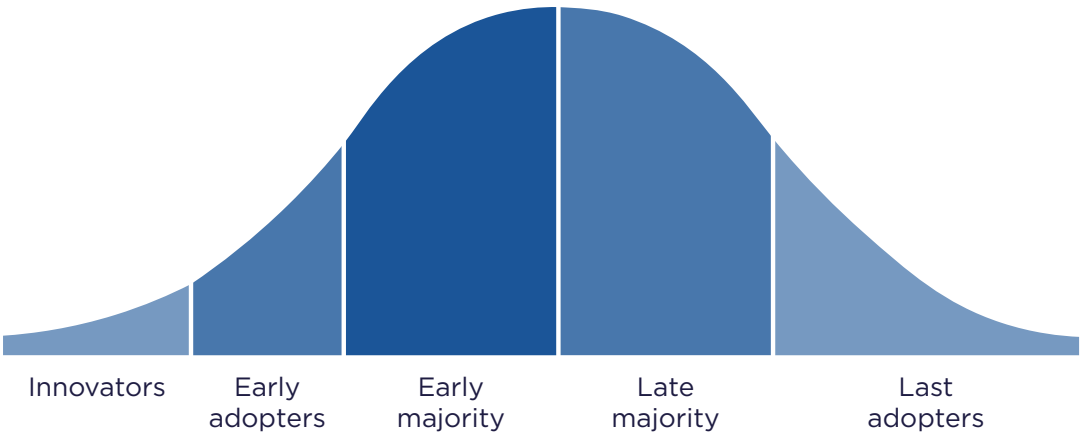
Tackling the barriers and underlying causes of exclusion requires multiple interconnected initiatives, often from different policy or regulatory areas. The annex to this paper illustrates three levels at which mitigating actions are needed: to reinforce capabilities and attributes at the household level, to address impacts of energy system design, and to address wider structural issues outside the energy system or market. This paper focuses on issues related to the energy system and energy policy.

Won't everyone catch up in time?

Early adopters of new technologies and services are typically those equipped to meet higher upfront costs[48] and to withstand the risk of technical failings, unforeseen consequences and unrealised benefits.[49]

Technology adoption is often depicted as a curve (as in Figure 5[50]) which predicts that a minority of technology enthusiasts will pave the way for large-scale uptake later when costs are lower and design wrinkles have been ironed out, provided that a critical mass of adoption is achieved.

Figure 5. Technology adoption curve



Source: Adapted from Pnautilus. (2011, 14 July). *Innovation adoption lifecycle*

45 For evidence of uneven smart meter coverage across the EU, see smartEn. (2022, March). *The implementation of the electricity market design to drive demand-side flexibility* (2nd ed.). https://smarten.eu/report-the-implementation-of-the-electricity-market-design-2022-smarten-monitoring-report/

46 Roberts et al., 2020.

47 Smith et al., 2023.

48 Given that early adopters are also more likely to be more affluent customers, when the technologies in question are large electrified loads, it is vital that integration of such loads is combined with smart functionality and strong incentives (or requirements) for flexible use to prevent and relieve network capacity constraints. Otherwise, early adopters would increase network costs for those farther along the adoption curve — who also are less affluent and less able to avoid network costs.

49 Roberts et al., 2020.

50 Adapted from Pnautilus. (2011, 14 July). *Innovation adoption lifecycle* [Figure]. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Diffusion OfInnovation.png. Original licensed under CC Attribution-Share Alike 3.0 Unported: https://creativecommons.org/licenses/by-sa/3.0/legalcode.en. The concept of the curve, long a staple of sociology research, was popularised by Everett M. Rogers in his book *Diffusion of Innovations,* first published in 1962 by The Free Press.

It does not necessarily follow, however, that everyone in society will catch up. Studies on the adoption of smart technologies and flexible tariffs reserve categories for people who adopt much later than others, adopt only with policy intervention, or never adopt.[51] Groups that are expected to take up smart energy offers last, or never, have been assessed as being more likely to have a low income and more likely to experience energy poverty or ill health.[52]

In the context of housing decarbonisation and electrification, the speed at which we must act to avoid climate catastrophe and the radical nature of the transformation the energy system is undergoing mean that previous models of technology design and deployment no longer serve on their own. As energy markets move ahead with pricing to guide how and when we use energy — and as the cost of failing to access direct flexibility benefits increases — waiting for innovation to trickle down is insufficient.

