100 Social Sciences and Humanities priority research questions for energy efficiency in Horizon Europe.

Report

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Executive summary

The launch of the European Union's (EU) Horizon Europe programme provides exciting opportunities for Social Sciences and Humanities (SSH) research to contribute to the fulfilment of the EU's ambitious policy goals on energy and climate change. This report presents 100 questions that have been identified by experts as key priorities for SSH research on energy efficiency, in order to inform and support these goals. Specifically, the questions within this report aim:

> *To promote SSH research that better situates energy efficiency in relation to social systems of energy demand and supply; and to constructively challenge notions of energy efficiency by opening up questions of its meanings, applications and implications across diverse contexts, actors and scales.*

The 100 priority questions are grouped into seven themes, as follows:

1. **Citizenship, engagement and knowledge exchange in relation to energy efficiency**

   Questions focus on the different ways in which various stakeholders can participate in design, implementation and learning processes around energy efficiency policies and interventions.

2. **Energy efficiency in relation to equity, justice, poverty and vulnerability**

   Questions focus on how energy efficiency affects, and is affected by, issues of equality, fairness, poverty and the differentiated forms of vulnerability that may concern social groups.

3. **Energy efficiency in relation to everyday life and practices of energy consumption and production**

   Questions explore issues around how energy efficiency policies play out in the 'real world' of daily life, as well as investigating how energy efficiency relates to shifting social norms, practices and systems of provision.

4. **Framing, defining and measuring energy efficiency**

   Questions deal with issues around how energy efficiency is defined and understood by various actors, and how energy efficiency and its impacts are (and should be) measured.

5. **Governance, policy and political issues around energy efficiency**

   Questions focus on how energy efficiency is governed by various kinds of decision-makers and interest groups, and explore ways in which energy efficiency policies and policy-making could be improved.

6. **Roles of economic systems, supply chains and financial mechanisms in improving energy efficiency**

   Questions go beyond established economic thinking on energy efficiency, to explore a range of specific mechanisms and broader approaches that can help embed energy efficiency within sustainable (including alternative) economic systems.

7. **The interactions, unintended consequences and rebound effects of energy efficiency interventions**

   Questions in this final theme explore a range of ways in which energy efficiency agendas interact with other agendas, including health and wellbeing priorities, and consider the complex ways in which energy efficiency measures may produce 'rebound effects' and/or other unintended consequences.

To identify the 100 questions, we undertook a Horizon Scanning exercise over August 2019 – October 2020. This involved a Working Group of 27 (initially 31) energy-SSH experts from across Europe, encompassing diverse SSH disciplines, interdisciplinary experiences, genders, geographies, research interests and career stages. A Horizon Scanning survey of this group and their wider contacts (152 respondents in total) generated a list of 513 possible questions. After an initial editing process, 383 revised questions were presented to the Working Group to be ranked according to their priorities, using a second survey. The results of this survey fed into two virtual workshops with Working Group members, where questions were discussed and revised. This deliberative process resulted in a final list of 100 priority questions for SSH research on energy efficiency.

This list is not intended to be exhaustive, but aims to serve as a stimulus or starting point for discussions between policymakers, funders and researchers on how SSH evidence on energy efficiency and related issues can best support policy goals on energy and climate change.

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1. Introduction

1.1. Background: the start of Horizon Europe

The end of 2020 sees the start of the handover between European Union (EU) Framework Programmes (FP). Specifically, Horizon 2020 (FP8) which ran principally over 2014-2020, is coming to an end, and Horizon Europe (FP9) is releasing its first funding calls for 2021-2022. As such, the outcomes of the European Commission's (EC) recent strategic planning exercises for European research and innovation over the period 2021-2027 are now being made public. As part of this handover, the European Commission has maintained its commitment both to mainstreaming Social Sciences and Humanities (SSH) across all of its funded research (which is likely to be predominantly technical and natural science-led research), as well as to creating opportunities for dedicated SSH-led research where needed.

It is these contexts – of strategic change in European research and innovation, and renewed commitments to SSH (without exact clarity on what forms this may take) – that provide the foundations for this report on research priorities. Indeed, there is an opportunity for truly cutting-edge programmes of research and innovation to be funded, and this is a key moment for SSH communities to constructively develop and communicate their own priorities. Such opportunities must be urgently grasped, not least in energy-related research and innovation, where the vast majority of funding has gone to the natural and technical sciences (c.f. Overland and Sovacool, 2020) and efforts towards interdisciplinarity have had limited effect (Baum and Bartkowski, 2020). Moreover, there is clear evidence indicating the funding of energy-related SSH in Horizon 2020 to be minimal, disciplinarily-narrow, overly-instrumental and lacking critical perspectives (Genus et al., 2018; Kania et al., 2019; Foulds and Christensen, 2016; Robison and Foulds, 2019). It is clear that much still needs to be done for the EC to get the most out of energy-SSH.

1.2. Aims and hopes for the use of this report to support the European Commission

The aim of this report is to present priority SSH research questions for the EC to consider funding in Horizon Europe, specifically in relation to energy efficiency. This is one of four reports detailing the 100 priority SSH research questions for key topics associated with the EU Energy Union: renewables; smart consumption; energy efficiency; and transport and mobility. These topics were set to align with existing EC research and innovation funding priorities, as part of contributing to EU energy policy commitments. Indeed, we understand that energy efficiency will be a core funding priority in Horizon Europe's Cluster 5 on 'Climate, energy, mobility' (EC, 2019c: Annex 5), given its consistently-core position in the Strategic Energy Technology Plan (EC, 2015), Clean Energy for All Europeans Package (EC, 2019a), long-term vision for A Clean Planet for All (EC, 2018), and European Green Deal (EC, 2019b). Given this, we set ourselves the challenge of identifying what an SSH-led research agenda could look like, with energy efficiency as the starting point[1].

