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

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Energy-SHIFTS

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FORUM
TARGETING THE
SET-PLAN

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Executive summary

This report presents 100 research questions that have been identified by scientific experts as key priorities for Social Science and Humanities (SSH) research on renewables, in order to inform and support EU-funded research and innovation leading to achieve climate-neutrality by 2050. The questions together aim:

To promote SSH research that contributes to better understanding the meaning and conditions of just transitions to renewables-based energy systems, by recognising the social conditions and consequences of using and further implementing renewable energy technologies.

These 100 priority questions are grouped into the following 11 themes. Note that the order of these themes does not indicate a ranking of themes and that overlaps may exist between the themes.

1. **Transformative governance**
Questions address the aspects of guiding and navigating the fundamental changes from the existing fossil-dominated energy regime to a renewables-based energy system.
2. **Culture, imaginaries, narratives**
Questions explore various cultural aspects of a transition towards a renewables-based energy system, such as the role of socio-technical imaginaries, learning and media discourses.
3. **Social acceptance**
Questions address the factors shaping social acceptance for different renewable energy technologies and emphasise aspects of trust-building and citizen empowerment.
4. **Energy democracy**
Questions consider aspects of democratising the energy system, relating to the potential of energy initiatives and structural conditions to foster transparency and participation.
5. **Energy justice**
Questions deal with justice, equity and societal inclusion in the context of energy systems, addressing the facets of a fair transition process to renewables-based energy systems.
6. **Financial and organisational structure**
Questions address the financial mechanisms, as well as the organisational conditions and dynamics, that influence the transition to a renewables-based energy system.
7. **Socio-ecological effects**
Questions critically touch upon the impacts of socio-technical change towards a renewables-based energy system on ecosystems, biodiversity and landscapes.
8. **Renewables policy**
Questions focus on public policy design, implementation and evaluation and look for evidence guiding multi-level policy-processes and decision-making on renewable energy.
9. **Renewables system design and integration across sectors**
Questions focus on specific features of renewables system design and the integration of socio-technical configurations, as well as policies, across sectors and implementation contexts.
10. **Geography of renewables**
Questions relate to the geographical differences of emerging energy transitions and address aspects related to localities of renewable energy systems in different contexts.
11. **Power dynamics & conflicts**
Questions reflect the role of power dynamics and conflicts within energy transitions towards renewables, and also consider power relations between different types of actors.

All 100 presented research questions were identified using a Horizon Scanning exercise, conducted between August 2019 – October 2020. We identified 30 SSH renewable energy experts from across Europe, encompassing diverse SSH disciplines, interdisciplinary experiences, genders, geographies, research interests and career stages, and involved them in a Working Group. The horizon scan surveys of this Group, and further affiliated experts (85 respondents in total), generated a list of 280 research questions. After an initial editing process, 279 revised questions were presented to the Working Group in a second survey, in order to be ranked according to their research priorities. The results of this second survey were discussed and reviewed during two virtual workshops among the Working Group members. This deliberative process led to creating a final list of 100 priority questions for SSH research on renewables, organised in 11 themes.

This list is not intended to be exhaustive or exclusive, instead it aims towards opening up new perspectives for further discussions between policymakers, funders and researchers on how SSH evidence on renewables can best support transitions towards climate-neutrality and towards more just and equal societies.



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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 clear. 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 renewable energy. 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 a transition to a renewables-based energy system 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 on renewables¹ could look like.

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 renewable energy in Cluster 5. Whilst we recognise that this cluster will have its own working structure, and that Member States interests will also need to actively help construct these 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

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¹ In defining 'renewables', our starting point is the definition provided in the Terms of Reference (Loorbach et al. 2019, p.5) as follows: "Renewable energy sources replenish themselves naturally without being depleted in the earth; they include bioenergy, hydropower, geothermal energy, solar energy, wind energy and ocean (tide and wave) energy". We also follow the definition for renewable energy provided by the International Renewable Energy Agency (IRENA) in 2013: "renewable energy includes all forms of energy produced from renewable sources in a sustainable manner, (...)" (SE4ALL 2013; p.194).



non-SSH specialists, who may have different expectations on what SSH can 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 between 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 exercise that sits behind our top 100 SSH questions.