Continuing to prioritise higher-income households for innovative offers and technologies, as well as the public subsidies and support that goes with them, risks increasing the economic divide in society and eroding social cohesion.[53] In contrast, strategically facilitating inclusive access to direct flexibility rewards now could kick-start a positive feedback loop through which households enjoy financial rewards and an improved experience of energy through their flexibility.

iStock.com/sturti

51 As noted by Roberts et al., 2020, 'laggards' is the 'official' term used in academic literature to describe "those who are the last set of people to engage in a new technology or product," notwithstanding its derogatory connotations in the modern world. Other terms exist to describe people who never adopt technologies or offers. See, for example, the use of a 'never takers' category in Cappers, P., Spurlock, A., Todd, A., Baylis, P., Fowlie, M., & Wolfram, C. (2016). *Time-of-use as a default rate for residential customers: Issues and insights.* Lawrence Berkeley National Laboratory. https://emp.lbl.gov/publications/time-use-default-rate-residential

52 Roberts et al., 2020.

53 European Commission. (2023). *Communication from the Commission to the European Parliament and Council: 2023 strategic foresight report — Sustainability and people's wellbeing at the heart of Europe's open strategic autonomy.* COM(2023) 376 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A376%3AFIN

PART 4:

What's holding us back?

In addition to the socioeconomic barriers to flexibility participation described in Part 3, another hindrance to progress is outdated or underdeveloped energy market policy approaches. This part of the paper pulls together these policy barriers in simplified form. In reality, the market barriers overlap each other and are fed by wider socioeconomic inequities.

Energy market policy barriers to inclusive flexibility can be categorised as follows.

- **System perspective, not household.** The demand-side flexibility challenge is framed purely as one of meeting energy system needs in the most efficient overall manner. Collective system gains are emphasised as the sole means of delivering equity, paying little attention to how different households view or experience flexibility.
- **Incentives over capability.** Wholesale market design focuses on price incentives for flexibility, while retail protections concentrate on customers' rights to adopt dynamic tariffs and smart meters. Neither focuses on how to build flexibility capability or needs-centric services. It is also not clear which actors are responsible for providing flexibility-boosting home infrastructure if households cannot afford to pay for it.
- **Protecting but excluding.** Energy bill support schemes err on the side of protecting at-risk groups from exposure to price signals — or at least shielding them from the impact of high prices — rather than empowering households to participate safely in emerging marketplaces for flexibility. People are excluded from the benefits as well as the risks.
- **Siloed sectors.** Decarbonisation of energy demand relies heavily on buildings and mobility becoming electrified and flexible. These transformations are happening largely outside of energy markets, with no overarching accountability for the customer journey to smart energy, and with poor communication with households over the role they are expected to play.[54] Siloed regulation of electricity and heat systems also prevents markets and services from coming together to deliver maximum flexibility value to households.
- **Retail market failings.** Insufficient retail regulation and limited consumer access to redress contribute to low levels of trust and confidence in energy suppliers.[55] Low-income and vulnerable households suffer most from supplier shortcomings.[56] Lack of choice and transparency over how flexibility value is passed through to households hampers engagement in market propositions. Innovative, more people-centric offers tend to target affluent groups with flexible assets.[57]

54 Only 5% of UK households surveyed were aware of the prosumer and active customer roles that they were expected to play in the future smart energy system. Smith et al., 2023.

55 Trust can also be undermined by poor communication of precontractual information and limited comparability and comprehension of flexible retail offers. Researchers in 2019 found that customers were already struggling to navigate the complex electricity retail market and that new, often opaque flexible offers were only adding to this confusion. BEUC, The European Consumer Organisation. (2019). *Fit for the consumer? The do's and don'ts of flexible electricity contracts.* https://www.beuc.eu/reports/fit-consumer-dos-and-donts-flexible-electricity-contracts.

56 For example, tens of thousands of UK households were forced by suppliers to switch to more expensive prepayment meters, resulting in self-disconnection, in breach of regulation designed to protect vulnerable groups. Smith et al., 2023. The proposed EU electricity market design arrangements contain provisions to prevent EU households from being forced onto a prepayment meter.

57 For example, 'upside-only' flexible retail offers are available to people who own an electric vehicle. These provide rebates for flexible actions such as lower use of grid power during times of system peak demand, but no higher cost for greater use during peaks. The Dutch software company Jedlix has partnered with supplier Engie in Belgium to offer bill discounts for smart charging, including for customers on a one-year flat rate. Engie. (n.d.). *Kan ik voordelig laden zonder prijsschommelingen?* [Can I charge cheaply without price fluctuations?] https://www.engie.be/nl/mobiliteit/energie-contract/drive-vast/. For more examples, see the text box on upside-only offers on Page 31.

PART 5:

What does inclusive flexibility look like?

From an energy system perspective, a kWh is a kWh. The function of clear price signals is to drive efficient actions by all market actors, without discrimination. From the household perspective, however, not all flexibility is equal. The benefits received and burdens imposed vary depending on household circumstances, the nature of the flexibility and how it is captured.

From the household perspective, not all flexibility is equal. The benefits received and burdens imposed vary.

For household flexibility to be truly inclusive, rather than just not explicitly discriminatory, policies must be tailored to the needs and priorities of low-income and vulnerable households. Delivering inclusive flexibility is not a cookie-cutter application of the general approach to demand-side flexibility to new groups. So, what *does* inclusive flexibility look like? Before a policy framework for implementation can be developed, it is necessary to identify key principles. These are outlined in Figure 6 and examined in turn below.