Our hope is therefore that this report provides the EC with resources to support reflection on alternative possibilities of energy-SSH, as it begins writing more funding calls around energy efficiency in Cluster 5. Whilst we recognise that this Cluster will have its own working structure, and that Member State interests will also need to actively help construct these

1 In defining energy efficiency, our starting point was the EU's 2012 Energy Efficiency Directive, which refers to "*the ratio of output of performance, service, goods or energy, to input of energy*" (European Parliament and Council, 2012: article 2, point 4; p.10). We do not treat energy-saving behaviours in general as equivalent to energy efficiency; however, we are open to critical perspectives on energy efficiency that draw on concepts of energy demand and sufficiency. We include energy efficiency at any and all scales, and also as existing across an array of appliances, machineries and buildings used in household, workplace, industry and public sphere activities. For further details on such matters, including how we implicitly differentiate between energy efficiency and energy conservation, please see our Terms of Reference (Foulds et al., 2019a).

calls, we certainly hope that the below priorities from the SSH communities themselves are useful. Indeed, a concern of SSH researchers has long been that their own research agendas have been overtly directed by non-SSH specialists, who may have different expectations on what SSH can and should do in supporting policy ambitions – both conceptually and practically, sometimes leading to misunderstandings and poor outcomes.

1.3. Using Horizon Scanning methods

In identifying our 100 priority SSH research questions, we undertook a Horizon Scanning exercise over August 2019 – October 2020. Horizon Scanning methods are "*used to gain foresight about emerging opportunities and risks, identify knowledge gaps at the frontiers of fast-evolving phenomena, and set strategic priorities for decision-makers or researchers*" (Foulds et al., 2019b, p.10). Over the last 10-20 years, Horizon Scanning has become relatively well-established in policy circles, with policy actors keen to better anticipate problems and novel solutions.

Within the range of Horizon Scanning methods on offer, there have been numerous 'question selection' exercises (e.g. Ingram et al., 2013; Pretty et al., 2010; Sutherland et al., 2019). These exercises have tended to create research agendas "*by better aligning research questions with policy needs... [so as to be] more relevant to policy makers and thus increase its real-world salience*" (Rudd, 2010, p.861). It is exactly this intent and approach that inspired the Horizon Scanning exercises that sits behind our 100 priority SSH questions.

Specifically, our own Horizon Scanning began with a core team producing Terms of Reference (Foulds et al., 2019a), which set the boundaries and starting points for each of the four Working Groups. Each Horizon Scanning exercise involved a Working Group of 25+ energy-SSH experts from across Europe. The Terms of Reference fed into the production of methodological guidelines (Foulds et al., 2019b), which all Working Groups followed. Please see these guidelines for an in-depth overview, but in brief[2]:

1. We systematically constructed a Working Group that prioritised diversity of e.g. SSH disciplines, interdisciplinary experiences, genders, geographies, research interests, career stages, etc. Appendix 1 includes a breakdown of final Working Group member characteristics.
2. We utilised the contacts of Working Group members, to gather submissions of priority questions via a first Horizon Scan survey (generating 513 questions in total) from European energy-SSH communities. Appendix 2 includes a breakdown of respondent characteristics.
3. We centrally processed and edited the submitted questions, to address e.g. irrelevance to energy efficiency, non-SSH focus, cross-question similarity, English language (Appendix 3).
4. Working Group members evaluated the newly-produced list of 383 SSH questions, via a second Horizon Scan survey, scoring them on a scale of 1 ('definitely exclude') to 5 ('definitely include'), and providing additional qualitative feedback on the questions. Appendix 4 includes the headline results from this Working Group member evaluation task.
5. Evaluation results were centrally analysed, feeding into two virtual workshops with Working Group members, where question selection decisions were deliberated. Appendix 5 includes information on the systematic procedure adopted in creating the 'longlist' of questions that was provided to members for deliberation. This deliberative process resulted in the final list of 100 priority questions.

Sitting alongside this Horizon Scanning exercise are 10 interviews with an interdisciplinary cross-section of Working Group members. These 10 interviews were undertaken shortly before the launch of the first Horizon Scanning survey, and focused on past SSH developments and debates on energy efficiency. They have provided steering context when reflecting on the past and future directions and contributions of SSH on energy efficiency.

1.4. Mission statement from Energy Efficiency Working Group members

Our 100 priority research questions share some common intentions, which became especially clear during Working Group discussions. This is not to say that each *individual* question represents a shared priority, upon which clear consensus was reached. This was not always possible and nor was it our intention; for the richness of SSH lies in its diversity. However, there are common threads linking many of our questions.

2 All four Energy-SHIFTS Working Groups followed the same five steps, albeit with each yielding e.g. different numbers of questions.

Drawing on these shared intentions, we constructed our mission statement:

> *To promote SSH research that better situates energy efficiency in relation to social systems of energy demand and supply; and to constructively challenge notions of energy efficiency by opening up questions of its meanings, applications and implications across diverse contexts, actors and scales.*

It is important to note that in framing our SSH research agenda around energy efficiency, we inevitably face the techno-centric origins and assumptions embedded in this concept. Indeed, we have done our utmost throughout our priority research questions to maintain explicit links to energy efficiency – to ensure alignment with EC priorities – but it is important to acknowledge that energy efficiency in itself would not have been our starting point for a truly SSH-led research agenda on how energy can be used in more sustainable ways.

This has led us to produce priority research questions that value alternative approaches, as well as those that work within current understandings of energy efficiency. Energy efficiency is a well-established part of EU energy policy, and is likely to retain an important role within work towards the EU's world-leading energy and climate goals. However, we argue that new approaches to energy efficiency are needed. These could include considering: alternative measures and interpretations of energy efficiency; new ways of engaging meaningfully with diverse stakeholders; and more holistic assessments of the impacts of energy efficiency measures. Going even further, greater consideration is also needed of energy sufficiency and the fundamental (but often overlooked) fact that *promoting energy efficiency is not the same as reducing energy demand.* All this being said, we do appreciate that the current definitions and approaches to energy efficiency are themselves outcomes of social processes and transformations that began centuries ago, and thus we recognise the inevitable constraints and sometimes need for pragmatism when advocating for alternative (e.g. broader, interrelated, critical) funding priorities.