This Horizon Scanning exercise began with a core team producing Terms of Reference (Loorbach et al. 2019), 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 brief²:

1. We systematically recruited a Working Group that prioritised diversity of e.g. SSH disciplines, interdisciplinary experiences, genders, geographies, research interests, career stages, and along other diversity criteria. 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

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

280 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 renewable energy, non-SSH focus, need for disaggregation, cross-question similarity, English language (see Appendix 3).
4. Working Group members evaluated the revised list of 279 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 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 frontrunners and leading experts (Working Group members). These 10 interviews were undertaken before the launch of the first Horizon Scanning survey, and were focused on past SSH developments and debates on renewable energy. They have provided steering context when reflecting on the past and future directions and contributions of SSH on transitioning to a renewables-based energy system.

1.4. Mission statement from Renewables Working Group members

The mission of the research priorities presented by this Renewable Energy Working Group’s priority 100 questions is:

To promote SSH research that contributes to better understanding the meaning and conditions of just transitions to renewables-based energy systems, by recognising the social conditions and consequences of using and further implementing renewable technologies.

The next stages of the transitions towards fully renewable energy systems are confronted with novel



challenges. We recognise that transforming the current energy systems requires further rebalancing the focus from mostly technical to societal dimensions. This should include: providing adequate responses to questions of energy justice and power dynamics; a shift from a techno-economic to socio-technical and socio-ecological perspectives on transitions to fully renewables-based systems; deep interventions for system integration and sector coupling; as well as novel policy mixes, cross-sector governance procedures and financial and organisational alternatives for renewables. This Horizon Scan further highlights the need to anticipate barriers for energy transitions, including the factors influencing the decline of existing fossil energy structures as an element of research on renewable energy diffusion.

We pay attention to the role of scholars as the agents of change - normative and engaged but also critical towards reality, and the role of SSH research on renewable energy that allows us to better understand the coupled system dynamics. Being conscious of social complexity, cultural diversity, historical trajectories, political traditions, geographical conditions and economic paradigms - we call for context-sensitive research on renewable energy to attain inclusivity and to guide just transitions. Being conscious of the richness and diversity of SSH research we call for plurality and freedom in knowledge production for a renewables-based, climate-neutral energy system in Europe.

This research agenda serves as a call for SSH research on renewable energy to open up and allow for explicitly normative stances embracing the thematic peripheries of the field, excluded groups and addressing hidden, unintended consequences of transitions to renewable energy systems. The proposed themes and research questions acknowledge diversity in energy transitions resulting in a diverging pace of change, different urgencies for intervention and plural transition pathways across different, interconnected localities and scales within Europe, which can be harnessed for cross-country knowledge development. Harnessing the unique strengths of SSH research will require support for inter- and transdisciplinary research to enable integrated thinking that examines renewable energy as deeply embedded in societal cultures, structures and practices, calling for the deliberative co-production of knowledge within broad networks of societal actors.

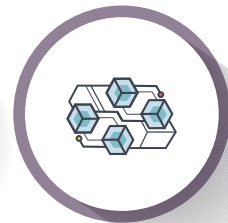
1.5. Navigating our 100 questions

The questions provided in this report are grouped into 11 themes. These were inductively generated after the majority of questions were submitted and revised by Working Group members and its Steering Committee. All themes and the distribution of questions across themes were discussed with the Working Group members to reveal boundaries, overlap and distinctiveness of themes and questions. The proposed themes do not suggest a sharp clustering nor are they ordered by importance. Instead, the themes are randomly presented. However, one theme (i.e. Transformative governance) was identified as cross-cutting and relevant to all other aspects of SSH research on transitioning towards renewable energy systems. The order of questions within the themes does not indicate either importance or priority.

The presented questions consist of different types: descriptive, explanatory, evaluative and normative questions; this reflects a deliberate plurality. Some of them are rather general, while others refer to particular issues of narrowly defined problems. The set of questions is not intended to be comprehensive. Instead, it aims 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 continuously evolving and that it is not possible to produce a single, all-encompassing set of research priorities that all SSH communities would agree upon. These questions present a stimulus for multiple points of discussion with the EC and other stakeholders, but most importantly serve to forge a 'practice-based research agenda', amongst energy-SSH communities recognising the EC's vision. Finally, in posing these questions, we are not advocating for particular ways to answer them. The diversity of SSH research means that answers can be constructed in diverse ways. We hope that a wide range of knowledge and skills from across all SSH communities will be called upon in addressing these priority questions for renewables' research.