Figure 6. Policy principles for inclusive flexibility

Direct benefits are available to those who need them most

Not all electricity use needs to be flexible, but all households and communities should have genuine access to opportunities to participate directly in flexibility, to receive fair financial rewards and to experience associated positive outcomes. Benefits should not be concentrated in more affluent early adopter groups.

Significant policy and media attention has been devoted to cases of energy market abuse such as mis-selling, in which consumers are offered unsuitable services. While it is vital to hold providers and regulators to account for these practices, the much less visible risk of missing out on energy market benefits — and the uneven distribution of that risk across society — should not be overlooked.[58]

Shutterstock/Stock Rocket

Missing out is a harm in itself. Even if an excluded household's individual circumstances do not change, social inequality is exacerbated if the position of more affluent or less marginalised households improves within the same time frame. For this reason, it is insufficient to point solely to indirect system savings as evidence of demand-side flexibility being equitable, especially while supporting more affluent users to receive direct flexibility rewards.

Flexibility is easy and stress-free for households

Accessing the direct benefits of using energy flexibly is not inclusive if it feels like more hard work or another source of stress. Avoiding extra mental load is important for everyone, but especially so for low-income and vulnerable households, who already live with additional daily stressors. If energy flexibility relies on effort and unpaid domestic labour, either it will not happen at all or it will perpetuate inequities and exclusion.

Households should not be required to become energy market experts to save on their bills through flexibility. Nor should they be constantly worrying about or manually adjusting energy use.[59] Technologies and services need to be intuitive, aligned with household priorities and facilitated by beneficial relationships with trustworthy providers.[60] Technology automation offers opportunities to deliver flexibility benefits and ensure comfort with minimal mental load. A new 'social licence to automate' must be established for engagement with energy services, upholding agency and dignity without requiring effort or ongoing vigilance.[61]

58 Roberts et al., 2020.

59 For example, accessing the benefits of rooftop solar imposed a mental burden on low-income households when the assets were not combined with storage, automation and user-friendly control equipment. See: Middlemiss, L. (2023, January). Taking control of energy as a solar prosumer. *Nature Energy, 8*, 13-14. https://doi.org/10.1038/s41560-022-01174-8; and Fox, N. (2023, January). Increasing solar entitlement and decreasing energy vulnerability in a low-income community by adopting the Prosuming Project. *Nature Energy, 8*, 74-83. https://doi.org/10.1038/s41560-022-01169-5

60 Ambrosio-Albala, P., Middlemiss, L., Owen, A., Hargreaves, T., Emmel, N., Gilbertson, J., Tod, A., Snell, C., Mullen, C., Longhurst, N., & Gillard, R. (2020, December). From rational to relational: How energy poor households engage with the British retail energy market. *Energy Research & Social Science, 70.* https://doi.org/10.1016/j.erss.2020.101765

61 Adams, S., Kuch, D., Diamond, L., Fröhlich, P., Henriksen, I. M., Katzeff, C., Ryghaug, M., & Yilmaz, S. (2021, October). Social license to automate: A critical review of emerging approaches to electricity demand management. *Energy Research & Social Science, 80.* https://doi.org/10.1016/j.erss.2021.102210. See also User-Centred Energy Systems Technology Collaboration Programme. (n.d.). *Social license to automate 1.0.* International Energy Agency. https://userstcp.org/task/social-license-to-automate/

Flex-ability in the eye of the beholder

A person's ability to respond to incentives for flexible energy use contains both objective and subjective elements. Research from Sweden found that the perception of flexibility potential varies according to context and personal attributes.[62] People living with poverty are more likely to judge their comfort as tradeable for reduced cost, and therefore to perceive their flexibility potential as higher. There are also temporal and cost variables; for example, self-perceived flexibility potential was higher in December 2021 than in September 2021 despite the technical flexibility of homes remaining the same. This suggests that self-perceived energy flexibility increases as the cost burden increases, especially the heat cost burden (in countries like Sweden where winter is the season of peak demand). Additional attributes were shown to be statistically significant, including gender identity. In the study women generally reported higher perceived flexibility than men, but having young children reduced perceived flexibility.

Flexibility offers savings without sacrificing comfort or well-being

To be inclusive, technologies, offers and services must be focused on meeting household needs, not just energy system needs.[63] Flexible actions should be genuinely voluntary and not forced — including by economic pressure — where there is a risk of not meeting energy or other basic lifestyle needs. A financial incentive to shift energy use to a different time of the day should provide an opportunity for low-income households to either reduce energy bills while enjoying the same energy services or increase comfort if they were previously rationing energy. Likewise, fear of price spikes at certain times of day should not perpetuate rationing and underconsumption.