Our emphasis on these alternative framings of energy efficiency is rooted in an understanding of social and technical matters as deeply connected. In other words, policies and interventions promoting technical energy efficiency are affected by social processes (such as shifting cultural norms; routines in everyday life; or dynamics of organisational behaviour) throughout their development, promotion, implementation, use, monitoring and so on. At the same time, the actions of individuals, communities and organisations are themselves shaped by the (more or less efficient) technologies, devices and infrastructures that are embedded throughout societies.

We also hope that our 100 priority questions collectively demonstrate various under-appreciated facets of SSH that can assist in investigating and governing energy efficiency and related issues. First, SSH have the capacity to analyse the complexities of sociotechnical systems; for instance matters of power, differentiation, participation and trajectories of social change. Second, the Humanities in particular have much to offer in understanding and addressing the cultural, ethical, historical and legal aspects of these complexities, despite being consistently overshadowed by Social Science disciplines. This all links to, third, the richness provided through diversity, and through acknowledging that there is no single answer or, (more pertinently here) no single question, that encompasses or represents the contribution of all SSH communities. Fourth, SSH do not only have narrowly instrumental applications (such as improving consumer uptake of an innovation), but can offer valuable insights into the formulation of problems and the scoping of solutions. However, this will require engagement with - and opening up of policy-focused funding calls to – a wider range of SSH communities.

1.5. Navigating our 100 questions

This report provides 100 priority questions, which are grouped into seven themes. It is significant to note that these themes were generated inductively after the majority of questions were selected, and not imposed top-down from the start by either the EC or the Working Group. The themes are not ordered by importance, instead being alphabetically presented. Similarly, the order of the questions within the themes does not indicate importance; we have aimed to present closely-related questions adjacently where possible. It will also be apparent to readers that different question types exist; for example, the list includes descriptive, explanatory, evaluative and normative questions; this diversity is deliberate. Not least, we were happy to include many questions that were project-driven and tightly-targeted in their scope (alongside wider questions), given how the EC, and indeed other funders, typically construct funding calls.

It is important to note when reading these questions that our intention is to not be comprehensive. Instead, these questions aim to assist with the process of prioritisation, to ensure that SSH research can best support and pragmatically align with policy ambitions.

We acknowledge that the field is ever-evolving and that it is not possible to produce one perfect set of research priorities that all SSH communities (or indeed all Working Group members) can agree upon. These questions do not represent an end point, but rather the stimulus for multiple points of discussion with the EC and other stakeholders, and amongst energy-SSH communities.

Finally, in posing these questions, we are not advocating for particular ways to answer them. The diversity of SSH means that answers can be constructed in many different ways, whether theoretically or methodologically. We hope that a wide range of knowledge and skills from across all the SSH communities will be called upon in addressing these priority questions for energy efficiency research.

2. Presenting 100 priority questions for Social Sciences and Humanities (SSH) research on energy efficiency

2.1. Theme 1: Citizenship, engagement and knowledge exchange in relation to energy efficiency

Keywords participation; inclusion; community engagement; learning; best practice.

This theme focuses on ideas around engagement, participation and the sharing of knowledge in relation to energy efficiency. The aim of this theme is to investigate practical issues of designing and implementing interventions for engagement and participation, but also to explore deeper issues of what constitutes meaningful engagement, and how engagement initiatives (including forms of social innovation) might go beyond a focus on individual behaviour change. While citizens and communities are central here, this theme also encompasses engagement and knowledge exchange in relation to other social actors. As well as constituting important questions for SSH studies of energy efficiency, these questions can also strengthen technological research, by identifying and addressing important issues around how different actors could and should be engaged with technical innovations and transitions, going beyond narrowly instrumental approaches to user uptake or acceptance.

1 How can the development and implementation of energy efficiency measures be democratised; in particular, how can policy choices around energy efficiency technologies be discussed and enacted through inclusive citizen participation?

2 What is the role of ground-level associations (e.g. community companies, trusts, charities, and other kinds of non-governmental organisations) in shaping and achieving energy efficiency goals; and how can localised approaches support citizens' active participation in energy systems?

3 To what extent are local energy initiatives currently active in the field of energy efficiency and sufficiency; what business models and practices are they employing; and how can these existing local initiatives be scaled up?

4 What social and procedural components need to be considered in establishing community-based energy efficiency projects; and how can these considerations be most effectively incorporated into project design and implementation?

5 How can 'real laboratories' – such as urban experiments that co-design, carry out, observe and evaluate complex social change processes – contribute to energy transitions?

6 What are the challenges to mobilising collective action around energy efficiency and sufficiency (e.g. convincing private apartment owners to undertake collective refurbishments); and what learnings on addressing these can be drawn from exemplars?

7 What forms of resistance emerge in response to energy efficiency measures; and what is the impact of negative narratives (e.g. conspiracy theories) around these measures?

8 Which organisations and individuals play important roles in the diffusion of energy efficiency measures to homes and businesses; and how do these diffusion processes operate (e.g. through developments in leadership, social norms and skills)?

9 What constitutes meaningful and long-lasting citizen engagement in energy efficiency policy; how can it be enabled and replicated; and who should or could participate in co-creating energy efficiency policies and actions?

10 What purposes are pursued by citizen engagement for energy efficiency (e.g. improving democracy, fostering a low carbon transition); what synergies and conflicts exist between these purposes; and to what extent does citizen engagement achieve these goals?

11 Who is being constructed as the target of energy efficiency policy (e.g. citizens, consumers, businesses); and how does this construction vary among governance actors?

12 What different kinds of social learning and participatory engagement, amongst which social actors, are needed in order to address energy efficiency/sufficiency challenges and scale up innovative energy efficiency solutions?

13 How can policies and public programmes aiming to increase energy efficiency, via citizen engagement, go beyond individualistic models of behaviour; and how can a social practice framing result in different types of programmes?