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





2.1. Theme 1: Transformative governance



Questions within this theme address the aspects of guiding and navigating the fundamental changes from the existing fossil-dominated energy regime, to a renewables-based energy system. Transformative governance covers the emergence of renewable alternatives and innovative knowledge from different actors in the energy system, for example from alternative niche players such as energy cooperatives. This theme focuses on the procedural aspects of moving towards a just and climate-neutral system.

1 What are new economic principles, incentives and institutions needed to support a transformation towards a just energy system?

2 How can the imperative of speed and the imperatives of social justice and inclusion be reconciled in questions of renewable energy implementation?

3 What is the role of disruptive events as potential game changers in transitions to renewable energy sources?

4 What is the scope and potential of grassroots innovations (i.e. citizen-led radical systems-initiatives) for renewable energy to develop sustainable energy systems; and how can they be supported?

5 What are the effective measures of engaging citizens in generating, conserving and distributing energy differently?

6 What are the main challenges and opportunities for the formation and flourishing of renewable energy cooperatives and communities?

7 What are the lessons learnt from the most rapid renewable energy transitions?

8 How can we deploy the full potential of technological and digital social innovation processes to create distributed, user-friendly, customised, sustainable and equitable systems of energy production, distribution and use?

9 How is it possible to combine the promotion of renewables with a reduction in energy demand, instead of assuming its endless increase?

10 How can energy governance processes be developed that balance the need for expert knowledge and management of renewable energy (infrastructures) on the one hand, and increasing democratisation and the proximity of citizens to energy infrastructure on the other?

11 Which new forms of alternative governance structures become enabled by renewable energy production?



12 How do renewables influence and shape energy transition pathways (e.g. electrification vs. blue hydrogen vs. efficiency)?

14 What potential do new organisational forms of energy production, exchange and consumption have for spurring on alternative development trajectories in developing countries?

13 How can renewable energy transitions be facilitated with post-growth and degrowth policies and discourses?



2.2. Theme 2: Culture, imaginaries, narratives



Questions within this theme explore various cultural aspects of transitions towards a renewables-based energy system, such as the role of socio-technical imaginaries, learning and media discourses. The various aspects of socio-technical imaginaries are addressed according to their geographical differences, interconnections with the dominant energy regimes, and their impacts on transition dynamics. This theme also addresses how discourses are constructed, evolve, and how they affect people's identities and perceptions. The role of media and education in facilitating information exchange and potentially impacting transition processes is also highlighted.

15 What are the challenges that transitions to renewable energy poses to multi-, inter-, and trans-disciplinary university education?

16 How do the political statements of 'climate emergency' affect the unfolding of transitions to renewable energy systems?

17 What challenges and opportunities do left/right populist politics pose for renewable energy uptake in Europe?

18 What are foundations of normativity regarding renewables?

19 What is the role of diverse socio-technical imaginaries in triggering or hampering the implementation of sustainable energy technologies?

20 What is the influence of counter-narratives on the diffusion of renewables?

21 How are the different interpretations of the renewables socially constructed and promoted at the local-level?

22 What are the socio-technical imaginaries of renewables in different regions of the world; in particular, how may they vary across China, India, USA, European countries, and Africa countries?

23 How is renewable energy framed in society?

24 What are the socio-technical imaginaries of renewable futures in the countries dependent on energy dominated by fossil fuels?

25 What is the role of media (both traditional and social media) in facilitating discussion between different social groups around new renewable energy solutions?

26 What are the emerging identities associated with renewables?

27 What approaches to energy education can facilitate rapid uptake of renewables?

28 How can new renewable energy landscapes generate new discourses on the perception of territories by their inhabitants?



2.3. Theme 3: Social acceptance



Questions within this theme address the factors shaping social acceptance for different renewable energy technologies and emphasise aspects of trust-building and citizen empowerment. This theme focuses on the relations between public perception of renewables and influencing factors on perceptions. Some of the questions consider social acceptance as a crucial symbolic resource, while other questions frame social acceptance differently: as a disposition related to trust and local involvement. SSH research is promoted here in going beyond an instrumental understanding of social acceptance, as part of recognising its complex nature. Social acceptance is thus reframed as being fundamental for democracy, citizen empowerment, and responsible engagement.