Flexibility should be predominantly technology-derived, not socially derived (see the box on flexibility capital on the next page), so that lower-income and vulnerable households are able to respond to price signals flexibly without increasing the risk of harm. Flexible assets — including smart, automated technologies — can be designed to meet the needs of the most vulnerable or excluded people, which means the assets are accessible to the largest group possible and do not add to mental load. Access to well-designed flexible assets facilitates inclusive flexibility, because it is not necessary to sacrifice comfort or convenience to benefit from direct flexibility savings.[64]

62 von Platten, J. (2022). Energy poverty in Sweden: Using flexibility capital to describe household vulnerability to rising energy prices. *Energy Research & Social Science, 91.* https://www.sciencedirect.com/science/article/pii/S221462962200250X

63 Chard, R., Lipson, M., & Fleck, R. (2021). *How can innovation deliver a smart energy system that works for low income and vulnerable customers?* United Kingdom Department of Business, Innovation and Industrial Strategy. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/994845/project-involve-smart-energy-system-low-income-vulnerable-consumers.pdf

64 This is not the same as saying that it's not possible for such assets to be used in a way that increases savings by sacrificing comfort and convenience, in certain conditions or under extreme pressures.

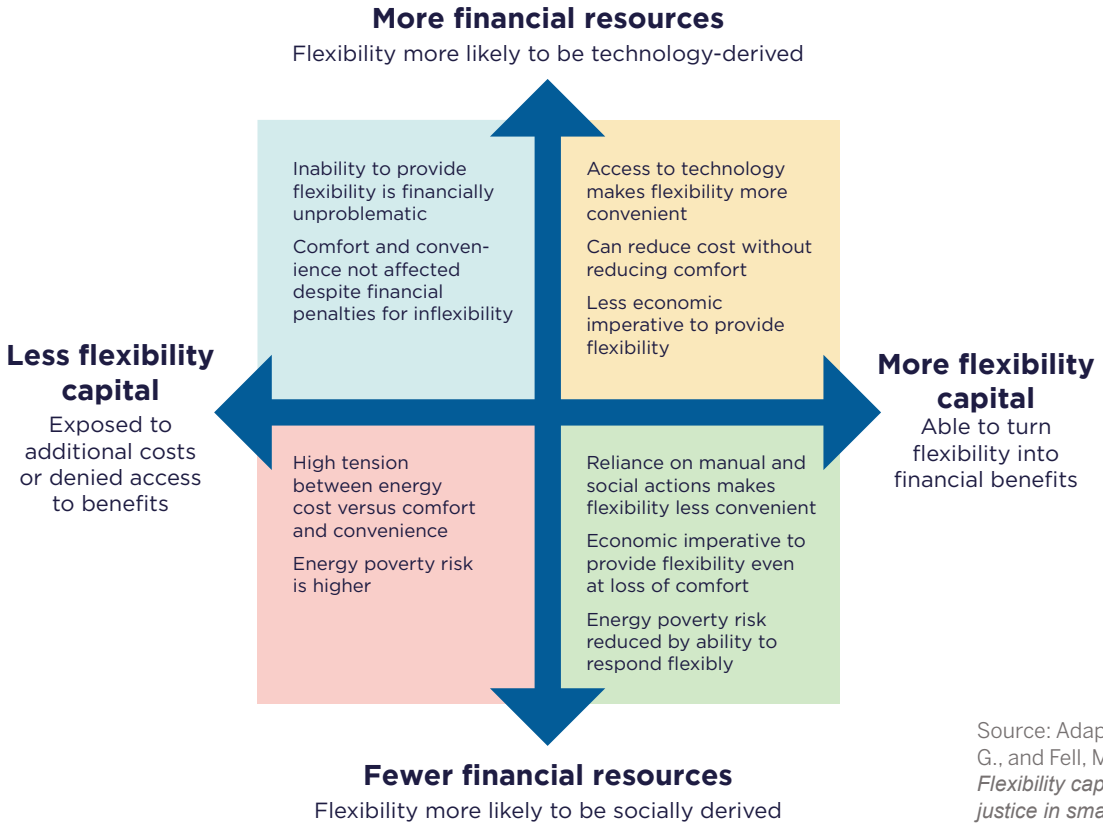
The flexibility capital divide

The flexibility capital model describes the capacity of energy users to responsively change their patterns of interaction with the energy system.[65] The model builds on other notions of capital, such as cultural and social capital, that are at times convertible to economic capital.

The way in which a household creates flexibility varies depending on factors such as access to financial resources. Affluent groups are more likely to derive flexibility capital from smart, automated technologies, without affecting comfort or convenience **(technology-derived flexibility).** Poorer groups have more limited access to these assets. To access direct savings and avoid penalties, they must draw on flexibility capital from manual, social actions such as turning things down or off and undertaking household tasks at different times **(socially derived flexibility).** This increases domestic labour and mental load, which already disproportionately fall to women, especially in low-income households.[66] Wealth also offers choice over whether to engage in flexibility at all.

