University of Dundee

Climate Risk Decision-making

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CLIMATE RISK DECISION-MAKING: TRANSLATION OF DECISION SUPPORT INTO POLICY

CONTENTS

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This study builds on the work from several preceding studies and outputs from the UUCN and others, which are acknowledged here:

- "Climate Risk Summit," UUCN, September 2021
- "Climate Change Risk Assessment 2021", Chatham House, September 2021
- "Recognizing Risk – Raising Climate Ambition," Woodwell Climate Research Center, November 2021
- "Climate Risk Communication – A Toolkit," UUCN and AU4DM Network, November 2021
- Other outputs from the UUCN Climate Risk Project, including technical reports and briefing papers.

I. EXECUTIVE SUMMARY

The impacts of climate change on humans and the natural environment are being experienced now, with extreme weather events such as heatwaves, droughts, and flooding increasing in frequency and severity across the globe. In the UK, the all-time maximum temperature record was broken again in July 2022 for the second time in just 3 years, breaching the 40°C mark for the first time ever. At the same time, the scientific evidence base has grown and warnings about the future risks posed by climate change are becoming ever clearer, including through the production of tailored climate risk assessments and other decision support tools.

However, despite this mounting evidence and warnings, current climate policy in the UK and globally falls far short of achieving the required reductions in greenhouse gas emissions needed to stave off the risks posed by climate change. Existing national climate policies and pledges set us on course for 2.7°C of global warming, which is well above the Paris Agreement's ambition of limiting warming to 1.5°C above pre-industrial levels. The science on climate risk is strong, but the policy response is currently lacking in effectiveness.

Therefore, we can ask, why are the plethora of climate risk assessments and decision support tools available to decision-makers not always translating into effective policy action on climate risk? What are the challenges, complexities and uncertainties associated with this translational process, and how can we improve the research translation pipeline in order to achieve more effective decision-making on climate policy? These are some of the key questions that this report aims to address, through a combination of a literature review, case study assessment and input from Policy Workshops with stakeholders.

From the findings of our research and from stakeholder input from the workshops, we set out three recommendations for policymakers and other stakeholders, including academic researchers and third sector organisations, to address the identified challenges associated with translating climate risk decision support into effective climate policy:

1. **Enhance collaboration** between decision-makers, policymakers, analysts, researchers, and other stakeholders to co-develop and co-design operational climate risk assessments and policies, relevant to context.
2. **Identify the research and capacity gaps around climate risk decision-making under uncertainty**, and work with stakeholders across the decision value chain to ensure those gaps are addressed.
3. **Co-create effective translation mechanisms to embed decision-support tools into policy better**, employing a participatory approach to ensure inclusion of diverse values and viewpoints.

Our study shows that greater focus must be given to the translational interface and to improving the effectiveness of decision support tools, in order for research and policy to translate into action that is responsive to the enormity, urgency and complexity of the challenges posed by climate change. This focus on translational interfaces needs to be augmented by further research, as more knowledge is urgently needed into how decision-making can be influenced by translational interfaces and decision support tools. It is fundamental that we improve our understanding about how we can make good decisions and operationalise them, rather than simply undertake further research focusing on the climate risk problem itself.

Current research reveals that improvement in the treatment of risk, uncertainty and complexity in climate risk decision making and policy is contingent upon the following:

a) decision analysis and support tools should match the degree of uncertainty and complexity in the specific context,

b) adoption of an interdisciplinary approach that integrates decision science and psychology,

c) design of policy within a system that promotes and enhances collaboration across diverse stakeholder groups, and across government departments,

d) institutionalising accountable governance mechanisms which model a range of possible futures, and include diverse actors,

e) further research into how climate risk expertise can be better translated into climate policy.

An increasing number of decision support tools, including climate risk assessments and indices, have been produced to help inform climate risk decision-making and policy development. However, these have so far proven to be ineffective in terms of their impact in sufficiently reducing carbon emissions. Furthermore, as our case study assessment shows, the potential of three recently developed decision support tools aimed at achieving impact via policy are unlikely to fully help to optimise policy outcomes, owing to each only partially meeting each of the criteria listed above. The disconnect between the scale of the climate risk challenge and current climate policy action, coupled with the requirement for improved decision support tools, is reflective of the degree of urgency by which greater attention should be given to the translational interface to improve outcomes.

A key insight from our workshops with policymakers is that research funders are not sufficiently focused on the decision making and translation aspect of the challenge, and that the research funding system and timelines are not well matched to the needs of the policymaking community. Other key findings from the workshops were the importance of using specific case studies to guide decision-making and employing a shared language with common concepts for improving outcomes.

2. INTRODUCTION

SCOPE AND PURPOSE OF THIS STUDY

Human-induced climate change is already having significant and widespread adverse impacts on people and the environment, including through increases in the intensity and frequency of extreme weather events.[1] Scientific evidence and warnings about the future risks posed by climate change are becoming stronger and clearer, detailing both the "physical risks" to humans and natural systems, as well as the "transition risks" associated with the switch to a net zero economy.[2] Climate change risk assessments are carried out regularly by many organisations across the globe for a range of public and private sector stakeholders, to help inform climate risk decision-making and policy-making.[3]

Yet, despite the numerous climate risk assessments and other climate risk decision support tools available, the translation of the scientific evidence base into emissions reduction and climate policymaking has so far proven to be limited in terms of its effectiveness for achieving swift and significant changes in carbon emissions levels. Current national climate policies in place around the world are projected to result in approximately +2.7°C warming above pre-industrial levels,[4] which is well above the Paris Agreement goal of limiting global warming to under 2°C. There is a clear disconnect between the scale of the climate risk challenge and current climate policy action for mitigation and adaptation. This suggests that more needs to be done to improve how climate risk is communicated to decision-makers and the ways in which climate risk decision support tools are translated into policy, in order to enable effective climate policymaking and emissions reductions.

This UK Universities Climate Network study tackles the question of how to address this disconnect and focuses on how the translation of decision support tools for decision making on climate risk can be improved, to achieve effective climate policy action whereby emission levels are both quickly and significantly reduced. We investigate the complex nature of climate risk decision-making under uncertainty and set out a number of recommendations for how to improve the translation of climate risk decision support tools into effective climate policy.

Figure 1 shows the stages of this study and the process that was followed to arrive at the recommendations being proposed in this report.

Figure 1: The structure and stages of this study

The body of work comprising the study is significantly broader than what has been synthesised into the main report itself. Full details are provided in the Annexes, which the reader is encouraged to consult. The study involved completing a comprehensive literature review of uncertainty, complexity, and current best practice in the translation of decision analysis into decision making across a range of domains, setting out a number of challenges that need to be addressed to enable effective decision-making for climate policy (See Annex 1). Subsequently, a meta study of three existing climate risk decision support tools was performed, with each case study being assessed against the challenges identified from the literature review (See Annex 2). The final output of the study is a set of three recommendations (See Section 3), which were co-created and stress-tested with policymakers and stakeholders during two workshops. These recommendations set out how to improve the translation of climate risk decision support into effective climate policy.

The two Policy Workshops were undertaken in collaboration with the Cambridge Centre for Science and Policy (CSaP), and were attended by UK Government representatives as well as academics, analysts and third sector stakeholders. During the first workshop (March 2022), draft versions of the recommendations presented in this report were stress tested with participants, and their input and feedback were synthesised to help refine the recommendations. The updated recommendations were then presented at the second workshop (May 2022), where discussion focussed on how these recommendations could be operationalised and implemented in practice.

STRUCTURE OF THIS REPORT

This report begins with the presentation and discussion of the 3 recommendations that were developed from this study, and which incorporate the input provided by workshop participants (section 3). The following sections of the report focus on the earlier stages of the study: characterising climate risk (section 4), investigating complexity in climate risk decision-making (section 5), and the case study assessment of existing climate risk decision support tools, and the workshop inputs (sections 6 and 7, respectively). Further details and evidence supporting sections 5 & 6 are provided in the Annexes at the end of the report.

3. RECOMMENDATIONS

From our research and analysis, as well as inputs from the two Policy Workshops held in March and May 2022, we present three recommendations to address the identified challenges associated with translating climate risk decision support into effective climate policy. These are to:

1. **Enhance collaboration between decision-makers, policymakers, analysts, researchers, and other stakeholders to co-develop and co-design operational climate risk assessments and policies, relevant to context.**
2. **Identify the research and capacity gaps around climate risk decision-making under uncertainty, and work with stakeholders across the decision value chain (Figure 2) to ensure those gaps are addressed.**
3. **Co-create effective translation mechanisms to embed decision-support tools into policy better, employing a participatory approach to ensure inclusion of diverse values and viewpoints.**

These recommendations are primarily targeted at decision-makers and policymakers in UK Government, e.g., in the Cabinet Office or BEIS. However, they are also of relevance to stakeholders in academia and in the third sector. Earlier draft versions of these recommendations were stress-tested during a workshop in March 2022 with key stakeholders from academia, government and the third sector. Insights and feedback obtained during this workshop were used to improve the recommendations, resulting in their current form.

Here, we provide additional detail to unpack these recommendations, drawing on inputs from workshop participants and the wider study, and provide suggestions on how they could be implemented in practice:

1. **Enhance collaboration between decision-makers, policymakers, analysts, and researchers to co-develop and co-design operational climate risk assessments and policies.**

The current process by which climate risk research and decision support feed into policymaking is often very linear, with the research or risk assessment being undertaken first and with the policy engagement process coming afterwards and often as an afterthought. Ideally this should be the other way around, with **policy needs informing the direction of interdisciplinary research**, in an iterative process whereby new climate risk research and risk assessments are developed collaboratively between decision-makers, policymakers, researchers and analysts to address policy needs.

Transparency and interdisciplinarity are key to the success of such a collaborative approach. This approach requires both **integration and the sharing of information** across stakeholder groups and scientific disciplines. These practices bridge the gaps between the research and policy communities and improve understanding of the policy and decision-making landscape through engagement with a wide range of people and information. Research funders and funding bodies should also be included in this conversation, to explore and enable different funding models and approaches to collaborative working, and to devise timescales that are appropriate for the policy process.

Diversity of viewpoints and sectors must be appropriately reflected in this process, to ensure that all stakeholders are represented and have buy-in. For example, in the case of the UNICEF Children's Climate Risk Index, actively engaging with children and other members of society as decision-makers in developing the Index and working with them to transform their lives for the better would constitute excellence in inclusive practice.

2. **Identify the research and capacity gaps around climate risk decision-making under uncertainty, and work with stakeholders across the decision value chain to ensure those gaps are addressed.**

There is a **significant research gap around climate risk decision-making under uncertainty**, especially in relation to how some decision support tools result in more effective decision-making than others and on how to avoid distortive effects. More work should be undertaken to better understand: a) what the current processes for translation of decision support are, and b) how current processes could be improved by **engaging with stakeholders across the entire decision value chain to better understand research needs**. This approach will help orient research funding towards the development of new knowledge for the purpose of risk assessment and translation needs in a more action-oriented approach, rather than for the advancement of science alone. There are also gaps in understanding user needs, which should be addressed by engaging with end users to find out what data, or other inputs, they require to follow recommendations.