29 Which factors influence the perception of renewables among citizens?

32 What are the demographics of renewable energy diffusion and adoption?

30 What determines the difference in public acceptance of different renewable energy sources and related infrastructures?

33 What drives the social acceptance and trust of renewable energy technologies; and how can local involvement in renewable energy be promoted, as part of ensuring a just transition?

31 What are the possibilities to transform public opinion and lifestyles, so as renewables would be given preference over other types of energy sources?

34 How can the social acceptance in cross-national cooperation for renewable energy in Europe be increased?



2.4. Theme 4: Energy democracy



Questions within this theme explore aspects of democratising the energy system, including the potential of energy initiatives and structural conditions to foster transparency and participation. This theme covers questions on citizen engagement with innovations processes, ownership structures and decision-making mechanisms concerning renewables.

35 What role have civil society/social movements played so far in the diffusion of renewables, and what potential do they have for the future?

39 What are the emerging models of citizen engagement with, and ownership of the energy transitions towards renewables?

36 What are the social challenges and opportunities of shifting to a decentralised, participative, renewable energy economy?

40 What implications does the phenomenon of 'energy citizenship' have for the transitions towards renewable energy?

37 How can transparency, awareness and democratisation of decision-making on renewables be improved through new ways of accountability and communication?

41 What tools and methods offered by SSH are useful for participatory governance of renewables?

38 How can citizens be appropriately positioned at the core of renewables-based energy systems, as envisaged in the Clean Energy package?

42 How can societies be engaged in effective and legitimate innovation processes concerning renewables?

43 How can renewable energy community initiatives be an effective measure for local energy transitions?



2.5. Theme 5: Energy justice



Questions within this theme deal with justice, equity and societal inclusion, in the context of energy systems, addressing the facets of fair transition processes to renewables-based energy systems. This includes aspects dealing with energy poverty, socio-economic inequality, energy access and implications of energy transitions on employment. This theme comprises both the critical analysis of justice issues, as well as more normative questions about how a 'just transition' can be attained.

44 What are the climate, environmental and social injustices associated with renewable energy?

49 How could a shift to renewable energy systems be combined with consumer protection and assurance of equal access to energy?

45 How will energy transitions to renewables influence energy poverty?

50 How can renewable energy installations support the rural development of the communities hosting them?

46 How is it possible to avoid or to reduce energy injustice?

51 What are the distributional implications of implementing policies for rapid transitions to renewable energy?

47 What types of policies should be implemented to ensure a good outcome and fair distribution of costs and benefits of renewable energy?

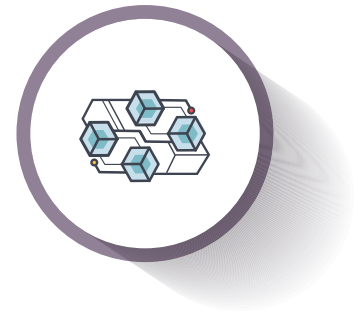
52 What are the key gaps in understanding the relation of gender equality with energy transitions (i.e. the shift to renewable energy)?

48 What are the possible public measures to ensure just transitions in the case of renewables?

53 What is the influence of renewables on jobs in the fossil energy sector?



2.6. Theme 6: Financial and organisational structures



Questions within this theme address the financial mechanisms supporting renewables, as well as the organisational conditions and dynamics. The questions span from distributed investment and novel organisational models (such as cooperatives or citizen investment), to more centralised, national and international finance models. These questions suggest a need to better understand the processes that give rise to both these models and their potential for supporting renewable energy transitions. It is also worth noting that the implications of these different models, in terms of social and environmental effects and justice considerations, is a potential area of overlap with other themes.

54 What drives the private sector actors (e.g. SMEs) to use renewables for self-consumption?

57 What is the role of new regulations, actors, and particular social milieus, in the emergence of new organisational forms of energy governance (e.g. cooperatives)?

55 Which governance innovations are required to mobilise the financial resources needed to support renewable energy transitions?

58 Which new collective investment approaches might enable renewable energy transitions on a large-scale across nation states; for example, what might the potential be of a global financial transaction tax or a global renewables investment trust?