14 What are the relationships, if any, between well-being and citizen participation on energy efficiency/sufficiency issues; how do the different ways of engaging people affect wellbeing; and what different participatory methods can be experimented with?

2.2. Theme 2: Energy efficiency in relation to equity, justice, poverty and vulnerability

Keywords inequality; just futures; distribution; social justice; poverty alleviation.

This theme centres on the relationships between energy efficiency and various forms of equity, justice, poverty and vulnerability. The core agenda of this theme is to investigate how energy efficiency policies and interventions intersect with these issues, and how their positive effects can be optimised and negative effects minimised. In other words: how can energy transitions be managed in order to promote equity and justice, and ensure that the most vulnerable groups in society do not lose out? It is important to note that all of the questions below should be understood as relating to people's multiple and intersecting characteristics and vulnerabilities. The Working Group especially highlights gender as a cross-cutting issue for this theme. Other important characteristics to consider include, but are not limited to: age, income, ethnicity, disability, family structure and religion. While issues of power and justice are central concerns for the Social Sciences, and for Humanities disciplines such as Philosophy, History and Law, these questions will also support technical research programmes in ensuring their work recognises and addresses, rather than retrenches, existing patterns of inequality, poverty and vulnerability.

15 What are the major barriers and enablers of installing energy efficiency measures among different socio-demographic and socio-economic groups; and what are the implications for designing policies that ensure energy efficiency is accessible to all?

16 To what extent can intersectional insights – regarding a person's social identities (e.g. gender, race, class, sexuality, religion, disability, etc.) – inform the design of energy efficiency solutions, and assist in devising strategies that address their unintended consequences?

17 What are the links between energy efficiency and energy justice at regional, national and global scales; and how can distributional impacts of energy efficiency policies be meaningfully evaluated and fairly managed across societies?

18 To what extent do existing energy efficiency policies, tools and initiatives employ a social justice approach; what would be the implications of embedding a social justice approach throughout policymaking on energy efficiency; and how can this best be achieved?

19 How does a fair distribution of energy efficiency costs and benefits feature in societies' idea of acceptability; including, what exactly does 'fair' mean to different stakeholders?

20 What role can be played by niche or innovative technologies, and by niche innovation management, as mechanisms to secure wider distribution of power, democratic engagement and more just transition management?

21 How do energy efficiency improvements affect inequalities (including across e.g. socio-economic groups and genders); and how can policies be designed to achieve both energy efficiency and equity goals?

22 How can energy efficiency be increased without increasing energy inequality; in particular, how can the allocation of EU funds take account of the different forms of energy services deprivation that exist across, and within, European countries?

23 What roles do material culture and interactions with technologies play in shaping the distributional inequalities experienced through different energy efficiency initiatives?

24 How do energy efficiency policies affect vulnerable groups with higher energy consumption needs (e.g. elderly, disabled); and how can policies ensure that such 'energy vulnerable' citizens benefit from energy efficiency solutions?

25 What kinds of institutional innovations are needed to ensure that energy efficiency policies serve to redress, not exacerbate, energy vulnerabilities; and what lessons can be learned from existing good practice in this area?

26 How significant is energy efficiency in alleviating existing energy poverty across different countries; and how can affordable energy efficiency programmes be supported, as part of delivering fairer energy futures?

27 To what extent do (i) current levels of poverty, including energy poverty, (ii) structure and quality of jobs, and (iii) inequalities within different countries, impact on the capacity for and actual delivery of energy efficiency improvements; and how do these vary across different countries?

28 How can energy efficiency be effectively embedded in future policies targeting energy poverty, and poverty alleviation more generally; and how can such policies be informed by more holistic, interdisciplinary and cross-sectoral approaches?

29 What are the short-, medium- and long-term effects of domestic energy efficiency improvements on the mental and physical health of people living in energy poverty?

30 How might 'efficiency' as a conceptual approach exacerbate vulnerabilities; and how can a sufficiency approach support just energy transitions?

2.3. Theme 3: Energy efficiency in relation to everyday life and practices of energy consumption and production

Keywords experience; systems of provision; infrastructures; norms.

This theme centres on the relationships between energy efficiency, energy demand and people's everyday lives, including practices of consumption and production, and the wider systems of provision in which these are embedded. The aim of this theme is to explore how energy efficiency policies and interventions intersect with ordinary practices and lived experiences, including how these are differentiated, for example, by gender. At the same time, this theme recognises that practices are inherently social, and so opens up issues around the wider cultural and material contexts within which energy efficiency interventions are situated; for example, social norms around thermal comfort. These are important questions for any research (within SSH or within STEM-centred projects) that aims to support the adoption, and long-term maintenance, of energy-efficient or energy-sufficient ways of life.

31 How do energy efficiency policies (e.g. energy pricing policies) affect everyday life for different groups, especially vulnerable groups and different gender identities?

32 How do different households and social groups understand energy efficiency and energy sufficiency in relation to their everyday lives and practices?

33 What are the emerging (disruptive) energy efficiency technologies that might significantly transform the ways people live and work?

34 What are the relationships between widespread uptake of energy efficiency improvements and changes in social practices of production and consumption?

35 How do new sociotechnical configurations of energy generation, and evolving systems of provision, relate to energy efficiency programmes; for example, what, if any, are the consequences of community-based energy schemes?

36 How do new technological energy efficiency measures interact with practices and infrastructures in consumers' everyday lives; and how are citizen values, relationships, and institutions reshaped by these technological changes?

37 What unanticipated challenges and poor outcomes arise from a lack of 'fit' between new initiatives or technologies with everyday lives and practices; and how can these be addressed?

38 What are the roles of personal, cultural and site-specific factors in the success or failure of energy efficiency initiatives?

39 How can participatory design and co-creation approaches contribute to the development of energy efficiency solutions that work with, rather than against, practices in everyday settings?