As illustrated in Figure 7,[67] households with less affluence and less flexibility capital face a higher risk of financial hardship and poverty when energy systems promote flexibility through price signals. For households with less affluence but higher levels of flexibility capital, flexibility is more likely to involve compromising their energy needs.

Figure 7. Interaction between flexibility capital and affluence



Source: Adapted from Powells, G., and Fell, M. J. (2019). *Flexibility capital and flexibility justice in smart energy systems*

65 The discussion in this text box is based on Powells, G., & Fell, M. J. (2019, 12 February). *Flexibility capital and flexibility justice in smart energy systems.* SocArXiv. https://osf.io/preprints/socarxiv/3nja6/

66 Johnson, C. (2020). Is demand response a woman's work? Domestic labour and electricity shifting in low income homes in the United Kingdom. *Energy Research & Social Science, 68.* https://www.sciencedirect.com/science/article/abs/pii/S2214629620301341

67 Adapted from Powells & Fell, 2019. Original licensed under CC-By Attribution 4.0 International: https://creativecommons.org/licenses/by/4.0/legalcode.en

Choosing a flexible offer does not mean sacrificing price protection and social support

The regulatory framework should encourage low-income and vulnerable customers to access flexibility benefits without compromising their eligibility for social tariffs or other regulated price protection. Regulatory protections need to adapt to new challenges and risks, providing a safe and smooth runway to flexibility.

Policy design should avoid creating false choices between flexibility and regulatory protections. Households must be permitted to layer flexibility rewards on top of regulatory protections — rather than replacing them — thereby ensuring a net benefit. Layering also prevents disincentives for flexibility and avoids criteria 'cliff edges,' which can result in households not getting the support they need due to falling out of eligibility for social schemes. People should be encouraged to take baby steps into flexibility, sampling offers on a low-risk basis.

Flex with support: Spain's dynamic + social tariff

In Spain, social support is layered on top of a flexible retail tariff to form a de facto flexible social tariff. The tariff is notable for offering price protection to low-income and vulnerable households while maintaining opportunities for flexibility savings and participation in smart retail offers.

The Bono Social de Electricidad (Social Electricity Bonus) is available to those struggling with energy costs. A discount of 25% or 40% of the entire bill is offered for households classed as vulnerable or severely vulnerable, respectively. This was increased to a discount of 65% or 80% during the 2022 and 2023 energy price crisis.[68]

To be eligible for the Bono Social scheme, households must be signed up to the regulated default dynamic tariff, the Precio Voluntario para el Pequeño Consumidor (Voluntary Price for Small Consumers). The energy portion of the tariff is fully dynamic as standard. For the policy and network cost elements, customers can choose between two time-of-use rates or a flat rate.[69] Making social support conditional on not opting out of the default dynamic tariff does raise risk as well as questions around agency and access, although the price risk of the dynamic tariff is partly mitigated by the discount available.[70]

68 Gobierno de España. (n.d.). *Bono social de electricidad* [Social electricity bonus]. https://www.bonosocial.gob.es/#inicio

69 Florence School of Regulation. (2020, 9 November). *The Spanish experience with dynamic tariffs.* https://fsr.eui.eu/the-spanish-experience-with-dynamic-tariffs/

70 A further equity consideration, detailed analysis of which is outside the scope of this paper, is the distributional impact of time-varying cost recovery of fixed policy costs (such as green levies) through energy bills. Specifically, the risk that more-affluent, more-flexible customers will opt into time-of-use tariffs to avoid these charges, leaving a larger proportion of the fixed elements for lower-income customers with poorer access to flexible assets. This can be distinguished from time-varying cost recovery methodologies for policy and system costs where the overall burden can be reduced through demand-side flexibility, such as capacity market costs.

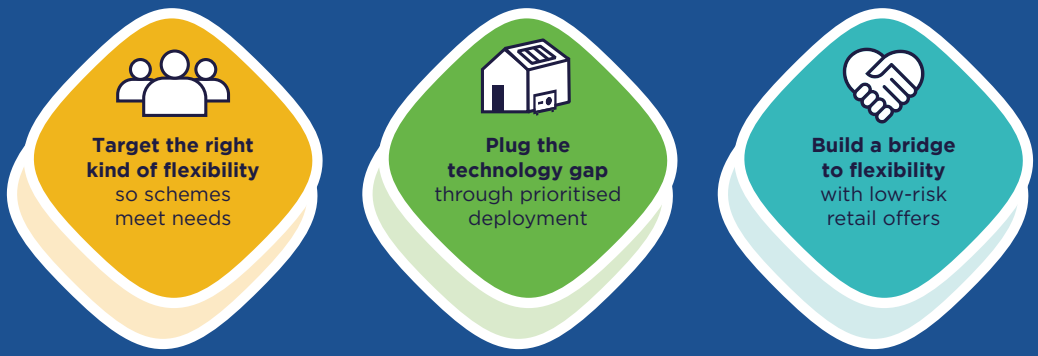
PART 6:

No-regrets flexibility policy steps

Although there is enough research to sketch out a broad picture of inclusive flexibility, the lack of evidence from real-world trials and market offerings[71] would render a fully fledged action plan for delivering it premature. Each element of inclusive flexibility set out in Part 5 deserves more focused policy discussion, analysis and stakeholder engagement.