56 What are the factors influencing people's willingness to invest in small-scale renewables?



2.7. Theme 7: Socio-ecological effects



Questions within this theme critically touch upon the impacts of socio-technical change towards a renewables-based energy system, on ecosystems, biodiversity and landscapes. This theme centres on the necessity of finding a consensus between different policies addressing the coupled social and environmental challenges of technology shifts to renewables. It thus relates to the fundamental concern of technological development and its impact on biodiversity and landscapes. Reflecting on some unintended consequences of undertaken actions, it considers how a solution implemented in one sector can influence other sectors.

59 How can renewable energy systems be developed without creating new resource conflicts?

63 What are the negative and positive impacts of renewables on landscape (with respect to human quality of life)?

60 How can renewable energy deployment be increased without creating negative impacts on biodiversity?

64 What are the impacts of increasing renewable energy generation on health?

61 Which policies address the trade-offs between renewables' implementation and biodiversity conservation?

65 How can social and ecological trade-offs be avoided and managed in supply chains and through citizen engagement for renewable energy transitions?

62 What are the mineral, metal, critical material, and supply chain demands for renewable energy expansion?



2.8. Theme 8: Renewables policies



Questions within this theme focus on public policy design, implementation and evaluation, and look for evidence to guide multi-level policy-processes and decision-making on renewable energy. Indeed, the aim of this theme is to provide insights for policymakers in their decisions regarding renewables. As such, the questions differ in terms of respective levels of policy-making, as well as in how they address trade-offs and procedural aspects of policy-making. While legislation is not explicitly mentioned in the questions, it remains an integral element to all.

66 Which policies on renewable energy need to be designed in order to reach the EU 2050 carbon-neutrality goal?

67 What governance mechanisms are required to ensure the adaptive and flexible policy(making) needed to guide transitions towards a renewable energy system?

68 What is the optimal policy combination of 'technology pull' (e.g. CO₂ prices) and 'technology push' (e.g. feed-in tariffs) strategies to bring societies towards a renewable energy system?

69 How can SSH insights be effectively integrated into the models that are typically used to inform international climate science assessments, and subsequently energy and climate policies?

70 How can EU Member States support industry creation and the deployment of secondary innovations in the field of renewable energy?

71 How can policies at different government levels (e.g. European, national, regional and local) reinforce each other, in increasing community acceptance of renewable energy projects?

72 By which criteria should we evaluate the effectiveness of policies, as well as policy mixes (e.g. renewable energy technology roadmaps), in bringing about transformational change across renewable energy sources?

73 What are the policy trade-offs, from a social perspective, in transitioning to a fully renewable energy system; and how can these be managed and/or mitigated?

74 What are policy approaches that are encompassing (policy mixes), adaptive (policy learning) and context sensitive (working for different places, levels and sectors) in order to support the expansion and successful integration of renewables in the next stage of the energy transitions?



2.9. Theme 9: Renewables system design and integration across sectors



Questions within this theme focus on specific features of renewables system design and the integration of socio-technical configurations, as well as policies, across implementation contexts. Indeed, this theme encompasses the ways in which renewables may be deployed and integrated within and across sectors (e.g. transport, agriculture). The core agenda of this theme is to investigate how renewable systems should be designed and implemented to ensure their lasting deployment.

75 What is the role of other sectors such as mobility, housing, digital, in furthering the diffusion of renewables?

82 What are the implications of coupling renewables with other sectors (e.g. through e-mobility or power-to-X) in organisational, institutional and political terms?

76 What are the positions of carbon-heavy industries (e.g. aviation, shipping, cement, chemicals) towards renewable energy?

83 What are the potentials and limitations of renewable energies for driving major transformations in other sectors, such as transport, heating, industrial processes, construction, agro-food?

77 How can scientific communities and technology developers deal with the risks and vulnerabilities related to renewable technologies?

84 How can renewable energy infrastructure become 'beautiful', so that its presence (aside from the production function) adds value to citizens' everyday lives?

78 How resilient is the decentralised renewable energy system?

85 How can renewable energy policies be reconciled with the impossibility to decouple growth from energy use?

79 What role can renewable energies play in decarbonising difficult-to-carbonise systems, such as shipping, air travel, cement, steel?