There is a need to improve organisations' and individuals' competency on the use of decision support tools , as well as a need for the research and decision support communities to communicate uncertainty in a way that policymakers understand. Reducing findings down to **key messages or action recommendations that resonate with policymakers can be very impactful**, e.g., this was the approach taken in the UK Climate Change Risk Assessment. Conversely, there is also potential demand from decision- and policymakers for more complex analysis, especially since the Covid-19 pandemic, which has shown that the capacity to deal with complexity and uncertainty can emerge in response to an emergency trigger.

3. **Co-create effective translation mechanisms to embed decision-support tools into policy better, employing a participatory approach to ensure inclusion of diverse values and viewpoints.**

Translating decision-support into policy and operational activity and gaining societal buy-in are integral components to the realisation of effective climate policy design. There is a need to **improve the research translation pipeline**, taking an end-to-end perspective for effective translation of decision support into policy. This process should take the form of an **iterative exchange with policy development, rather than a process separate from it**. This, in turn, requires aligning of timescales and urgency in order for different sectors to work together effectively, e.g., policy sector timescales tend to be much tighter than research timelines.

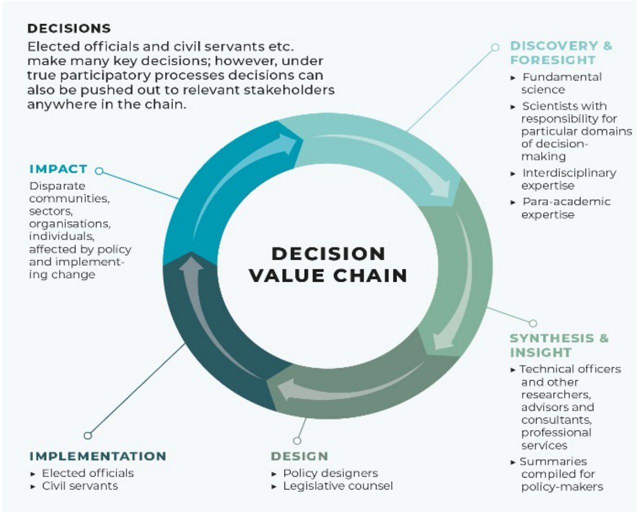

Figure 2: Illustrative diagram of the decision value chain.

Employing participatory and bottom-up approaches are crucial for this process as they ensure the **inclusion of multiple values and stakeholders, and a diversity of viewpoints**, especially from those most marginalised within society and from whom one usually hears from the least. It is important here to use a relevant common lexicon, and to **match the tools and methods used to the problem at hand and the specific audiences. The framing should also be broader than just climate risk alone**. From the end user's point of view, it is about the broad envelope of risks they are experiencing, not just from climate change. So, framing in terms of resilience rather than risk might be more appropriate. For example, in the case of the UNICEF Children's Climate Risk Index (see case studies), it is about promoting child-centred policies and practices amongst community-based practitioners and providing the resources necessary to transform children's lives by eliminating poverty, providing high quality healthcare, and facilitating access to all levels of education. An example of what such an iterative process could look like in practice as part of a Decision Value Chain is shown in Figure 2[5]:

4. DEFINING AND CHARACTERISING CLIMATE RISK

Climate risk manifests as physical risk which is the risk of physical impacts resulting from climate change, and also as transition risk which is the risk inherent in new policies, strategies or investments associated with the transformation to a net zero economy.[6]

The Intergovernmental Panel on Climate Change (IPCC) defines risk as "the potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems. In the context of climate change, risks can arise from potential impacts of climate change as well as from human responses to climate change."[7]

According to the IPCC definition of risk, risk is a combination of three key components: hazard, exposure, and vulnerability.

Hazard = physical climate impact driver or natural hazard, e.g., increased frequency of flooding due to climate change.

Exposure = the inventory of elements (location, attributes, value of assets) in an area in which hazardous events may occur, e.g., living in a floodplain.

Vulnerability = the likelihood that assets will be damaged/destroyed/affected when exposed to a hazard, e.g., an older person may be more vulnerable to flooding as they could be slower at evacuating.

Climate risks are interconnected, multidimensional, multifaceted, and occur on a range of scales from local to global.[9] They can be characterised as:

- **Increasing**: The physical risks and socioeconomic impacts of climate change are increasing across the globe and will continue to increase with further global warming. Climate-related risks to human and natural systems will be greater for warming of 1.5°C than at present, and even greater for warming of 2.0°C.[10]
- **Non-linear**: Nearly all modelling of future climate risks assumes that climate impacts are proportional to their drivers and behave in a linear fashion. Yet, there are non-linear changes in weather and climate variables, such as weather extremes[11], the potential for crossing climate tipping points , and responses of human and natural systems which should also be captured in climate risk assessments and adaptation planning.[12]
- **Context-dependent**: The impacts of climate change are context dependent as some societies have the capacity to adapt to significant levels of climate shocks and stresses, while others suffer severe impacts from lower levels of pressures.[8] Climate change should be understood as increasing risks on a contextual basis, rather than inevitably causing them.
- **Networked**: Climate risk is transmitted across time and space due to the linked nature of climates across different regions of the world, and large-scale climatic events may occur simultaneously, e.g. through global scale climate phenomena such as the El Niño–Southern Oscillation (ENSO) which affects the climate of much of the tropics and subtropics.[13] Climate risk can also be transmitted across sectors and international boundaries and a combination of interacting processes can result in extreme impacts.[14]
- **Cascading**: Risks to one sector or to one region, can cascade through networks and across multiple regions. Climate risks have multiple direct and indirect pathways that cascade through complex social–ecological systems.[15] The mechanisms of transmission include flows of material, movement of people, and economic and trade linkages.
- **Compounding**: Climate risks can accumulate through a combination of interacting physical processes, such as floods, wildfires, heatwaves and droughts.[16] These are referred to as "compound events" and can lead to gradual build-up of climate impacts in specific locations, e.g. through compound hot-dry events.[17] Policymakers need to pay attention to how these interactions affect any particular region, and improve individual and community preparedness and response plans.[18]

5. COMPLEXITY IN CLIMATE RISK DECISION-MAKING

RISK, UNCERTAINTY & COMPLEXITY

Climate risk is a multidimensional problem, fraught with complexity and deep uncertainty. With this in mind, it is worth unpacking **risk, uncertainty, and complexity**. Understanding these dimensions is an integral component of decision-making for any given climate or net-zero system context and is an often-overlooked aspect of the decision processes.

Mischaracterisation of the sources and the extent of risk, uncertainty and complexity involved can lead to misalignment of the entire analytical and decision-making process, i.e., the way that a problem is framed, the application of the appropriate decision support tools, the decision-making processes and policy design – for a range of climate and net-zero interventions. Here, we introduce and define some of these key concepts[19]:

Risk vs uncertainty[20]:

- **Risk** is where probabilities are known and available
- **Uncertainty** is where probabilities are unknown or unavailable and no relevant data available, within time constraints.

Uncertainty can in turn be characterised by the following features:

- **Sources**: uncertainty can result from an incomplete understanding of the way the world works, or as a result of an inability to translate components of real-world systems into analytical tools, e.g., model uncertainty.

- **Types**: uncertainty can be either **bounded**, e.g., when inherent to variations in model parameters, or **unbounded**, when it is due to a lack of knowledge.
- **Levels**[21]: a system context can possess different levels of uncertainty ranging from a single deterministic model with a clear enough future, through to **deep uncertainty**[22] with an unlimited, unbounded set of possible futures.

Complicated vs complex systems:

- **Complicated systems** are characterised by nested components whereby reductionist thinking is possible, as the behaviour of each component is understandable independent of the whole – this allows for predictions of risk.
- **Complex systems** are characterised by a large number of interacting components whereby aggregated activity is nonlinear and can exhibit hierarchical self-organisation.

The relationship between uncertainty and complexity, and how it shapes analysis and decision contexts, is best explained through the Cynefin framework , shown in Figure 3.

Cynefin frames uncertainty in the context of knowledge of the 'system context' cause and effect in general terms, and identifies four broad categories:

- **Known Contexts**, in which the only uncertainties relate to stochastic effects, i.e., randomness. Cause and effect are broadly understood within natural variation and randomness.
- **Knowable Contexts**, in which one has models and good scientific understanding, but there is a need for data to determine certain parameters.
- **Complex Contexts**, in which there is considerable lack of knowledge. Causes and effects are known, but not precisely how they are related, making prediction of the consequences of a decision difficult and very uncertain. Uncertainties may be deep.
- **Chaotic Contexts**, in which hardly anything is known; possible causes and effects are both unidentified.

Recognition of the system context and the extent of risk, uncertainty, and complexity as a function of the state of system knowledge effectively frames a problem and how audiences perceive it. This then impacts how analysts will apply decision support tools to how an issue is translated from the scientific community through policy makers and the public.

Developing the appropriate framing of a problem based on the accurate diagnosis of the system context has corresponding implications on how policy solution sets are characterised. A **complicated system** framing often leads to a '*solutions at scale*' solution set and limits the extent of audiences that will be engaged with to realise policy objectives. Conversely, a **complex system** context translates to a transformation approach, and frames the policy solution as requiring much broader audience engagement, deeper insights on issues around culture and belief systems and most significantly substantively increased policy design predicated on non-techno-centric solution sets.

Complex problem framings for socio-technical systems better systemise the approaches and allow for better accommodation of risk, uncertainty, complexity, and emergence around the system context. This is important as it acknowledges that individual components of the system will be reflexive and will therefore be in a perpetual state of flux as they co-evolve responding to multiple stimuli. It also recognises that complexity is a system property which is better managed through attraction and coercion and is rarely, if ever, solved. In contrast, risk and uncertainty are atomistic perspectives and can, to varying degrees, be addressed and/or managed.

The unpacking of the nuances regarding risk, uncertainty and complexity in system contexts **highlights how our world views and the way we investigate the world can distort climate policy design and its effectiveness.** This is especially important when system contexts are complex. However, there can be a tendency for policymakers, operational planners, and the analytical community to continue to think with perspectives that are often deterministic, optimised and technocentric. Such mindsets will tend to blind actors as to how to reconcile the management of uncertainty, complexity, non-linearity, and emergence which prevail in managing climate risk in policy design.

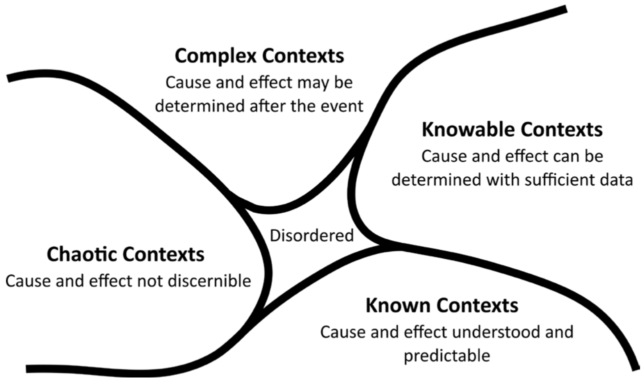

Figure 3: Cynefin Framework.