40 What are the user profiles (time-use and electricity use) of energy 'efficient' appliances in real life; what rebound effects or unintended consequences are associated with these; and how can evidence on these inform better governance?

41 How is thermal comfort perception related to physiological, psychological and social influences; and how could understanding of these relationships help to improve energy efficiency and reduce energy consumption in everyday life?

42 What insights do the Humanities provide about how to create 'cultures of energy efficiency' that go beyond the usual dominant focus on consumer choices and ethical concerns?

43 What are the conditions that facilitate the acceptance and pursuit of energy sufficiency (e.g. living in smaller spaces, avoiding mobility, reducing consumption) over energy efficiency; and how can these conditions be scaled-up across society?

44 How are energy efficiency and sufficiency affected by changes to everyday life through ongoing processes of digitalisation (including e.g. smart technologies, artificial intelligence and big data); and how do digital tools designed to improve energy efficiency and sufficiency interact with everyday practices?

2.4. Theme 4: Framing, defining and measuring energy efficiency

Keywords definition; measurement; quantification; assessment; framing; alternative perspectives.

This theme centres on fundamental issues of how energy efficiency is defined, understood and measured. The aim of this theme is to recognise that energy efficiency can be defined and measured in many different ways, and to investigate how and why these framings vary between actors and over time. Crucially, it also aims to explore the implications of these different framings for policies and their outcomes, and to highlight critiques and alternative framings, including those based on systemic approaches and those emphasising energy sufficiency, which draw attention to the important difference between 'improving energy efficiency' and actually reducing energy demand. The questions in this theme will suggest valuable insights to any project (SSH or STEM-based) that involves measuring and monitoring energy efficiency, or that engages with stakeholders who play a role in governing energy efficiency.

45 How are benefits and costs of EU, national and regional energy efficiency policies measured; and how can environmental and social outcomes, and unintended consequences, be more effectively included in these assessments (e.g. impact assessments for Directives)?

46 How is the making of energy efficiency policies influenced by forecasts, models, imaginaries and visions of energy supply and energy demand?

47 How have understandings of energy efficiency changed over time across different countries; and how have these visions affected technological pathways and lock-ins?

48 How are energy efficiency concepts used and implemented by policy(makers); and how can Social Sciences and Humanities insights improve this usage?

49 How do political and institutional contexts shape the ways in which energy efficiency is defined and measured; and how do these contexts determine who has authority in these processes of classification and quantification?

50 How do framings of energy efficiency vary between different social actors, including policymakers, industry, system operators, intermediaries, and energy service users; and how do these affect motivations for pursuing energy efficiency investments?

51 What values, assumptions and ethical choices are involved in the definition and measurement of energy efficiency; and what insights can the Humanities bring to understanding of these issues?

52 What responsibility do policymakers and energy efficiency 'experts' have to make indicators, sub-indicators and benchmarks (and related processes of creating these) transparent; and how could they be more transparent?

53 What are the taboos of energy efficiency (policy); and what energy efficiency issues remain unspoken due to inconvenience for those who benefit from the status quo (e.g. wealthiest, incumbents, particular disciplines, trade unions, other vested interests)?

54 How have neoliberalism's tenets contributed to an emphasis on behavioural psychological and microeconomic framings of energy efficiency; and how might sociotechnical, cultural, structural and macro-economic perspectives inform more fundamental challenges to current levels of energy demand?

55 To what extent might the pursuit of energy efficiency serve to reproduce unsustainable patterns of practice; and how can 'energy efficiency' narratives be redefined to encompass more systemic transformations?

56 How may 'energy efficiency' need to be redefined to adequately account for system- and sector-scale energy efficiency, rather than device-scale energy efficiency; and what are the implications of this redefinition for the forms of transformative change being pursued?

57 How can insights from social practice theories provide alternative understandings of energy efficiency; and how could re-organisation of energy-using practices contribute to greater energy efficiency and sufficiency at a societal scale?

58 How does the concept of energy sufficiency help to (radically) enrich and/or challenge current energy efficiency policies and understandings; and how can sufficient energy services and basic energy needs be defined?

59 In what ways has the term 'user' been implicitly and explicitly conceptualised across the Social Sciences and Humanities literatures on energy efficiency; and what are the implications of utilising broader perspectives on alternative modes of 'use'?

2.5. Theme 5: Governance, policy and political issues around energy efficiency

Keywords policies; politics; power; institutions; interventions.

This theme centres on how energy efficiency is governed by various actors and institutions across multiple scales; how policies are designed and implemented; and the politics of energy efficiency. A core aim of this theme is to investigate how energy efficiency is currently addressed through policies, and in particular to highlight challenges, opportunities and learnings for policy improvement as well as the main obstacles that these policies face. At the same time, a further aim of this theme is to critically examine the power dynamics at play, and to explore policy and governance issues around the emerging concept of energy sufficiency. The Working Group notes that while many of these questions are deliberately formulating to be wide-ranging, there are also more specific questions tacitly embedded within them, regarding the causal mechanisms and influences through which these governance and policy processes operate and take effect. While this theme concerns core issues within political, administrative and organisational studies, these questions will also be of value to any technical research that aims to achieve policy impact, or that requires an understanding of how governance contexts shape the emergence and development of technical innovations and transitions.

60 What role can policy instruments play in advancing energy efficiency and sufficiency in different fields, such as 'deep renovation' of buildings, product policy, or digital infrastructures; and how do existing policy instruments perform on efficiency and actual energy savings?

61 What can be learned through a cross-national comparison of energy efficiency policies; how does best practice in energy efficiency policy diffuse between countries, regions and cities; and how can the underlying learning processes be facilitated?

62 What can be learned from a 'policy mix' analytical perspective on energy efficiency; specifically regarding policies' coherence, consistency, development over time, and overall effectiveness; and how should policy mixes be designed to be most effective?

63 How (and to what extent) do the EU, national governments, and their associated regions and municipalities, coordinate policy decisions on energy efficiency; and how do they attempt to align these with spatial planning, environmental, social, and/or economic policies?