86 What are the main determinants of and obstacles to the use of renewable energy sources in agriculture?

80 How can transitions to renewable energy technologies be combined with shifting to a circular economy?

87 What is the role of different types of emerging and established intermediaries, which influence the production, distribution and storage of renewable energy; and how are these roles changing?

81 What are the consequences of coupling renewables with other sectors for path-dependency and potential (new) lock-ins?



2.10. Theme 10: Geography of renewables



Questions within this theme cover the geographical similarities and differences of emerging renewable energy transitions, specifically between different EU Member States. It also addresses aspects related to localities and scales of renewable energy systems in different contexts. The aim of this theme is to investigate practical issues of transitions towards renewables, within different national and geographical contexts.

88 What are the most effective and efficient scenarios of reaching 100% renewable energy in different EU Member States?

89 How do the multi-speed energy transitions among different EU Member States affect European energy security and international relations?



2.11. Theme 11: Power dynamics & conflicts



Questions within this theme reflect the role of power dynamics and conflicts within energy transitions towards renewables, and also the power relations in play between different types of actors. The aim of this theme is to investigate the role of power as a crucial element of leveraging or hampering energy transitions. While the role of power and conflicts is central here, this theme also covers the relations between social actors, political dimensions, conflicts within the energy systems, and barriers and incentives for renewables.

90 What lessons can be learnt from societal and political debates on renewables in the past; for example, what factors shaped the 'turning points' related to climate denial and/or an unwillingness to act on renewables?

91 Under what conditions does societal support for renewable energy translate, or not, into political action?

92 What are the political, institutional and organisational implications of different renewable energy pathways of the future?

93 How can synergies be enhanced between different transition objectives (e.g. employment, economic development, resilience of energy system)?

94 How can the resistance of incumbent actors in the fossil fuel based energy system be overcome in energy transitions?

95 How can the dominant fossil fuel frames be challenged and replaced?

96 How can the energy oligopoly's resistance to change be counteracted?

97 How might elites and incumbents co-opt or otherwise capture renewable energy pathways?

98 How can eco-authoritarian approaches be avoided in energy transitions?

99 What political controversies are shaping, and/or slowing down, innovations and the deployment of existing renewable energy technologies?

100 How can powerful fossil fuel actors and interests be involved in transitions towards renewable energy systems?



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5. Appendices

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

SOCIO-DEMOGRAPHIC CRITERIA	COUNT	%
Working Group members participating in the full Horizon Scanning exercise	30 ³	100.00
Held a researcher identity	30	100.00
Based in organisations/countries eligible for Horizon 2020 funding	30	100.00
Had research interests directly relating to Working Group topic area	30	100.00
Different countries represented	21	N/A
Number of members in Northern Europe ⁴	8	26.67
Number of members in Eastern Europe ⁴	6	20.00
Number of members in Southern Europe ⁴	8	26.67
Number of members in Western Europe ⁴	8	26.67
Female	16	53.33
Male	14	46.67
Different SSH disciplines represented	17	N/A
With prior STEM background	9	30.00
Frontrunners ⁵	9	30.00
Field leaders ⁶	21	70.00

3 The Renewables Working Group began with 31 members, with one dropping out throughout the Horizon Scanning exercise. This total also excludes the five members of the Group's Steering Committee, and its related three contributors.