Still, some policy steps towards inclusive flexibility are clear and could begin straight away. Figure 8 organises these into three areas. The actions support each other and should take place concurrently.

Figure 8. Policy steps towards inclusive flexibility



Target the right kind of flexibility so schemes meet needs

Regulatory mechanisms for scaling up demand-side flexibility to meet system requirements could be vehicles for inclusive flexibility. Examples include national flexibility targets, electricity supplier obligations, network operator incentives and peak demand reduction schemes. However, inclusive flexibility is about more than just getting more people through the door; it must also serve their needs.

Which kilowatts flexibility schemes extract and *how* they are extracted is socially important, but this is not recognised by the energy system. There is no distinction in regulation between socially derived and technology-derived flexibility, for example. Current demand-side flexibility policies do not see, or seek to find out, where flexibility is at risk of being derived from household financial duress, manual effort or energy rationing.

71 Chard et al., 2021.

Caution is essential, therefore, when inserting targets or ring-fences for low-income and vulnerable household uptake into supplier obligations or other duties of regulated entities, without well-informed safeguards. Policy mechanisms must be sensitive to the question of who is providing the flexibility and how and the consequences to them of doing so. Aspects that could be explored as part of policy design include:

- Establishing clear common language around the technical and manual origins and social consequences of flexibility, including convenience and mental and domestic loads. Having common language can aid in designing inclusive policies and articulating best practices.[72]
- Developing a better understanding and common indicators of technical flexibility potential in homes, considering a building's ability to retain heat or cold and the presence of smart metering, control and automation.[73]
- Incentivising regulated and market actors to fund or partly fund energy efficiency and flexible assets for low-income and vulnerable households as part of, for example, supplier obligations or cost-efficiency incentives for network companies.[74]

Plug the technology gap through prioritised deployment

To grow flexibility capital among the households that would benefit most from offering the value of their flexibility to the system, we must move them to the front of the line when deploying user-friendly, flexible assets. This includes providing affordable access to technologies and services that facilitate flexibility — such as high-speed internet access and smart meters and controls — and to flexibility-enabling upgrades to buildings and other infrastructure.

The European energy efficiency and buildings policy framework is increasingly focusing on low-income and vulnerable households (see the box on Page 7 on leaving no one behind). Energy poverty alleviation programmes commonly focus on delivering efficiency measures to reduce energy demand and overcome the structural inequalities that lead to high energy burdens. Some programmes are also expanding the range of technologies offered, with solar photovoltaics in particular being increasingly offered as a way to alleviate energy poverty.[75] Integrating the deployment of flexible assets and controls into these programmes can deliver greater benefits to households, potentially multiplying the savings and benefits from any single energy-saving or generation measure and reducing the risk of future energy poverty (see Figure 9 on the next page).

Home renovation programmes, advisory services and one-stop shops should not focus only on maximising households' technical flexibility capability through combinations of energy production, storage and controls. They should also maximise the value of those assets through flexible tariffs and services.

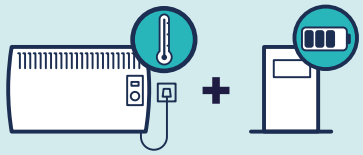
72 Powells & Fell, 2019; Chard et al., 2021.

73 The concept of a smart-readiness indicator — a common EU tool for rating buildings — has been introduced as part of the Energy Performance of Buildings Directive recast and is due to be rolled out for larger, mainly nondomestic buildings. European Commission. (n.d.). *What is the SRI?* https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator/what-sri_en. For another approach to quantifying a building's potential to operate flexibly, see Crawley, J., Manouseli, D., Mallaburn, P., & Elwell, C. (2022). An empirical energy demand flexibility metric for residential properties. *Energies, 15*(14), Article 5304. https://www.creds.ac.uk/publications/an-empirical-energy-demand-flexibility-metric-for-residential-properties/

74 For further analysis on approaching public investments in building flexibility as a system resource and a national resilience measure, see Yule-Bennett & Sunderland, 2022.

75 For example, see the Sun4All project. Sun4All. (n.d.). *Energy communities for a fair energy transition in Europe.* https://sunforall.eu/about/sun4all-project

Figure 9. Winning flexibility combinations



Electric heaters plus batteries

Example: Warmworks and Dumfries and Galloway Housing Partnership installed batteries and supported tenants to move to optimal tariffs, enabling the use of existing electric heaters to serve heating needs for the whole day with electricity bought at lower prices.