CHALLENGES

In this study, we set out **five challenges** that should be addressed to improve the treatment of risk, uncertainty, and complexity in climate risk decision-making and policy design:

1. **Matching decision analysis and support tools to the extent of uncertainty and complexity encountered in the system context.**
2. **Ensuring an Interdisciplinary approach integrating decision science and psychology and accommodating decision cultures.**
3. **Policy design within a systemic collaborative value chain framework.**
4. **Institutionalise accountable governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors.**
5. **Climate risk is under researched, especially social science and interdisciplinary approaches, and in how expertise is translated into effective climate policy.**

These five challenges are based on a review of the available literature on decision making across a number of domains and current thinking on complexity which are likely relevant to climate policymaking. This literature review is included in Annex 1, which also sets out a number of criteria to be addressed under each of these challenges. Those criteria form the basis of the case study assessment which follows in Section 6.

6. CASE STUDY ASSESSMENT OF THREE DECISION SUPPORT TOOLS

In order to assess the state of current best practice, we examined three recent decision support tools focusing on climate risk and covering different geographical scales (global, national, and regional). The aim was to ascertain their potential for improving decision-making and outcomes in their final presented form (from the information provided in the reports themselves) through their attempts to consider the complexities and uncertainties that characterise climate risk. The three case studies used in this assessment were:

1. **UNICEF Children's Climate Risk Index (CCRI)[24] – global scale.**
2. **UK Climate Change Risk Assessment (CCRA)[25] – national scale.**
3. **Climate Risk Assessment in Cities (C40 Cities)[26]: C40 Infrastructure Interdependencies and Cascading Climate Impacts Study – regional.**

Assessment of their potential for improving climate risk decision-making was made by examining the developments and outcomes presented in each of the three final case study reports in relation to each of the five challenges set out in Section 5. The 20 criteria set out below, as recognised means by which these challenges may be addressed, were used to evaluate each of the case studies against each of the challenges. These criteria were developed from the review of the literature on complexity in climate risk decision-making, which is detailed in Annex 1. A full description of the evaluation of the case studies against these criteria, and discussion of the findings, is provided in Annex 2.

Challenge 1 – Matching decision analysis and support tools to the extent of uncertainty and complexity encountered in the system context.

- **Criteria 1: complexity and uncertainty**
  Recognition and characterisation of the full extent of complexity and uncertainty present in the system context, as evident through description and mapping of system complexity.
- **Criteria 2: consolidative and exploratory modelling**
  Demonstrable use of exploratory modelling with diverse actors, reflecting diverse priorities, goals and values, and engagement in polycentric decision-making without privileging one set of assumptions over others.
- **Criteria 3: complex decision analysis**
  Acknowledgement of the limitations of decision analysis support tools and robust awareness of the characteristics of complex, real-world problems.
- **Criteria 4: integrative decision support tools**
  Parametric and data-driven tools are used as part of a wider array of integrative decision support tools to explore options. Consideration is given to multiple variables and how the relationships and interconnections between them may lead to different outcomes, without heavy reliance on numerical outputs only.
- **Criteria 5: transparency**
  Use of hybrid parametric-qualitative approaches, with uncertainties and assumptions being made transparent through evidence of a process of 'deliberation with analyses.' Parametric outputs are not used to provide definitive outcomes or to influence choices.

Challenge 2 – Ensuring an Interdisciplinary approach integrating decision science and psychology and accommodating decision cultures.

- **Criteria 1: better accommodation of human behaviour**
  Recognition that optimised outcomes in multi-actor constructs result in far from robust strategies.
- **Criteria 2: cognitive bias recognition**
  Demonstrates attempts to deal with the impact of interaction of multiple cognitive biases and expert judgement in decision making and policy design through use of formal processes to accommodate the effects of cognitive bias.
- **Criteria 3: common lexicon**
  Use of common lexicon around climate risk by multiple audiences.
- **Criteria 4: open framing**
  In exploratory assessments, questions are framed in an open manner, and framing is used in value-based approaches for objective criteria.
- **Criteria 5: culture and psychology**
  Demonstrable evidence as to how the culture of agents involved in the policy design has been considered and accommodated, along with the psychology of making decisions in deep uncertainty.

Challenge 3 – Policy design within a systemic collaborative value chain framework.

- **Criteria 1: avoidance of over-specialisation and over-separation**
  Recognises that the specialisation and separation of climate policy analysis, design and decision making within governmental departments and the institutional fragmentation of government departments makes for the addressing of systemic, cross-cutting climate risk and uncertainty highly problematic.
- **Criteria 2: enhanced collaboration**
  Reflective of collaborative, specific, standardisation and greater interdisciplinarity between actors along the decision value chain through open and regular communication between diverse groups, engagement in regional climate modelling and climate model downscaling, standardisation of best practice, co-creation of climate risk assessments and complementary solutions for cascading climate impacts.
- **Criteria 3: trans-department collaboration**
  New developments cut across government departments and subject matter expertise within governments.

Challenge 4 – Institutionalise accountable governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors.

- **Criteria 1: non-traditional governance**
  Evidence of anticipatory dimensions to governance to address deep uncertainty, including proactive, inclusive, and collaborative approaches, and iterative and experimental approaches to problem solving.
- **Criteria 2: participatory approaches**
  Demonstrates participatory approaches with diverse societal actors that allow for multiple values and viewpoints in ongoing dialogue.
- **Criteria 3: leadership, culture, and competency**
  Accountability of policy design through systematic tracking.

Challenge 5 – Climate risk is under researched, especially social science and interdisciplinary approaches and how expertise is translated into effective climate policy.

- **Criteria 1: research theme/perspective range**
  Draws upon a range of research from multiple disciplines based on multiple research methods and does not privilege 'traditional' approaches ground in engineering, economics, and the natural sciences. New interdisciplinary research and approaches are embraced and applied, and multiple theoretical perspectives are considered. Adopts an action-oriented approach to policy relevant research and considers multiple forms of climate risk and how these risks interrelate.
- **Criteria 2: diversity of representation**
  Research includes diversity of experiences and actively addresses inequalities of representation, including inequalities based on gender, disability, ethnicity, culture, geographic, social-economics, political and educational factors and adopts a non-tokenistic approach to inclusion. Research agendas and decision-making allow multiple social actors to collaborate at every stage of the process, including in the research design and development of solutions.
- **Criteria 3: analytical perspectives**
  Draws on a broad range of analytical perspectives and moves beyond consolidative modelling approaches.
- **Criteria 4: transdisciplinary approaches**
  Demonstrates evidence of cross-cutting transdisciplinary collaborative research that actively seeks to support effective decision making to address climate risk and to avoid distortive effects, including new decision support tools.

Each of the 3 case studies were evaluated against these 20 criteria for their potential to improve climate risk decision-making. The extent to which each case study was judged to have met each of the criteria was graded using a Likert Scale measurement, where:

1 = Absent – Not ascertainable or does not meet the criteria i.e., the potential cannot be determined on the basis of the contents of the final report alone, such as in instances where the focus of the criteria is out with the scope of the contents of the report.

2 = Poor – Poorly meets some aspects of the criteria, i.e., only partly meets some aspects of the criteria, for example where awareness of the benefits of adopting key features of the criteria are indicated via statements made in the report but where there is little, or no evidence presented of how this was actioned in developments and outcomes.

3 = Fair – Meets some aspects of the criteria but does not meet other aspects.

4 = Good – Meets the criteria, but with room for improvement, such as in instances where methods and recommendations for dealing with complexity as part of the criteria have been used, but where there remains a dominant use of traditional, consolidative methods and decision-making practices.

5 = Excellent – Shows compelling evidence of meeting all aspects of the criteria.

The potential of each study for meeting the 5 challenges to improving decision-making was then graded accordingly:

Mostly absent = Not ascertainable

Mostly poor = Low potential

Mostly fair = Fair potential

Mostly good = Significant potential

Mostly Excellent = Significantly high potential

Table 1 provides a summary of the results of that case study assessment, just showing the final grading for each case study against each of the challenges. The full assessment showing how each case study scored against each of the 20 criteria is provided in Table 2 in Annex 2, together with a detailed evaluation of each of the case studies.

The findings of the analysis reveal that although recent research focusing on climate risk aimed at informing policymakers has acknowledged the complexities and uncertainties associated with climate change, little information is available that reveals the processes through which the scientific research can be effectively translated and operationalised for policy decision-making, development, and implementation. Limitations in the knowledge available, including in the diversity of examples of the effective mobilisation of knowledge for decision support, means that discerning best practice for improving decision-making aimed at tackling the five key challenges in real-world situations cannot be readily ascertained from the case studies alone.

Challenges	Children's Climate Risk Index	UK Climate Change Risk Assessment	C40 Cities
Challenge 1: Matching decision analysis and support tools to the extent of uncertainty being encountered in the system context	**Not Ascertainable**	**Limited Potential**	**Fair Potential**
Challenge 2: Ensuring an interdisciplinary approach integrating decision science and psychology and accommodating for decision cultures	**Not Ascertainable**	**Not Ascertainable**	**Limited Potential**
Challenge 3: Policy design within a systemic value chain framework	**Not Ascertainable**	**Limited Potential**	**Fair Potential**
Challenge 4: Institutionalise governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors	**Not Ascertainable**	**Limited potential**	**Limited Potential**
Challenge 5: Improving the breadth and depth of research	**Limited Potential**	**Fair Potential**	**Fair Potential**

Table 1: Summary table of the case study assessment. See Table 2 in Annex 2 for the full assessment.

While analysis of the case studies reveals that each study, at least in part, meets some of the criteria associated with meeting each of the five key challenges, further research needs to be undertaken to improve understanding of how decision support can be optimised for policy development. While each of the case studies is reflective of at least some potential for enabling policy developments to meet each of the five key challenges, gaps remain in terms of understanding how this potential can be maximised to improve outcomes.

Greater focus must be given to the translational interface and on improving the effectiveness of decision support tools for climate action. The findings of the study show that there is a need for further research focusing on the actual processes of collaborative decision making for enhancing the translation of scientific evidence into policy, including research examining the ways in which scientific research and policy can be more mutually informative to enable climate risk research to be more impactful. In addition, more needs to be done to identify limitations in the existing research and capacity gaps for climate risk decision-making under uncertainty to aid the development of translation mechanisms for improving best practice in operationalising decision-support.

Given that the focus on the translational interface is fundamental for enabling swift action to be taken to both quickly and significantly reduce carbon emissions, research focusing on this interface and on improving decision support tools therein can be viewed as necessary for improving outcomes in this area.

It is important to note that these reports were produced with the purpose of informing policymakers about developments in research to help support policy decision-making, rather than for improving decision-making processes per se. In other words, their aim was *to inform for the purpose of translation rather than to inform the translation process* itself. This means that the processes and discussions through which decisions were made as to how the developments, outcomes and recommendations detailed in the final reports were produced are not readily ascertainable from the final reports alone. Consequently, it may well be that the processes that lay behind the production of the final reports may have reflected engagement with the criteria used to evaluate the final reports and that further knowledge for informing best practice may be obtained through discussion with members of the project teams involved in the development of each of the reports. However, this would require further research to be undertaken involving interviews with project team members to ascertain how these decisions were made.