4 European regions 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 Renewables Horizon Scanning survey

SOCIO-DEMOGRAPHIC CRITERIA	COUNT	%
Number of respondents	85	100.00
Male	54	63.53
Female	29	34.12
Other	1	1.18
Rather not say	1	1.18
Number of SSH (sub-)disciplines represented	43	N/A
1 st most represented (sub-)discipline – Sociology	24	28.24
2 nd most represented (sub-)discipline – Political Sciences	20	23.53
3 rd most represented (sub-)discipline – Geography	16	18.82
4 th most represented (sub-)discipline – Environmental Sciences	15	17.65
5 th most represented (sub-)discipline – Economics	13	15.29
Number of different countries represented	20	N/A
1 st most represented country – Poland	11	12.94
Joint 2 nd most represented country – Germany; UK	9	10.59
Joint 4 th most represented country – Norway; Switzerland	7	8.24
6 th most represented country – Netherlands	6	7.06
Joint 7 th most represented country – Spain; Italy	5	5.88
Number of different nationalities represented	27	N/A
1 st most represented country – German	13	15.29
2 nd most represented country – Polish	11	12.94
3 rd most represented country – Spanish	7	8.24
Joint 4 th most represented country – Norwegian; Italian	6	7.06
6 th most represented country – British (including English or Welsh)	5	5.88
Completed PhD	78	91.76
Not completed PhD	7	8.24
Of those without a PhD: Not currently participating in a PhD programme	4	4.71
Of those without a PhD: Currently participating in a PhD programme	3	3.53
0-5 years since graduating PhD	18	21.18
6-10 years since graduating PhD	24	28.24
11-15 years since graduating PhD	15	17.65
16-20 years since graduating PhD	10	11.76
21-25 years since graduating PhD	6	7.06
26-30 years since graduating PhD	1	1.18
31-35 years since graduating PhD	3	3.53
36-40 years since graduating PhD	1	1.18
41+ years since graduating PhD	0	0.00



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

PROCESSING STEP	COUNT	%
Number of questions submitted via Horizon Scanning survey	280	100.00
Number of submitted questions immediately deleted due to e.g. lack of SSH grounding, lack of relevance to renewables, etc.	27	9.64
Number of additional questions generated through disaggregating multiple questions from one single submitted question, or through sourcing further questions from the question justification text themselves.	35	12.50
Number of questions removed due to merging, i.e. where a same question had been posed multiple times in overly similar ways.	9	3.21
Final number of questions sent to Working Group members for evaluation.	279	99.64



5.4. Appendix 4 – Aggregated quantitative findings from Working Group member evaluations of the 279 edited questions

Working Group members evaluated a list of 279 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 ⁷	No. OF QUESTIONS IN EVALUATION SURVEY	MEAN SCORE	VARIANCES OF MEANS	% OF QUESTIONS WITH MEDIAN ≥ 4	% OF QUESTIONS SCORED 5	% SCORES OF 5, ACROSS ALL Qs IN THEME	% OF QUESTIONS SCORED 3	% OF QUESTIONS SCORED 2	% OF QUESTIONS SCORED 1
Culture, imaginaries, narratives	30	3.49	1.39	63.33	25.48	30.00	21.19	14.40	8.93
Energy democracy	12	3.68	1.47	83.33	33.04	26.79	22.32	11.31	6.55
Energy justice	29	3.68	1.41	79.31	33.00	28.82	19.83	10.22	8.13
Financial and organisational structures	24	3.15	1.69	37.50	19.94	25.89	19.05	19.64	15.48
Geography of RE (Renewables Development)	16	3.08	1.97	31.25	21.21	22.32	18.97	18.30	19.20
Implications of Corona pandemic	7	2.99	1.91	14.29	18.37	21.43	19.90	21.94	18.37
Power dynamics and conflicts	27	3.35	1.67	55.55	23.68	27.78	19.97	16.80	11.77
Renewables policies and legislation	20	3.47	1.83	70.00	30.54	25.71	15.71	16.61	11.43
Renewables system design and integration across sectors	37	3.09	1.82	37.84	18.63	26.06	19.69	17.08	18.53
Social acceptance	31	3.32	1.67	54.84	22.24	28.11	22.12	14.63	12.90
Socio-ecological effects	20	3.42	1.64	65.00	25.71	26.07	22.86	15.18	10.18
Transformative governance	26	3.34	1.74	73.08	22.94	29.53	19.09	15.38	13.05

⁷ The 279 questions were organised and presented for evaluation in 12 inductively-generated themes. When further prioritizing the research questions, one theme was excluded, finally resulting in 11 themes.



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

1. All those with a median of 5 or median of 4 and mean equal or higher than 3.75 were automatically selected for inclusion.
 - ♦ 58 questions were included.
2. All those with medians of 1-3 were automatically excluded.
 - ♦ 101 questions excluded.
3. All those with medians of 4 and mean smaller than 3.75 were put on a longlist.
 - ♦ 120 questions put on a longlist.
4. Outputs ready for deliberations.
 - ♦ A list of 58 questions were locked in as a starting point for final, deeper discussions amongst the Working Group members (e.g. editing, further merging), with 120 questions presented as 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).



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