Source: Warmworks. (n.d.). *Domestic battery storage.* https://www.warmworks.co.uk/our-work/domestic-battery-storage/

Hot water tanks plus smart controls

Example: EnergyCloud, working with Clúid Housing, installed smart controls on existing hot water tanks so tenants could access free hot water at times of surplus wind generation on the grid, utilising clean energy that otherwise would go to waste.

Source: Clúid Housing. (n.d.). *EnergyCloud and Clúid Housing announce renewable energy partnership.* https://www.cluid.ie/medias-centre/energy-cloud/

Solar plus batteries

Example: A subsidy scheme in Greece is designed to allow households to use batteries to control when they use the grid and when they export their solar power, maximising the return on investment and providing backup power.

Source: Tsagas, L. (2023, 29 March). Greece launches €200 million residential solar-plus-battery subsidy scheme. *pv magazine.* https://www.pv-magazine.com/2023/03/29/greece-launches-e200-million-residential-solar-plus-battery-subsidy-scheme-2/

Air-source heat pump plus solar plus batteries

Example: Warmworks and Angus Housing Association installed solar panels and batteries alongside newly electrified heating so more solar energy could be used on-site, providing heat after sunset and reducing tenants' bills.

Source: Warmworks. (n.d.). *Renewable heat project with Angus Housing Association.* https://www.warmworks.co.uk/our-work/renewable-heat-project-with-angus-housing-association/

Build a bridge to flexibility with low-risk retail offers

Policymakers can support and incentivise electricity suppliers, network operators and other service providers to ensure that households are empowered to access flexible retail offers, while protecting against financial risk and other harm.

Flexible retail propositions on the market today were not designed with low-income and vulnerable households in mind. To ensure inclusivity, new propositions need to be developed which meet people where they are. Retail choice should be supported by user-friendly tools for comparing offers. Consumption data can be used — with appropriate safeguards and customer consent — to predict whether households are likely to benefit most from a dynamic tariff or another form of flexible offer. Households managing a tight budget may prefer to trade in a portion of potential upside for increased certainty, through a fixed rate with flexibility savings priced in (based on estimated usage, including asset automation) or layered on top.

Opportunities that could be explored now include:

- Flexible offers with price protection. These offers could include 'upside-only' opportunities to earn cash bonuses, bill credits or periods of free power through flexibility; shadow billing and money-back guarantees to illustrate cost comparisons and the potential bill savings from flexibility;[76] and dynamic tariffs that have capped peak prices,[77] which could be lower for social tariff customers.
- Social tariffs with flexible benefits, or flexibility offers that sit on top of a social tariff or other energy bill support, so households do not have to forgo regulatory price support to benefit from offering their flexibility. (See the box on Page 27 describing Spain's dynamic + social tariff.)
- Services with safeguards like subsidised energy or heat-as-a-service options. These services guarantee that households will enjoy at least a minimum level of physical comfort, and they enable flexible assets to be partly paid for through reduced running costs and partly by the state.[78]

The only way is up: Rewards without the risk

Upside-only offers reward households for flexible actions, without imposing penalties for failure to deliver. They can be stand-alone propositions or bonuses such as rebates or free power integrated into retail offers and services.

- The pilot scheme that EnergyCloud is running with Clúid Housing in Ireland (see Figure 9 on winning flexibility combinations) provides energy-poor households with free hot water, using renewable energy that would otherwise be wasted.[79]
- UK energy supplier Octopus, along with distribution system operator UK Power Networks, is offering households in eligible areas 'Power-ups.' These are periods of free electricity to utilise local renewable generation, usually lasting for an hour or two and announced by email around a day in advance.[80]
- Octopus also partnered with the British electricity system operator National Grid ESO to launch a national peak demand reduction turndown trial, due to run for a second winter in 2023-24. The 'Big Dirty Turn Down trial' offers bill rebates to households that are able to reduce their electricity consumption during key two-hour periods, notified a few hours in advance, thereby reducing system reliance on fossil generation.[81]

76 California utility regulators ruled in 2018 that two customer protections should be included in the systemwide rollout of default time-of-use tariffs. First is a 'shadow bill' that shows customers whether they are better off with the time-of-use rate or their old rate. The other is a guarantee that, for the first year of the transition, customers who would have saved more on the old rate will be credited the difference. California Public Utilities Commission, Application 17-12-011 and related matters, Decision 18-12-004 on 13 December 2018, addressing residential default time-of-use rate design proposals and transition implementation. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M250/K279/250279386.PDF

77 For example, Octopus Energy's 'Agile' dynamic retail tariff contains a price cap, currently set at 100 pence per kWh in the UK. Octopus Energy. (n.d.). *Introducing Agile Octopus: The 100% green electricity tariff with plunge pricing.* https://octopus.energy/smart/agile/https://octopus.energy/smart/agile/. Before the energy crisis, the cap was 35 pence per kWh.