Recommendations from the case study analysis

From the findings, three specific recommendations were made for improving decision making processes for actioning research in policy. These are the recommendations that were brought to the first Policy Workshop in March 2022:

1. To enhance collaboration between decision-makers, policymakers, analysts, researchers, and other stakeholders to co-develop and co-design operational climate risk assessments and policies, relevant to context.
2. To identify the research and capacity gaps around climate risk decision-making under uncertainty, and work with stakeholders across the decision value chain to ensure those gaps are addressed.
3. To co-create effective translation mechanisms to embed decision-support tools into policy better, employing a participatory approach to ensure inclusion of diverse values and viewpoints.

7. POLICY WORKSHOPS

A key component of this project was to draw on expert input from participants at two Policy Workshops, organised in collaboration with the Cambridge Centre for Science and Policy, and held in March and May 2022 under Chatham House rules. These workshops were attended by policymakers from the UK Cabinet Office and Government Departments, as well as by academics, analysts and third sector personnel.

The first of these workshops served as an opportunity to stress test the first version of the recommendations that were drawn from the findings of the case study analysis (Section 6). A summary of the findings from the case study analysis was shared with participants in advance of the workshop, along with draft versions of the recommendations. During the workshop, participants shared their feedback on the recommendations, and suggested how each could be refined and improved. This feedback was incorporated into the updated version of the recommendations, which are presented in Section 3 of this report.

Having refined the recommendations during the first workshop, the next challenge was to explore how recommendations could be operationalised and implemented in practice across the entire decision value chain. This was the focus of the second Policy Workshop, where participants shared valuable insights into the challenges they face when making decisions about how to action research in policy.

Some of the **common themes and messages** from the workshops include:

- The importance of **transparency & interdisciplinarity** and the **integration** of information across stakeholder groups and disciplines.
- **Policy needs should inform the direction of research**, instead of policy engagement being an afterthought.
- The **diversity of viewpoints and sectors** needs to be reflected. Solutions should be participatory, bottom-up approaches.
- **Specificity**: The recommendations need to be specific and include examples.
- **What is the gap?** It is important to identify what the research/capacity gap actually is. Need to speak with end users to identify those gaps.
- There is a need to **communicate uncertainty** in a way that policymakers can understand e.g., condensed into key messages.
- **Timescales & urgency**: it is crucial to align the different timescales of different sectors in order to work together effectively (e.g., research vs. policy).
- The importance of developing an effective **research translation pipeline**. This translational aspect is crucial but can also be very resource intensive.
- **This issue is broader than just climate risk alone**: from the end users' point of view, it is about the broad envelope of risks they experience. This should be reflected effectively e.g., through a focus on **resilience**.

8. CONCLUSION

There is a growing body of research warning of the current and future risks posed by the impacts of climate change. An ever-increasing number of decision support tools, including climate risk assessments and indices, are produced on a regular basis to help inform climate risk decision-making and policymaking. Yet, despite mounting evidence of the risks, climate policymaking has so far been ineffective in achieving the required emissions reductions to limit global warming in line with the Paris Agreement goals. There is a clear disconnect between the scale of the climate risk challenge and current climate policy actions on adaptation and especially mitigation.

This study tackles the question of how to address that disconnect and focuses on how to translate decision support tools into better decision making on climate risk in order to achieve effective climate action. We completed a comprehensive cross-domain literature review of uncertainty, complexity, and current best practice in the translation of analytical support into decision-making, setting out a number of challenges that need to be addressed to enable effective decision and policymaking (See Annex 1). Subsequently, a meta study of three existing climate risk decision support tools was performed, with each case study being assessed against the identified challenges (See Annex 2). The final output of the study is a set of three recommendations (See Section 3), which were co-created and stress-tested with policymakers and stakeholders during a series of workshops. These recommendations set out how to improve the translation of climate risk decision support into effective climate policy.

Our study shows that more research is urgently needed into how decision-making is influenced by these translational interfaces and decision support tools. There is an urgent need to improve our knowledge about how to make good decisions and how to operationalise them, rather than simply for more research into the nature of the climate risk problem itself. We have ample evidence and warnings about the risks posed by climate change, but the real problem is how do we translate that evidence into effective policy action at different scales.

A key insight from our workshops with policymakers is that research funders are not currently focussing on this aspect of the challenge, and that the research funding system and timelines are not well matched to the needs of policymaking community.

Other key findings from the workshops included the importance of using specific case studies to guide decision-making, which is far more powerful than merely providing generic advice on how to improve things. Employing a shared language with common concepts is also especially important as this will ensure that all participants in the decision value chain, from researchers and analysts through to policymakers, are on the same page.

9. ANNEX I: COMPLEXITY IN CLIMATE RISK DECISION-MAKING: LITERATURE REVIEW AND ASSESSMENT CRITERIA

This Annex sets out a targeted review of the literature and the latest thinking on complexity in climate risk decision-making. It provides further detail on each of the 5 challenges that were set out in Section 5, as well as detailing each of the criteria that were used in the case study assessment in Section 6. Those challenges are:

1. Matching decision analysis and support tools to the extent of uncertainty and complexity encountered in the system context.
2. Ensuring an Interdisciplinary approach integrating decision science and psychology and accommodating decision cultures.
3. Policy design within a systemic collaborative value chain framework.
4. Institutionalise accountable governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors.
5. Climate risk is under researched, especially social science and interdisciplinary approaches and how expertise is translated into effective climate policy.

Challenge 1: Matching decision analysis and support tools to the extent of uncertainty and complexity encountered in the system context.

- **Characterising the extent of complexity and uncertainty in the system context is important to ensure that the most appropriate analytical tool is matched, as not all decision support tools are able to manage extensive or high levels uncertainty.** This is emphasised in Figure 4 and detailed in AU4DM Network, 2019[27,28].
- **Consolidative Modelling vs Exploratory Modelling**. Traditional decision support tools adopted by policy makers and the corporate community tend be based on parametric modelling particularly in the energy sector[29]. These have a significant role in assessing risk and uncertainty in climate policy. **Consolidative models** are models where all relevant knowledge is gathered into a single package which, once validated can be used as a surrogate for the real world. Such models are particularly prevalent, e.g., Integrated Assessment Models (IAMs) are used by the IPCC to inform climate policy. They are appropriate for complicated systems. However, in optimising for pre-defined goals and parameters, they can be sensitive to false assumptions, and tend to obscure both the value judgements implicit in their goals and alternative pathways for achieving them. In complex systems, **exploratory models** – which map assumptions onto consequences, without privileging any one set of assumptions - are more appropriate. The construct embraces actors which have a diversity of priorities, goals, and values to the decision, embraces irreducible uncertainty regarding the consequences of audience actions – and a decentralised, polycentric decision-making audience[30]. They accommodate for the fact that some uncertainty (e.g., ethical uncertainty) cannot necessarily be resolved via the modelling tool itself and needs be addressed in the broader elements involved in the decision-making analysis. Fortunately, there is increasing recognition of the limitations of consolidative decision support tools and their miss-application in some strands of policy design – particularly around net zero[31].

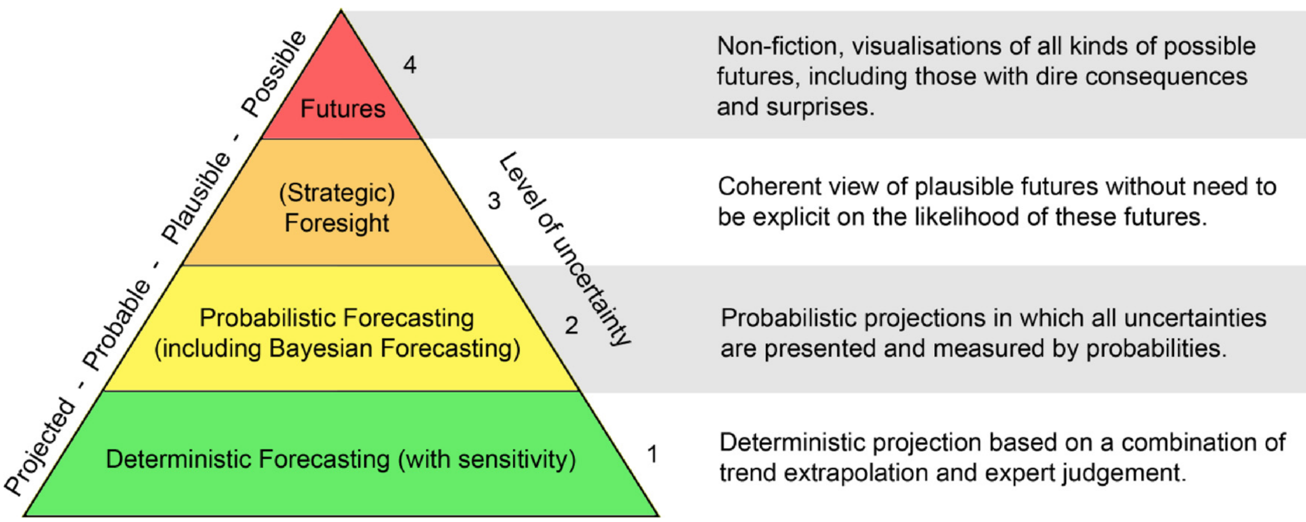

Figure 4: The need to match the decision support tools to the levels of uncertainty in the system context.

- **There is an inevitable miss-match between decision analysis support tools and the characteristics of real-world problems**. This situation is well articulated in Figure 5[32]. Decision support tools can only manage a limited range of uncertainty and realise a handful of objectives. Many climate risk system contexts are deeply uncertain and policy makers are seeking multiple objectives.

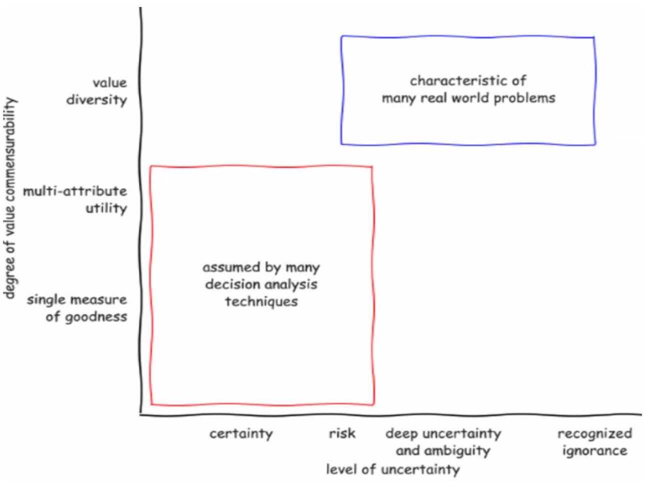

Figure 5: Levels of uncertainty vs Degree of value commensurability.

- **Parametric and data-driven tools should be part of a wider arsenal of integrative decision support tools**[33]. With the increased prevalence of data and data science techniques there will be a temptation to use the outputs of data-driven tools to provide definitive choices as to what to do. However, a wider set of tools should be used to assist policy makers to explore the future option space and how the variables interact for any given strategy. Data driven outputs have a habit of the cognitive lapse of the `*fallacy of misplaced concreteness*' in outputs when in fact the numerical outputs hide much in the way of assumptions and uncertainty[34].
- **Developing transparency of the process to avoid the tendency for parametric outputs to be used to provide definitive outcomes or choices as to what to do**. Hybrid parametric-qualitative approaches can allow parametric outputs of models to be integrated into the wider understanding of the policy space, provided uncertainties and assumptions are made transparent through a process of `deliberation with analysis'[35]. This approach can ensure that modelling tools are used appropriately to **explore** the way that strategies should be designed to achieve stated objectives, rather than as a way to confirm the realisability or otherwise of stated plans[36]. The hybrid approach can therefore enable better exploration of the likely high dimensional, deeply uncertain future climate option space[37].