64 How has the mind-set and work of EU and Member States' civil servants evolved, in response to the EU's Energy Efficiency First principle that requires them to include energy efficiency gains in mainstream policy planning; and what is their influence on energy efficiency policy?

65 What kinds of governance are needed (and at what spatial and temporal scales) to support a move from energy efficiency projects as largely ad-hoc and piecemeal activities, into strategic and systemic programmes that transform the built environment and ensure an integrated focus on energy, water, waste and resource use in the long-term?

66 What is the role and responsibility of the state in managing the shift toward energy efficiency; and what patterns and types of energy transition are developed under different governance regimes (e.g. market-led, state-led, or civil society-led)?

67 What are the under-explored 'leverage points' for policymakers to intervene in social and built environment systems to promote energy efficiency; in particular, which intermediary actors could be more effectively engaged (e.g. tradespeople and community leaders)?

68 What is the role of intermediary organisations in creating an 'entrepreneurial ecosystem'; and what kinds of organisational ecosystem governance can help scale up energy efficiency innovations?

69 Which geo-political factors play important roles in facilitating international cooperation for enhancing energy efficiency policies?

70 How can political will for driving energy efficiency be measured and stimulated?

71 How do power relations and vested interests affect (and potentially obstruct) policymaking on energy efficiency; and how can existing patterns of dominance in this sector be challenged?

72 To what extent, if at all, may energy efficiency policies be used by incumbent actors to reinforce the marginalisation of niche sociotechnical innovations?

73 How can the concept of sufficiency be effectively integrated into energy efficiency government policies, energy scenarios and anticipatory governance approaches; and how can energy sufficiency be 'mainstreamed' into other policies?

74 How does the political feasibility of energy efficiency policies compare to that of energy sufficiency policies; and to what extent are different countries adopting policies within each of these two paradigms?

2.6. Theme 6: Roles of economic systems, supply chains and financial mechanisms in improving energy efficiency

Keywords finance; markets; innovation; investment.

This theme centres on the roles of various kinds of economic systems, financial mechanisms, markets and supply chains in relation to improving energy efficiency and energy sufficiency. The aim of this theme is to investigate how interventions in these areas could contribute to energy efficiency and sufficiency goals, and in particular to raise a range of important questions that have not yet been adequately addressed through the already extensive work on energy efficiency within Economics, Marketing, Business Studies and related disciplines. This includes a focus on specific sub-sectors, global regions, innovations and topical challenges that are not currently well-understood, as well as on issues of consumption, production and their intersections. As such, these questions will provide important insights to any research relating to the economics of energy efficiency, and the roles of business and industry. This theme also highlights questions relating to how energy sufficiency can be promoted through socio-economic innovations and transitions.

75 How do energy efficiency measures interact with other policy frameworks and financial mechanisms affecting the business and industrial sectors, such as fiscal and monetary policies and carbon pricing?

76 What impacts do energy audits of companies (such as those required by the EU's 2012 Energy Efficiency Directive) have on the actual implementation of energy efficiency measures by those companies; and how can the design of auditing processes be made more effective?

77 In what ways do financial priorities in business and industry conflict with or complement energy efficiency goals; and to what extent are businesses implementing the 'Energy Efficiency First' principle, which stipulates that energy efficiency investments must be prioritised when it is cost-effective to do so?

78 Given that a large proportion of intentions to invest in energy efficiency measures (in existing buildings) are never carried out or are substantially delayed, how can Social Sciences and Humanities improve understandings of this implementation gap?

79 How can energy efficiency policy benefit from an analysis of the transnational markets and global supply chains that underpin different energy efficiency technologies, going beyond national-level assessments?

80 Given that Global South households often rely on second-hand donated electrical goods from Europe, what are the implications for importing energy (in)efficiency and how can these be addressed?

81 How can innovation in energy efficiency be encouraged in the Global South, so that inefficient consumption 'lock-ins' can be avoided?

82 How can stimulus packages after rare-destructive events (e.g. COVID-19 outbreak) be designed to include energy efficiency; to what extent is it viable to promote energy efficiency investments as an anti-crisis measure; and what would be the macro-effects of such an approach?

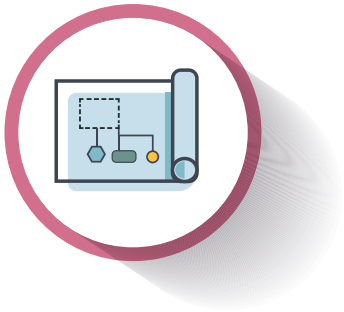
83 In what ways (if any) do post-COVID-19 recovery plans account for energy efficiency; how does energy efficiency complement and/or clash with economic recovery; and how will economic recovery affect the ability to achieve the goal of improving energy efficiency in different countries?

84 What new models and mechanisms for sharing, trading and accounting for energy resources are emerging; and what might these socio-economic innovations mean for energy efficiency and energy sufficiency?

85 How can policy support development of an adequately skilled workforce to implement the innovations needed to fulfil the EU's energy efficiency targets; in particular, digital innovations in the building and construction sector?

86 How could alternative economic systems (e.g. slow, local, time-rich, high-satisfaction economies) contribute to energy efficiency and energy sufficiency?

2.7. Theme 7: The interactions, unintended consequences and rebound effects of energy efficiency interventions



Keywords multiple benefits; consistency; integration; cross-sectoral; systemic.

This theme encompasses a diverse set of interactions between energy efficiency and other policy areas, and the related issue of rebound effects and unintended consequences. This theme explores how energy efficiency is embedded in a network of related agendas, and how energy efficiency (and sufficiency) interventions have complex ramifications, which may be socio-cultural, technical and/or economic. By exploring these linkages, which are rarely recognised by researchers or policymakers, this theme aims to improve the evidence that informs energy efficiency policy, thus helping to avoid unintended consequences and optimise potential win-win scenarios or double-dividends. These questions thus have direct value to any research that aims to fully understand and effectively manage both the direct and indirect outcomes of energy efficiency policies and interventions, including work grounded in Science, Engineering, Technology and Mathematics (STEM) disciplines.