78 See recommendations in Sunderland & Gibb, 2022.

79 Clúid Housing. (n.d.). *EnergyCloud and Clúid Housing announce renewable energy partnership.* https://www.cluid.ie/medias-centre/energy-cloud/

80 Octopus Energy. (n.d.). *Octopus Power-ups: Power up for free on spare green electricity.* https://octopus.energy/power-ups/

81 Octopus Energy. (2022, 8 February.) *Join the Big Dirty Turn Down trial.* https://octopus.energy/blog/the-big-dirty-turn-down-free-electricity-trial/

Conclusions

***"Diversity is being invited to the party. Inclusion is being asked to dance."* — Vernā Myers**[82]

Inclusive flexibility demands more than protecting households from the harm of price shocks and coerced energy rationing, though this is an essential baseline. It is about welcoming excluded people into new smart energy systems and opportunities, enabling them to "shape, shed, shift, and shimmy"[83] their energy demand in a way that works with their needs and rhythms of everyday life, not against them. On a societal level, it means Europeans are able to move forward to a net-zero economy together, avoiding a two-tier energy market in which only the privileged harvest the juiciest fruits of digitalisation and decarbonisation. Regulatory duties and safeguards must keep pace with the rapidly evolving electricity market design. In today's and tomorrow's energy system, there is no real customer protection or system resilience without empowerment and inclusion.

In today's and tomorrow's energy system, there is no real customer protection or system resilience without empowerment and inclusion.

Europe is embarking on an unprecedented scale-up of demand-side flexibility and electrification. It is incumbent on policymakers to ask which households new technologies, offers and flexibility schemes are serving. We must quickly move beyond surface-level neutrality, which leaves excluded households watching the action from the sidelines — if they make it into the party at all. Active inclusion requires timely, well-targeted and proactive policy interventions across multiple sectors. Ultimately, the energy justice movement strives for deeper structural reform, co-design and collaboration.[84] In this vision for our energy future, not only will low-income and vulnerable households not have to wait to be asked to dance, they will be on the party planning committee.[85]

82 Myers, V. (2015, 10 December). *Diversity is being invited to the party: Inclusion is being asked to dance* [Video]. YouTube. https://www.youtube.com/watch?v=9gS2VPUkB3M

83 Alstone, P., Potter, J., Piette, M. A., Schwartz, P., Berger, M. A., Dunn, L. N., Smith, S. J., Sohn, M. D., Aghajanzadeh, A., Stensson, S., Szinai, J., Walter, T., McKenzie, L., Lavin, L., Schneiderman, B., Mileva, A., Cutter, E., Olson, A., Bode, J., ... Jain, A. (2017). *2025 California demand response potential study — Charting California's demand response future: Final report on Phase 2 results.* https://eta-publications.lbl.gov/sites/default/files/lbnl-2001113.pdf

84 DellaValle & Czako, 2022.

85 Juday, D. (2017, 3 May). *Inclusion isn't "being asked to dance."* LinkedIn. https://www.linkedin.com/pulse/inclusion-isnt-being-asked-dance-daniel-juday/

Annex: Tackling the underlying causes of exclusion

Tackling the barriers and underlying causes of exclusion requires multiple interconnected initiatives, often from different policy or regulatory areas. The challenge is to blend accessible, user-centric energy products and services with systemic interventions to promote justice and inclusion across multiple integrated systems.

A 2020 study by the UK Centre for Sustainable Energy[86] identified three categories of mitigating action, as outlined in Table 1 (with examples of mitigation added by RAP). This illustrates a range of approaches that can be used in combination.

Table 1. Three clusters of mitigating actions to overcome barriers to smart energy participation

Type of mitigation intervention	Examples of mitigating action
Interventions to support consumers by providing or making up for key missing capabilities and attributes.	Creating energy technology grants and loans to make up for lack of capital. Providing training and support around smart technologies to improve access and knowledge, thereby helping people make smart choices to compensate for educational, skills-based and risk-perception barriers.
Interventions to change the energy system (or an individual offer) so that some capabilities and attributes are no longer essential.	Reforming the way energy companies and technology service providers are regulated and including cost and comfort protections, so lack of trust and confidence is less of a barrier. Amending private and social landlord regulation to give tenants additional energy retail choice rights, so homeownership is not a requirement of participation.
Interventions from 'outside' the energy system which increase the likelihood that required capabilities and attributes are more widely available and so no longer distinguish participants from nonparticipants.	Amending telecommunications regulation to ensure ubiquitous high-speed broadband and high-quality 4G mobile phone signals, to ensure that all homes have the requisite connectivity to support high performance of smart energy technologies. Reforming the banking sector to ensure that suitable personal financial products are available for people outside of mainstream financial services, while offering ongoing support and advice via accessible apps and services. (Chard et al., 2021.)

Source: Adapted in part from text in Roberts, S., Bridgeman, T., Broman, D., Hodges, N., & Sage, C. (2020, September). *Smart and fair? Exploring social justice in the future energy system (Phase One report)*

86 Roberts et al., 2020.

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