Challenge 2: Ensuring an Interdisciplinary approach integrating decision science and psychology and accommodating decision cultures.

- **Many decision support tools assume that actors will optimise for a desired outcome. However, it has been well established that individuals and actors often satisfice[38] and that equilibrium conditions in multi-actor constructs result in far from optimum seeking strategies[39]**. The inability for decision support tools to mimic real work behaviour is most manifest in the form of cognitive biases rooted in psychology. The psychology as to how decisions regarding policy are actually formulated, the role of detailed analysis and expertise such as that involved in parametric modelling in the process of policy development, and its role in final policy output and decision-making is poorly researched and therefore little understood[40]. What is known is that heuristics and biases are prevalent, particularly around issues involving substantial uncertainty and that the dialectic process between the analytical and policy making communities is marked by very different cultures, processes, and lexica[41]. This is exemplified in a recent meta study as to how uncertainty is visually communicated and its impact on decision making[42].
- **There is a need to deal with the impact of the interaction of multiple cognitive biases (Figure 6)[43] and expert judgement in decision making and policy design – called noise[44]**. Much in the realm of anticipating climate risk and uncertainty requires the making of judgment calls, which are guided by informal experience and general principles rather than by rigid rules e.g., the reductions in the costs of novel low carbon technologies at designated timesteps. Policy design requires consistency. However, experiences in other professions have found that judgments are strongly influenced by irrelevant factors – e.g., in real estate appraisal, qualified valuers in the same market with the same input assumptions are considered to be able to develop estimation of price with 5 to 10% variation. In reality 80% of assessments resulted in 90% variation[45]. Therefore, there is a need to introduce formal processes which accommodate these effects by the development of a noise audit.

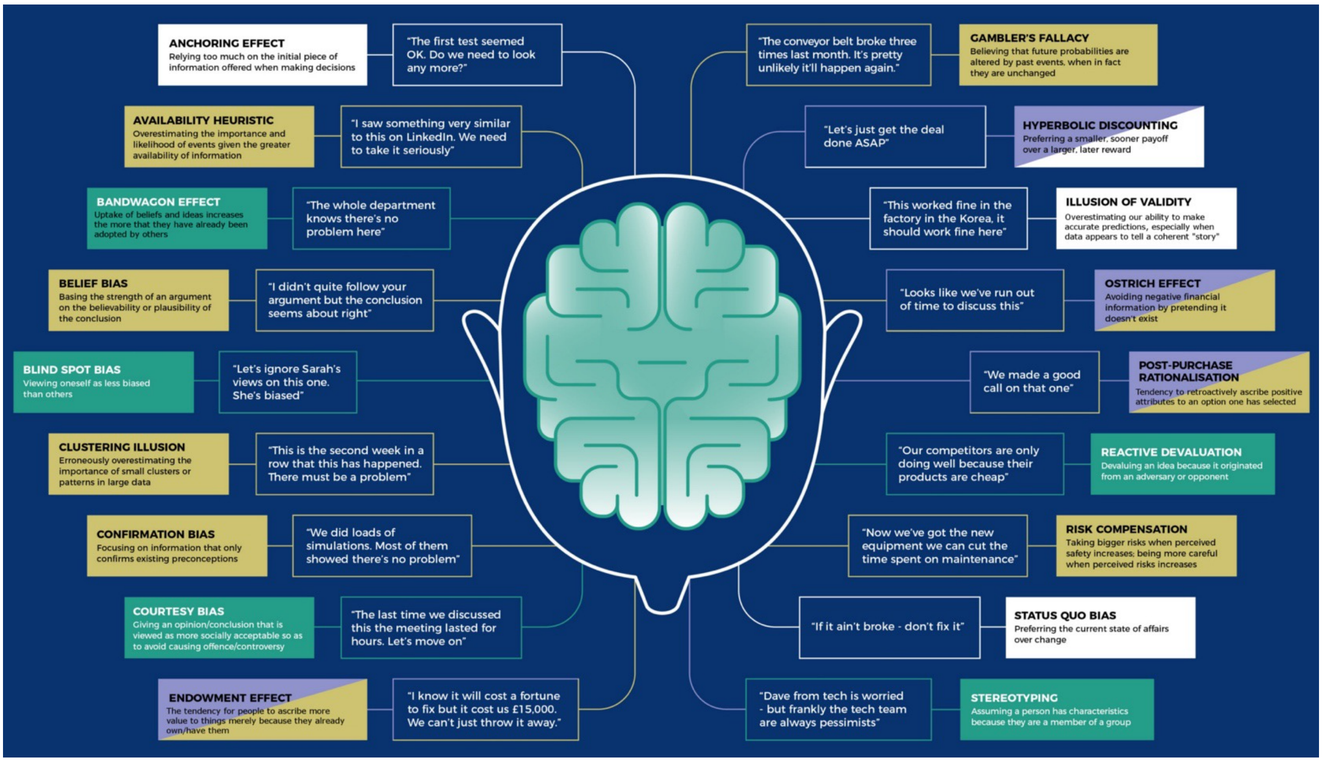

Figure 6: Cognitive Bias Codex.

- **There is a need to develop a common lexicon around climate risk across relevant audiences**. Verbal descriptions of uncertainty can mask important, often critical, differences between the views of different experts. For example, members of the Executive Committee of the Environmental Protection Agency (EPA) Science Advisory Board were asked to assign numerical probabilities to uncertainty words that had been proposed for use with EPA cancer guidelines (see Figure 7)[46]. This has to some degree been addressed within the IPCC process but less so beyond[47].

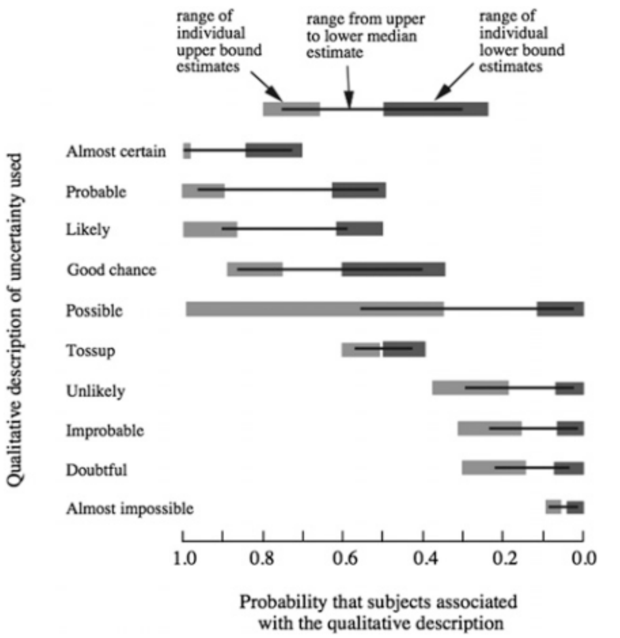

Figure 7: Variation in uncertainty words assigned probability functions for use in EPA cancer guidelines.

- **When undertaking exploratory assessments, framing questions in an open manner is vital to avoid distortions in decision making**. This is best exemplified by the decision in 2003 to invade Iraq. An assessment was made as to whether the regime possessed Weapons of Mass Destruction – the US intelligence community agreed that the assertion was correct. However, the question should not have been answered in as closed fashion as '*Was it correct?*' It should have been '*Was the assertion reasonable?*' Had the assessment associated with an open manner then it might have changed people's perception of the certainty with which it was proposed. The intelligence analysis was not merely wrong – but it was wrong when it said that it could not be wrong[48]. Framing effects also extend to values-based approaches in terms of objective criteria as to what policy is seeking to achieve as opposed to alternative based approaches[49]. Furthermore, other forms of framing effects can make climate risk and uncertainty appeal to audiences to gain policy traction e.g., the health in UK[50] and security in the US[51].

- **Accommodating for the culture of the agents involved in the policy design is a very important consideration along with the psychology of making decisions in deep uncertainty**. Policy formulation cultures can be described as: an analytical community undertaking evidence gathering and analysis, while a policymaking community debates, negotiates or further develops policy for enactment based on potential outcomes and acceptability. Popper (2019)[52] distinguishes these two cultures as a numerate, reductionist analytical community, rooted in deductive logic, while the culture of policy is more narrative based and framed in the logic of abductive reasoning. Whereas the culture of policy considers questions of the future: "How will we be affected if present trends continue? What could go wrong if we follow this course or that? If the circumstances we most fear come to pass, how will we cope?."

Challenge 3: Policy design within a systemic collaborative value chain framework.

- **The specialisation and separation of climate policy analysis, design and decision making within governmental departments and the institutional fragmentation of government departments makes the addressing of systemic, cross-cutting climate risk and uncertainty highly problematic**. There is a need to understand policy design and decision making as taking place along a value chain in that any one impact on one part will have an impact on other aspects, as illustrated in Figure 2.
- **Recent research has emphasised the need for more collaborative, specific, standardisation and greater interdisciplinarity between actors along the decision value chain**[3]. Specifically, these include the need to:
  - Develop risk assessments in collaboration with policymakers: Create channels for climate scientists to collaborate with policymakers and support open and regular communication between these groups to build a shared knowledge base and appropriately address relevant policy questions.
  - Provide granular climate risk information about specific locations and industries: To illustrate localised risk that can be avoided and to highlight the limits to adaptation, stakeholders should be continually engaged in regional climate modelling and climate model downscaling.
  - Standardise best practices in climate risk assessments: best practices should be standardized in climate assessment processes to facilitate comparisons, while ensuring that each assessment is tailored to a specific audience.
  - Engage interdisciplinary teams to illustrate cascading climate change impacts and develop solutions: Support interdisciplinary and cross-sectoral teams to co-create climate risk assessments and complementary solutions that will sufficiently address cascading climate impacts.

Challenge 4: Institutionalise accountable governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors.

- **Traditional governance tends to be didactic and prescriptive in nature which struggles to address deep uncertainty and/or fast-moving technology development**. There are, however, new governance constructs such as Anticipatory Governance[53] which have a future-facing, inclusive, iterative, and experimental dimension to innovation development, as shown in Figure 8. Governments around the world are gradually subscribing to elements of anticipatory governance – see[54], for example the UK has developed a Better Regulation Executive in the department of Business Energy and Industrial Strategy[55].
- **Developing participatory approaches with societal actors to allow multiple values and diversity, stakeholders, and viewpoints. This should enable decision making constructs which exist in an iterative exchange with policy development rather than separate from it thereby generating societal buy-in on climate policy**. It needs to go beyond the information deficit model constructs and discrete end-of-process component of policy design, to which it is often relegated. Inclusive approaches to enable societal actors to generate the policy enabling environment through an ongoing dialogue `legitimizing' the actions of decision makers around climate policy – see Figure 9. It enables the capacity for social imagination for the future to be expanded[56] and allows purposeful and aspirational narratives to give meaning to actions[57]. Opening up the discussion in this way would likely force societies to confront the reality that keeping global average warming to well below 2 °C, let alone 1.5 °C, is probably obtainable only with transformative change in all elements of society, the impacts of which could be unequally distributed. This is happening in the form of Climate Assemblies, Random Control Trials, and Living Labs but their integration into policy design has yet to be formalised[58].