87 How can transdisciplinary approaches provide more nuanced understandings of 'rebound effects' of energy efficiency interventions (including effects on social practices, and on cultural and organisational dynamics); and how can such approaches inform more effective new policies and measures?

88 How can various 'rebound effects' or unintended consequences resulting from increasing energy efficiency be minimised through technological design, new policies, alignment with particular contextual conditions, or even the formulation of alternative approaches to reducing energy demand?

89 How does energy efficiency interact with other policy areas, such as urban planning, trade, gender, finance, labour policies, etc.; and in what ways can the promotion of other policy agendas conflict with energy efficiency goals?

90 How does transformation in various sociotechnical systems (e.g. housing, transport, agriculture, education, finance, etc.) affect change in the energy system; and what are the implications for the alternative framings of energy efficiency?

91 What is the degree of consistency between energy efficiency policies, energy market policies, environmental policies, welfare policies, economic and financial policies, across different countries; and how should this consistency be defined and measured?

92 How can energy efficiency policymaking and other environmental policymaking (regarding e.g. climate adaptation, circular economy) be linked to create synergies for climate protection; and how can such approaches be mainstreamed?

93 How do new energy services and accompanying ICT platforms contribute to energy efficiency at societal scales; and what are the implications for inequalities; and how can policy address these?

94 How can Social Sciences and Humanities contribute to better qualifying and quantifying of the non-energy related benefits of energy efficiency; and how can this be translated into better Monitoring and Evaluation tools for policymakers?

95 How can energy efficiency objectives be aligned with public health objectives; for example, how can new packaging designs respect both public health and safety and energy efficiency aims?

96 What are the relationships between energy efficiency and healthy and productive indoor environments; and how can human-building interactions be improved to optimise all these outcomes?

97 What are the relationships between energy efficiency, energy demand and human well-being; and what roles could energy efficiency and energy sufficiency play in policy interventions to tackle inequalities in well-being?

98 What are the savings potentials of energy sufficiency initiatives across different (interconnected) sectors; and what are the suitable tools and possible business models to tap these potentials?

99 How do different forms of maintenance - for example, processes for monitoring, repairing and upgrading infrastructures - shape energy efficiency outcomes over long time-scales?

100 How do different actors perceive and understand the interactions between energy efficiency and other policy agendas?

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5. Appendices

5.1. Appendix 1 – Socio-demographic breakdown of Energy Efficiency Working Group members

Socio-demographic criteria	Count	%
Working Group members participating in the full Horizon Scanning exercise[3]	27	100.00
Held a researcher identity	27	100.00
Based in organisations/countries eligible for Horizon 2020 funding	27	100.00
Had research interests directly relating to Working Group topic area	27	100.00
Different countries represented	21	N/A
Number of members in Northern Europe[4]	9	33.33
Number of members in Eastern Europe[4]	3	11.11
Number of members in Southern Europe[4]	7	25.93
Number of members in Western Europe[4]	8	29.63
Male	13	48.15
Female	14	51.85
Different SSH disciplines represented	29	N/A
With prior STEM backgrounds	7	25.93
Frontrunners[5]	9	33.33
Field leaders[6]	18	66.67

3 The Energy Efficiency Working Group began with 31 members, with four dropping out for different reasons throughout the Horizon Scanning exercise. Three of the four dropouts were from Eastern Europe, hence the slightly uneven geographic spread. Our original Working Group member recruitment very much prioritised geographical balance. These totals of 31 and 27 do not include the Steering Committee (of four), who oversaw the whole Horizon Scanning exercise.

4 European regions were classified using the UN's Geographic Regions classifications for Europe's regions (https://unstats.un.org/unsd/methodology/m49/). For those Horizon 2020 Associate Countries, which fell outside of UN European regional classifications, they were classified/counted in accordance with their nearest neighbouring European country.

5 Full guiding definition available in methodological guidelines (Foulds et al., 2019a, p.18). Focus on researchers working at the boundaries of conventional academic structures and conventions, perhaps through their research's interdisciplinarity, practical applications, exploratory nature, etc.

6 Full guiding definition available in methodological guidelines (Foulds et al., 2019a, p.18). Focus on representatives of key SSH projects/communities, as well as on theoretical expertise, rather than practical application.

5.2. Appendix 2 – Socio-demographic breakdown of respondents to Energy Efficiency Horizon Scanning survey

Socio-demographic criteria	Count	%
Survey respondents	152	100.00
Male	94	61.84
Female	56	36.84
Other	0	0.00
Rather not say	2	1.32
SSH (sub-)disciplines represented[7]	62	N/A
1st most represented (sub-)discipline – Economics	35	23.03
2nd most represented (sub-)discipline – Sociology	33	21.71
Joint 3rd most represented (sub-)discipline – Science & Technology Studies; Political Science	20 each	13.16
5th most represented (sub-)discipline – Human Geography	17	11.18
6th most represented (sub-)discipline – Policy Studies	7	4.61
Different countries represented[8]	23	N/A
1st most represented country – UK	32	21.05
2nd most represented country – Turkey	15	9.87
3rd most represented country – Bulgaria	11	7.24
4th most represented country – Germany	10	6.58
Joint 5th most represented country – Belgium; Italy; Norway	8 each	5.26
Different nationalities represented[8]	26	N/A
1st most represented country – British	25	16.45
2nd most represented country – German	16	10.53
3rd most represented country – Turkish	15	9.87
4th most represented country – Bulgarian	11	7.24
5th most represented country – Italian	10	6.58
Completed PhD	118	77.63
Not completed PhD	34	22.37
Of those without a PhD: Not currently participating in a PhD programme	21	13.82
Of those without a PhD: Currently participating in a PhD programme	13	8.55
0-5 years since graduating PhD	20	13.16
6-10 years since graduating PhD	28	18.42
11-15 years since graduating PhD	24	15.79
16-20 years since graduating PhD	16	10.53
21-25 years since graduating PhD	14	9.21
26-30 years since graduating PhD	5	3.29
31-35 years since graduating PhD	5	3.29
36-40 years since graduating PhD	4	2.63
41+ years since graduating PhD	2	1.32

7 Self-assigned in open textbox question.
8 Representation indicated by at least one Horizon Scanning respondent completing the survey. Country representation was specifically based on the location of their organisation.

5.3. Appendix 3 – Processing of submitted questions via Horizon Scanning survey, prior to Energy Efficiency Working Group member evaluations

Processing step	Count	%
Number of questions submitted via first Horizon Scanning survey	513	100.00
Number of submitted questions immediately deleted due to: lack of SSH grounding, lack of relevance to energy efficiency, or not containing question content.	101	19.69
Number of additional questions generated through disaggregating multiple questions from one single submitted question, or through sourcing further questions from accompanying explanatory texts that were provided by the respondents	35	6.82
Number of questions removed due to merging, i.e. where a same question had been posed multiple times in overly similar ways.	64	12.48
Final number of questions sent to Working Group members for evaluation in the second Horizon Scanning survey.	383	74.66

5.4. Appendix 4 – Aggregated quantitative findings from Working Group member evaluations of the 383 edited questions

Working Group members evaluated a list of 383 edited SSH questions, via a second Horizon Scanning survey, scoring them on a scale of 1 ('definite exclude') to 5 ('definitively include') and providing other qualitative feedback.

Theme[9]	No. of questions in evaluation survey	Mean score	Variances of means	% of questions with median ≥4	% scores of 5, across all Qs in theme	% of questions scored 4	% of questions scored 3	% of questions scored 2	% of questions scored 1
Beyond energy efficiency	25	3.57	1.41	64.00	28.13	27.74	22.71	15.87	5.55
Energy efficiency industry and related sectors	12	3.59	1.16	16.67	20.70	38.98	23.12	13.17	4.03
Energy efficiency research and methods	25	3.37	1.01	52.00	13.81	33.03	34.32	14.19	4.65
Energy justice, poverty and equity – equity and justice	13	3.78	1.16	92.31	29.78	33.99	25.31	6.45	4.47
Energy justice, poverty and equity – poverty	12	3.57	1.26	58.33	24.73	29.03	29.04	12.90	4.30
Energy justice, poverty and equity – vulnerabilities	11	3.71	1.09	81.82	25.81	34.01	29.04	7.62	3.52
Energy sufficiency	11	3.94	1.00	90.91	35.19	34.90	21.41	5.27	3.23
Engagement, participation and citizenship	28	3.51	1.10	57.14	20.05	32.60	30.41	12.22	4.72
Everyday life and user practices	23	3.43	1.10	52.17	17.95	31.42	30.15	16.27	4.21
Governance and policy	34	3.44	1.00	50.00	15.65	33.97	31.59	16.23	2.56
Information, knowledge, skills	12	3.23	0.90	16.67	9.14	29.84	39.78	17.21	4.03
Intersections of energy efficiency with health and well-being	14	3.67	1.27	85.71	27.88	30.65	26.72	10.37	4.38
Intersections of energy efficiency with other (policy) priorities	26	3.32	1.00	30.77	12.66	31.14	35.23	17.37	3.60
Knowledge exchange and learning	9	3.34	0.96	55.56	10.75	35.49	34.41	15.41	3.94
Markets, incentives and financial mechanisms	40	3.09	1.08	15.00	7.90	28.39	36.29	19.36	8.06
Miscellaneous	2	2.87	1.30	0.00	8.06	20.97	33.87	24.20	12.90
Perceptions, discourses, meanings	28	3.43	1.28	53.57	20.05	31.79	25.00	17.05	6.11
Power and politics	22	3.47	1.04	54.55	16.72	34.16	32.55	12.17	4.40
Rebound effect	11	3.47	1.27	54.55	21.99	29.33	26.98	16.71	4.99
Societal and systemic level energy efficiency	25	3.45	1.11	52.00	18.71	31.23	30.71	14.7	4.65

9 The 383 questions were organised and presented for evaluation in 17 inductively-generated themes, with one of those themes ('Energy justice, poverty and equity') split into three sub-themes. These themes were intended only to aid the evaluation exercise and were not intended to directly feed into to our final themes, which were also inductively-generated, albeit on the basis of a different (more final) question set.

5.5. Appendix 5 – Systematic procedure used to create and deliberate on the longlist of questions for the Energy Efficiency Working Group

1. All those with a median of 5 were automatically selected for inclusion.
    - One question from the energy sufficiency theme (Appendix 4) automatically included.
2. All those with medians of 1-3 were automatically excluded.
    - 183 questions excluded.
3. From those remaining, the top 49 Qs were selected based on the highest scores.
    - The 199 questions with a median of 4 were ranked according to the highest total scores (i.e. mean) that they received across all Working Group members. The top 45 questions could be easily selected (total scores ranging from 136 to 119), but those questions with evaluation scores totalling 118 straddled the inclusion/exclusion boundary.
4. For questions with a median of 4 that straddled the in/out boundary, the remaining spots were selected using the percentage of 5-scores.
    - From the 12 (median of 4) questions that scored a total of 118, the remaining four spots were selected because they were ranked more highly in terms of the percentage of 5-scores ('definitely include' scores). Specifically, the selected four had a range of 35.48-29.03% of 5-scores, compared to a range of 25.81-19.35% for the other eight questions.
5. Outputs ready for deliberations.
    - A list of 50 questions were locked in as a starting point for final, deeper discussions amongst the Working Group members (e.g. editing), with 150 questions presented as a longlist for Working Group consideration (e.g. which ideas can be merged with the existing 50 questions; which questions should be prioritised; which gaps still remain). Two virtual deliberation workshops were then hosted, with debate initially stimulated by each Working Group member advocating for their preferred three questions from this longlist.

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