- **Inclusive and collaborative**, in engaging the public and diverse stakeholders where new technologies and how they are deployed raise ethical issues, and in leveraging the capabilities of businesses, cities and civil society to secure policy goals.
- **Future-facing**, in developing resilient, adaptive strategies that can cope with the inherent uncertainty of fast-changing markets.
- **Proactive**, in engaging with innovators and innovation early in the cycle to provide predictability and enable timely, proportionate responses to issues that may scale rapidly.
- **Iterative**, in taking a test-and-evolve rather than solve-and-leave approach to novel problems, for which there may be no established playbook.
- **Outcomes-based**, in focusing on validating companies' efforts to achieve well-defined goals, rather than setting rules, and particularly on incentivising platforms to support regulatory objectives.
- **Experimental**, in facilitating diverse responses to regulation of early-stage opportunities and risks, and where national or global policies and standards are still to be established.

Figure 8: Components of Anticipatory Governance.

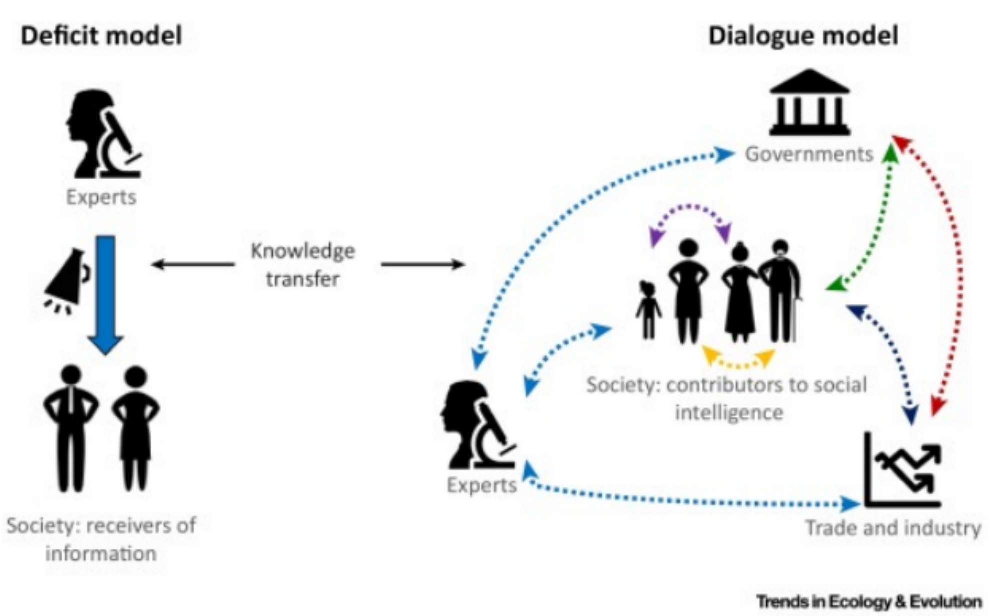

Figure 9: Deficit model vs Dialogue model.

- **This is a leadership, cultural and competency challenge**: There is a need to address meaningful accountability via systematic tracking of policy design processes and their effectiveness so that they can be assessed. As Tetlock[59] puts it `*To have accountability for [one without the other] is like ensuring that physicians wash their hands, examine the patient, and consider all the symptoms, but never checking to see whether the treatment works.*' One reason that this is under appreciated is that the problem of noise – see above – is invisible in that people do not go through life imagining plausible alternatives to every judgment they make. This emphasises **the need for ex-post analysis and further research** – which is the next challenge.

Challenge 5: Climate risk is under researched, especially social science and interdisciplinary approaches and how expertise is translated into effective climate policy.

- **There is a lack of research on climate change related risk across a range of topics**. Figure 10 shows the number of journal articles (per decade) on decision-making and risk management found in the literature database SCOPUS for seven climate-related risks, with the number specifically related to 'climate change' indicated. It can be seen that climate change makes up a very small proportion of the total corpus.

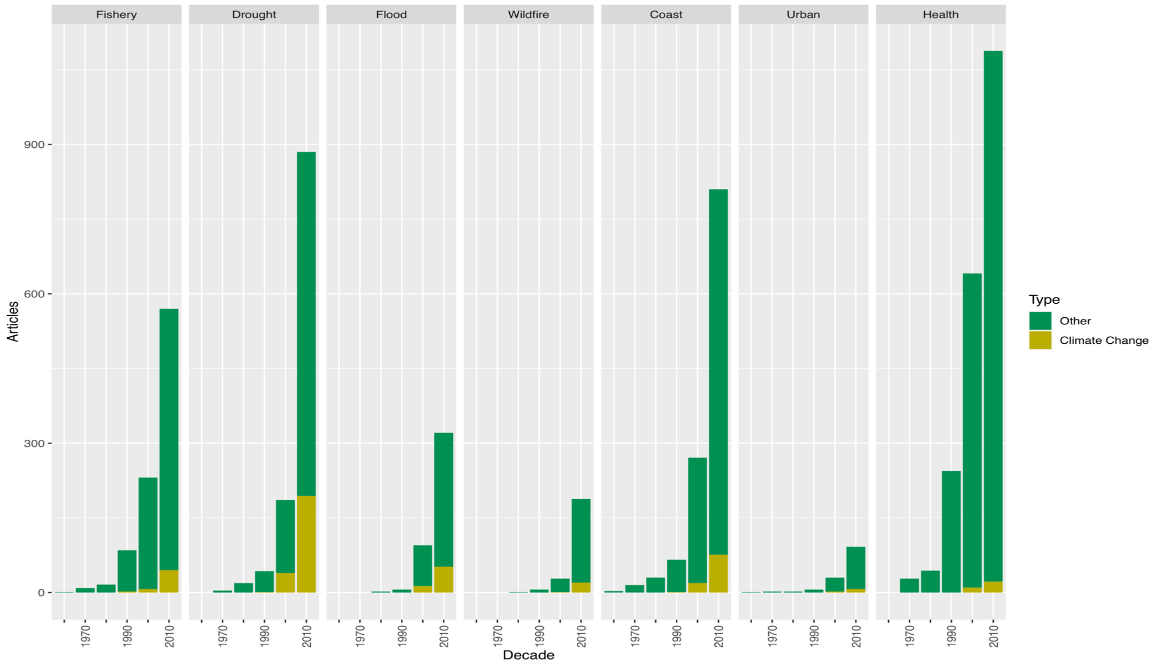

Figure 10: Number of journal articles (per decade) on decision-making and risk management found in the literature database SCOPUS for seven climate-related risks.

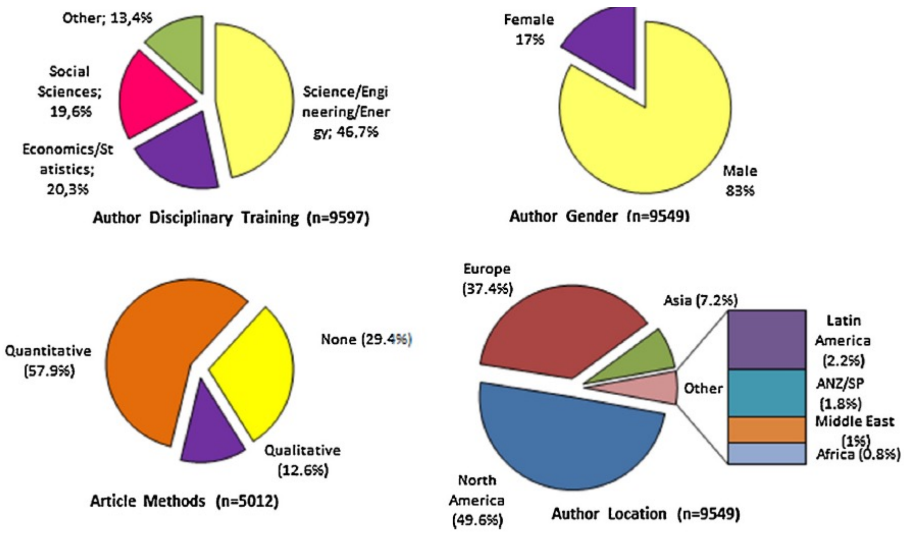

Figure 11: Meta study of energy studies research between 1999 – 2013 for the Energy Sector.

- **Climate change related research lacks diversity, gender and ethnic representation and suffers from disciplinary chauvinism**. Figure 11 displays a meta study of energy studies research between 1999 – 2013 for the Energy Sector[60]. The disciplinary, gender, methodological, and geographic trends underrepresent social science, qualitative methods, non-European and US contributors and women. Climate risk and the net zero transformation is a global issue and research and the development of insight on solution sets needs societally representative research.

- **Policymakers and analysts who have been providing insights as to what is required to manage climate risk and realise the net zero transition by 2050 have tended to be schooled in the constructs around consolidative modelling**. However, though energy system modelling was relevant to develop policy insights for an energy system which was a highly centralised, heavily regulated, tightly bounded, and unidirectional electricity system – when you augment such models by bolting on increasingly diverse and immature technologies which have cross-economy impacts – their capacity to manage the extent of uncertainty encountered is superseded[61].

10. ANNEX 2: DETAILED CASE STUDY ASSESSMENT OF THREE DECISION SUPPORT TOOLS

A study was undertaken to identify current best practice for improving decision-making processes for operationalising research focusing on the complexities and uncertainties associated with climate risk for policy development, and to assess the extent to which recently developed decision support tools may help improve decision-making and the translation of research into action in a context characterised by complexity and uncertainty. In order to assess the potential of decision support tools for achieving impact via policy, three support tools focusing on climate risk were analysed, with each of these covering different geographical scales (global, national, and regional).

CASE STUDIES

The three case studies examined in the assessment were:

1. **UNICEF Children's Climate Risk Index (CCRI)[62] – global scale.**
2. **UK Climate Change Risk Assessment (CCRA)[63] – national scale.**
3. **Climate Risk Assessment in Cities (C40 Cities)[64]: C40 Infrastructure Interdependencies and Cascading Climate Impacts Study – regional.**

The first case study, the Children's Climate Risk Index (CCRI), was published by UNICEF in 2021. The CCRI is a global, multi-dimensional child risk index that maps child exposures to climate hazards, shocks, and stresses in 2020, and vulnerabilities to these hazards. It uses global data sources to identify the risk of climate impacts specifically on children who, compared with adults, have limited resources and are particularly sensitive to diseases, malnutrition, and disasters, and can also become subject to the indirect effects of climate change, such as migration. While the maps identify sub-Saharan Africa and South Asia as areas presenting the highest climate risk, the current CCRI report does not make projections about the risks to children in the future. However, the CCRI is unique in that it incorporates child-specific dimensions of vulnerability, including child health, education, nutrition, WASH (water, sanitation, and hygiene), social protection and child engagement in decision-making about their futures as endorsed in the United Nations Convention on the Rights of the Child (CRC). As a decision support tool, it helps to identify a) the countries and areas most at risk of child deprivations and humanitarian situations affecting children as a result of their exposure to climate, environmental and socio-economic institutional shocks, or stresses; and b) the underlying factors that could contribute to these risks.

The second case study was the UK National Climate Change Risk Assessment, which was published in 2022. The assessment was undertaken by the UK government in collaboration with the Climate Change Committee as the third five-year assessment of the risks of climate change on the UK, as per the requirements of the Climate Change Act of 2008. The assessment uses evidence from the latest scientific research to explore the future impacts of climate change on the UK under multiple possible global warning scenarios. It reveals how, even under low warming scenarios, the UK will be subject to a range of significant impacts. The risk assessment is endorsed by both the UK government and the devolved administrations and the Technical Report for the assessment identifies sixty-one climate risks cutting across multiple sectors of our society and their associated impacts. Risks and impacts are considered in relation to the following: natural environment and assets; infrastructure; health, communities, and the built environment; business and industry; and international dimensions.
The assessment considers the urgency of adapting to climate risks in relation to the current and future projected climate along two potential pathways: (i) stabilising 2°C by the end of the century, representing achievement of the Paris Agreement goals; (ii) 4°C global warming at the end of the century, consistent with the current limited global ambition for reducing emissions The extent to which current UK adaptation plans will manage these risks is also assessed, as well as the potential of additional action on adaptation within the next 5 years. Risks are scored according to the urgency of additional adaptation action. The assessment includes specific national summaries for each of the devolved nations and specific sector briefings.

The third decision support tool examined was the C40 Infrastructure Interdependencies and Climate Risks Report (C40 Infrastructure Interdependencies and Cascading Climate Impacts Study), which was published in 2017. This report examines how several city governments in different regions of the world and other public agencies have understood and considered the cascading impacts of climate change on complex, interconnected, urban infrastructure systems. In particular, it explores how identification and consideration of these interdependencies and climate impacts can reduce risks to systems, and the diverse ways that sectoral and infrastructural interdependences and risks can be communicated to help city government departments and local agencies to tailor the development of adaptation strategies. The report includes several recommendations for best practice for city agencies for facilitating collective action and for conducting preliminary analyses of climate risks to interdependent infrastructure for the tailoring of adaptation strategies.

Identification of requirements for best practice for engaging with complexity and uncertainty in climate risk decision-making.

Requirements for best practice for engaging with complexity and uncertainty in climate risk decision-making were ascertained from examining the literature and the latest thinking on complexity in climate risk decision-making (see Annex 1). These were derived according to their potential for addressing each of the five key challenges associated with managing the complexity and uncertainty surrounding climate risk (see Section 5), and for which a set of criteria for best practice in meeting each of the challenges were identified. Requirements for best practice were therefore defined as follows:

Challenge 1: Matching of decision analysis and support tools to the extent of uncertainty and complexity encountered in the system context.

Challenge 2: Ensuring an Interdisciplinary approach integrating decision science and psychology and accommodating decision cultures.

Challenge 3: Policy design within a systemic collaborative value chain framework.

Challenge 4: Institutionalisation of accountable governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors.

Challenge 5: Engagement in research focused on climate risk that moves beyond the natural sciences and includes social science and interdisciplinary approaches and which examines how expertise can be translated into effective climate policy.

The particular criteria and associated aspects of each criteria used to indicate best practice in relation to the requirements of each of the five challenges were identified from the literature as follows (as shown in Section 6):

Challenge 1 – Matching decision analysis and support tools to the extent of uncertainty and complexity encountered in the system context.

- **Criteria 1: complexity and uncertainty**
  Recognition and characterisation of the full extent of complexity and uncertainty present in the system context, as evident through description and mapping of system complexity.
- **Criteria 2: consolidative and exploratory modelling**
  Demonstrable use of exploratory modelling with diverse actors, reflecting diverse priorities, goals and values, and engagement in polycentric decision-making without privileging one set of assumptions over others.
- **Criteria 3: complex decision analysis**
  Acknowledgement of the limitations of decision analysis support tools and robust awareness of the characteristics of complex, real-world problems.
- **Criteria 4: integrative decision support tools**
  Parametric and data-driven tools are used as part of a wider array of integrative decision support tools to explore options. Consideration is given to multiple variables and how the relationships and interconnections between them may lead to different outcomes, without heavy reliance on numerical outputs only.
- **Criteria 5: transparency**
  Use of hybrid parametric-qualitative approaches, with uncertainties and assumptions being made transparent through evidence of a process of `deliberation with analyses. Parametric outputs are not used to provide definitive outcomes or to influence choices.

Challenge 2 – Ensuring an Interdisciplinary approach integrating decision science and psychology and accommodating decision cultures.

- **Criteria 1: better accommodation of human behaviour**
  Recognition that optimised outcomes in multi-actor constructs result in far from robust strategies.
- **Criteria 2: cognitive bias recognition**
  Demonstrates attempts to deal with the impact of interaction of multiple cognitive biases and expert judgement in decision making and policy design through use of formal processes to accommodate the effects of cognitive bias.
- **Criteria 3: common lexicon**
  Use of common lexicon around climate risk by multiple audiences.
- **Criteria 4: open framing**
  In exploratory assessments, questions are framed in an open manner, and framing is used in value-based approaches for objective criteria.
- **Criteria 5: culture and psychology**
  Demonstrable evidence as to how the culture of agents involved in the policy design has been considered and accommodated, along with the psychology of making decisions in deep uncertainty.

Challenge 3 – Policy design within a systemic collaborative value chain framework.

- **Criteria 1: avoidance of over-specialisation and over-separation**
  Recognises that the specialisation and separation of climate policy analysis, design and decision making within governmental departments and the institutional fragmentation of government departments makes for the addressing of systemic, cross-cutting climate risk and uncertainty highly problematic.
- **Criteria 2: enhanced collaboration**
  Reflective of collaborative, specific, standardisation and greater interdisciplinarity between actors along the decision value chain through open and regular communication between diverse groups, engagement in regional climate modelling and climate model downscaling, standardisation of best practice, co-creation of climate risk assessments and complementary solutions for cascading climate impacts.
- **Criteria 3: trans-department collaboration**
  New developments cut across government departments and subject matter expertise within governments.

Challenge 4 – Institutionalise accountable governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors.

- **Criteria 1: non-traditional governance**
  Evidence of anticipatory governance to address deep uncertainty, including proactive, inclusive, and collaborative approaches, and iterative and experimental approaches to problem solving.
- **Criteria 2: participatory approaches**
  Demonstrates participatory approaches with diverse societal actors that allow for multiple values and viewpoints in ongoing dialogue.
- **Criteria 3: leadership, culture, and competency**
  Accountability of policy design through systematic tracking.

Challenge 5 – Climate risk is under researched, especially social science and interdisciplinary approaches and how expertise is translated into effective climate policy.

- **Criteria 1: research theme/perspective range**
  Draws upon a range of research from multiple disciplines based on multiple research methods and does not privilege 'traditional' approaches ground in engineering, economics, and the natural sciences. New interdisciplinary research and approaches are embraced and applied, and multiple theoretical perspectives are considered. Adopts an action-oriented approach to policy relevant research and considers multiple forms of climate risk and how these risks interrelate.
- **Criteria 2: diversity of representation**
  Research includes diversity of experiences and actively addresses inequalities of representation, including inequalities based on gender, disability, ethnicity, culture, geographic, social-economics, political and educational factors and adopts a non-tokenistic approach to inclusion. Research agendas and decision-making allow multiple social actors to collaborate at every stage of the process, including in the research design and development of solutions.
- **Criteria 3: analytical perspectives**
  Draws on a broad range of analytical perspectives and moves beyond consolidative modelling approaches.
- **Criteria 4: transdisciplinary approaches**
  Demonstrates evidence of cross-cutting transdisciplinary collaborative research that actively seeks to support effective decision making to address climate risk and to avoid distortive effects, including new decision support tools.

It is important to note that the criteria for best practice were compiled through examination of the available literature. Exactly how the criteria representing best practice may be met and actioned in examples of recent research focusing on the development and implementation of decision-support tools for managing climate risk remains unknown.

Assessment of the potential of each of the case study decision support tools for improving decision-making for policy and the translation of research into action.

Assessment of the potential of each of the three decision support tools for improving decision-making and the translation of research evidence into policy was made by examining and evaluating each of the decision support tools against each of the 20 criteria associated with the five challenges. The extent to which each of the tools met each of the criteria was graded using a Likert Scale measurement:

1 = Absent – Not ascertainable or does not meet the criteria. This was applied in instances where the potential cannot be determined on the basis of the contents of the final report alone, such as in instances where the focus of the criteria lies outwith the scope of the contents of the report.

2 = Poor – Poorly meets some aspects of the criteria. For example, where the decision support tool only partly meets the criteria such as when awareness of the benefits of adopting key features of the criteria are shown via statements made in the report, but where there is little or no evidence presented of how this was or can be actioned in practice through developments and outcomes.

3 = Fair – Meets some aspects of the criteria but does not meet other aspects.

4 = Good – Meets the criteria, but with room for improvement. This was applied in instances where methods and recommendations for dealing with complexity and uncertainty in decision-making were used, but where the use of traditional, consolidative methods, approaches and decision-making practices remained dominant.

5 = Excellent – Shows convincing evidence of meeting all aspects of the criteria.

The overall potential of each of the decision support tools for meeting the five challenges for improving decision-making was derived as follows:

Mostly absent (at least 50% of the criteria being absent) = Not ascertainable

Mostly poor = Low potential

Mostly fair = Fair potential

Mostly good = Significant potential

Mostly Excellent = Significantly high potential.

RESULTS

The full result of the assessment is shown in Table 2.

DISCUSSION OF FINDINGS

Challenge 1: Matching decision analysis and support tools to the extent of uncertainty and complexity encountered in the system context.

The findings show that the potential of each of the decision support tools to meet challenge 1 differ. The potential of the Children's Climate Risk Index for meeting the challenge could not be ascertained from the final report. This is because although it maps the complexity concerning children's exposure to climate hazards, shocks and stresses and the interconnected nature of the socio-economic factors that influence their vulnerability to the harmful impacts associated with these climate phenomena, it does not discuss how the recommendations made can be actioned through policy development processes.

While the UK Climate Change Risk Assessment reflects slightly greater potential than the CCRI for meeting the challenge, its potential for successfully meeting the challenge remains limited. This is because although it maps different possible climate change scenarios, thereby demonstrating understanding of the complexity of the system, the ways in which decisions were made and projected outcomes used in decision making for policy development were outwith the remit of the report itself. Nevertheless, the technical report demonstrates how slight changes in climate can have cascading impacts across the system and analyses the risks across the different sectors and recognises the importance of both local and international risks. It also directs readers to a range of tools that have been developed to help decision makers assess climate risk and develop and deliver a policy response that affects real change. However, it does not assess the appropriateness or effectiveness of these in practice. In addition to the use of consolidative models, the CCRA also stresses the importance of the potential of using storylines and scenarios to explore the factors that contribute to how events may unfold, revealing awareness of the need to move beyond the use of predictive, numerical data-driven tools to explore options and to consider how multiple variables and the relationships and interconnections between them may lead to different outcomes. However, additional examples of how this may be implemented in actual decision-making contexts would help to highlight opportunities for improving best practice in these decision-making contexts.

Key Challenges	Potential for Improving Decision-Making and Outcomes		
	Children's Climate Risk Index (CCRI)	UK national Climate Change Risk Assessment (CCRA)	Climate Risk in Cities – C40 Cities
Challenge 1: Matching decision analysis and support tools to the extent of uncertainty and complexity encountered in the system context	**Not Ascertainable**	**Limited Potential**	**Fair Potential**
• Criteria 1: complexity and uncertainty	2	2	4
• Criteria 2: exploratory modelling	1	1	3
• Criteria 3: complex decision analysis	1	2	3
• Criteria 4: integrative decision support tools	1	2	3
• Criteria 5: transparency	1	3	4
Challenge 2: Ensuring an Interdisciplinary approach integrating decision science and psychology and accommodating decision cultures	**Not Ascertainable**	**Not Ascertainable**	**Limited Potential**
• Criteria 1: better accommodation of human behaviour	1	1	2
• Criteria 2: cognitive bias recognition	1	1	1
• Criteria 3: common lexicon	1	2	3
• Criteria 4: open framing	1	2	3
• Criteria 5: culture and psychology	1	1	1
Challenge 3: Policy design within a systemic collaborative value chain framework.	**Not Ascertainable**	**Limited Potential**	**Fair Potential**
• Criteria 1: avoidance of over-specialisation and over-separation	1	1	4
• Criterial 2: enhanced collaboration	1	2	3
• Criteria 3: trans-department collaboration	1	2	3
Challenge 4: Institutionalise accountable governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors.	**Not Ascertainable**	**Limited potential**	**Limited potential**
• Criteria 1: non-traditional governance	1	1	2
• Criteria 2: participatory approaches	2	2	2
• Criteria 3: leadership, culture, and competency	1	2	2
Challenge 5: Climate risk is under researched, especially social science and interdisciplinary approaches and how expertise is translated into effective climate policy.	**Limited Potential**	**Fair Potential**	**Fair Potential**
• Criteria 1: research theme/perspective range	3	3	4
• Criteria 2: diversity of representation	2	2	2
• Criteria 3: analytical perspectives	2	1	3
• Criteria 4: transdisciplinary approaches	2	3	4

Table 2: Full results of the assessment, on the potential of each case study to improve decision-making.

The C40 Cities report provided more evidence of greater engagement with system complexity than the CCRI report and provided greater evidence and examples of how this could be actively used to select appropriate decision support tools. It also detailed a range of approaches and methods that have been used to facilitate understanding of interdependencies among stakeholders. Furthermore, it highlighted the importance of identifying failure points in interconnected systems to help tailor more appropriate adaptation strategies. However, more could be done to develop integrated support tools for use with a broader range of stakeholders in different and more diverse urban contexts.

Challenge 2 – Ensuring an Interdisciplinary approach integrating decision science and psychology and accommodating decision cultures.

The extent to which each of the decision-support tools can meet the challenge of ensuring an interdisciplinary approach that integrates decision science and psychology and accommodates for decision cultures is more limited than the potential of the tools for meeting challenge 1. This is because neither the CCRI nor the CCRA focus on how to specifically action the science within the policy context, including how best to support decision-making in the actioning of recommendations. While the CCRA acknowledges that the impact of adaptation measures can take a long time to take effect and that there is a need to monitor the impacts of such actions, the ways in which this could be achieved by the different stakeholders and the importance of considering different decision cultures in relation to actioning the recommendations is not discussed. It does however acknowledge the need for a shared lexicon and provides a list of key terms and concepts to achieve this. The C40 Cities report provides information about how infrastructure sectors can reduce risks to an acceptable level on a mutually prioritized basis and highlights the importance of identifying areas of common risk between organizations and overlapping or common responsibilities for risk mitigation, and any gaps to addressing these risks. However, it does not demonstrate ways in which the impact of the interaction of multiple cognitive biases and expert judgement can affect decision making or deploy formal processes to accommodate the effects of cognitive bias. This indicates that more research needs to be undertaken to explore how interventions targeted at decision support cultures may help to facilitate effective decision making for enhancing policy.

Challenge 3 – Policy design within a systemic collaborative value chain framework.

The potential of the CCRI to improve policy design within a systematic value chain framework was assessed to be low. This is because of its lack of focus on how the recommendations from the research can actually be actioned in the policy decision making context. While the CCRA acknowledges the importance of enhanced and trans-department collaboration, the assessment is policy sector-specific focused (including in outputs specifically developed for the policy sector) and thus questions remain about how greater trans-department or intersectoral collaboration may be achieved in practice. There also remains a gap between strategic level policy and how policies may be actioned at the local level, as well as in how to achieve greater collaboration between the public and private sector in practice. In contrast, the C40 Cities report not only acknowledges the need for enhanced collaboration but looks at the different types of data that may be used as part of this collaborative decision-making process for identifying and analysing climate risks in interdependent systems and how this may be actioned in collaborative adaptation strategy development between the public and private sector to overcome data barriers in the development of outcomes. It also provides a summary of recommendations for practice from the lessons learned from efforts to facilitate engagement to develop and implement collective adaptation strategies, including the need to involve multiple scales of government, the private sector and community organisations. However, the extent to which these recommendations may be implemented in other policy contexts remains uncertain.

Challenge 4 – Institutionalise accountable governance mechanisms which accommodate anticipatory, future facing and participatory engagement with societal actors.

The findings show that the potential of the decision support tools to meet challenge 4 remains limited or non-ascertainable for each tool. This suggests that a priority area for future research would be to explore how methods of governance and leadership may influence policy decisions and the translation of research evidence into actionable outcomes.

Challenge 5 – Climate risk is under researched, especially social science and interdisciplinary approaches and how expertise is translated into effective climate policy.

In contrast with the findings for challenge 4, all three decision support tools demonstrated greater engagement with each of the criteria required to meet challenge 5. However, the potential of the C40 report and the CCRA for doing so was greater than for the CCRI. While the CCRI recommends greater diversity of research and representation in more transdisciplinary applied-action research focused on climate risk, once again it does not mention this specifically in relation to the policy decision making and knowledge operationalisation processes. The CCRA report recommends for future research not only to improve understandings of the science of climate, but to focus on ways of helping decision makers understand risk and implement these understandings in localised risk assessments. It also directs readers to a policy development tool developed by Frontier Economics and Paul Watkiss Associates that helps policy makers develop cases for action and identify appropriate options. However, more could be done to actively address inequalities of representation in decision making to allow multiple social actors to collaborate at all stages of the decision-making process. The C40 Cities report places greater emphasis on drawing on a wider range of analytical perspectives than the other reports for moving beyond consolidative modelling approaches. However, it also acknowledges that further research needs to be undertaken to explore the connectedness between infrastructure characteristics to help develop and implement adaptation solutions.

CONCLUSION OF THE CASE STUDY ANALYSIS

While the findings show that each of the decision support tools analysed have at least some potential for successfully meeting each of the challenges, further research needs to be undertaken to explore how decision-making support tools can more effectively aid the mobilisation of research into policy. This is because none of the tools examined fully met all of the criteria associated with best practice for meeting each of the five challenges identified.

Although recent research focusing on climate risk aimed at informing policymakers has acknowledged the complexities and uncertainties associated with climate change, it remains the case that little information is available that reveals the processes through which the scientific research can be effectively translated and operationalised for policy decision-making, development, and implementation. Limitations in the knowledge available, including examples of the effective mobilisation of knowledge for decision support, means that discerning best practice for improving decision-making aimed at tackling the five key challenges in diverse, real-world situations cannot be readily ascertained on the basis of the case studies alone. While analysis of the decision support tools reveals that each one at least partly meets some of the criteria associated with meeting each of the five key challenges, more work needs to be undertaken to improve understanding of how decision support can be optimised for policy developments. While each of the case studies is reflective of at least some potential for enabling policy developments to meet each of the five key challenges, gaps remain in understanding how this potential can be maximised to improve outcomes aimed in the context of the complexity and uncertainty associated with climate risk.

In particular, the findings show that there is a need for further research focusing on the actual processes of collaborative decision making for enhancing the translation of scientific evidence into policy, including examining the ways in which research and policy can be more mutually informative to enable climate risk research to be more impactful. In addition, more needs to be done to identify limitations in the existing research and capacity gaps for climate risk decision-making under uncertainty to aid the development of translation mechanisms for improving best practice in operationalising decision-support.

It is important to note however that these reports were produced with the purpose of informing policymakers about developments in research to help support policy decision-making rather than for improving decision-making processes per se. In other words, the aim was to inform for the purpose of translation rather than to inform the translation process itself. This means that the processes and discussions through which decisions were made as to how the developments, outcomes and recommendations detailed in the final reports were produced are not readily ascertainable from the final reports alone. Consequently, it may well be that the processes that lay behind the production of the final reports may have reflected engagement with the criteria used to evaluate the final reports and that further knowledge for informing best practice may be obtained from discussion with members of the project teams involved in developing each of the three reports. However, this would require further research to be undertaken involving interviews with project team members to ascertain how decisions were made.

RECOMMENDATIONS

From the findings of the case study analysis, three specific recommendations were made for improving decision making in the operationalising research for policy to better meet the challenges associated with the complexities and uncertainties that characterise the climate risk context. These were:

1. To enhance collaboration between decision-makers, policymakers, analysts, researchers, and other stakeholders to co-develop and co-design operational climate risk assessments and policies, relevant to context.
2. To identify the research and capacity gaps around climate risk decision-making under uncertainty, and work with stakeholders across the decision value chain to ensure those gaps are addressed.
3. To co-create effective translation mechanisms to embed decision-support tools into policy better, employing a participatory approach to ensure inclusion of diverse values and viewpoints.

NEXT STEPS

The next steps in the research were to validate the findings of the case study analysis and test the recommendations drawn from these findings through a workshop with members of the UK policy community (Section 7). Following this workshop, a second workshop was held to explore the ways that the recommendations could be actioned to achieve their aims via collaboration between researchers and policy makers.

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THE UK UNIVERSITIES CLIMATE NETWORK

This report is produced in association with the UK Universities Climate Network, a growing group of over 80 UK-based universities and research centres working together to deliver a low carbon, resilient world.

We enable collaboration across the UK academic sector to advance climate action nationally and internationally. We do this by disseminating climate change research and analysis, conducting evidence-based public engagement, and sharing evidence for climate action with policymakers, such as UK Government officials, to support the integration of science and policy.

We first assembled in Autumn 2019 as the COP26 Universities Network with a goal to ensure the academic sector played its role in delivering a successful UN COP26 Climate Change Conference in Glasgow in November 2021. We carried out an extensive work programme in the lead up to the conference to create momentum, engage public and business audiences, and provide support to the UK Government.

We became the UK Universities Climate Network in March 2022 and will continue our work in the lead up to COP27 and beyond. Our Secretariat is based at the Grantham Institute for Climate Change and Environment at Imperial College London. For more information about the UK Universities Climate Network, please contact UKClimateUniversities@imperial.ac.uk

This report represents the views of its authors (listed on page one) and not necessarily that of every University or institution participating in the network.

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