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Integrating climate mitigation and adaptation: A new framework for achieving "Climate Resilient Net Zero" in preparing for heat risk

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Abstract

Climate Policy Integration (CPI) is key to mainstreaming and harmonising mitigation and adaptation in policy responses to climate change worldwide. However, little is known about how CPI can be applied in practice, beyond single policy areas, particularly in the integration of adaptation and mitigation responses. We investigate this in the context of responding to climate impacts such as extreme heat, a climate risk growing in international importance. Using the 2022 UK heatwaves as a case study, our paper explores: (a) the extent to which key stakeholders consider the integration of adaptation and mitigation to be important; (b) perceptions of the feasibility of integration; and (c) main enablers and/or challenges with integration of adaptation and mitigation. To do this, interviews (N=38) and four focus groups (N=21) were conducted with policymakers, first responders, utilities providers, and civil society responsible for managing heat risks. Our findings reveal a tension that CPI is essential to achieving a "climate resilient net zero", yet unrealised. To explain this, we present a new framework with international and multi-contextual significance, highlighting the convergence of key elements integral to realising effective CPI: (1) 'Challenges' - that may hinder, undermine, or act as a barrier to the integration of mitigation and adaptation; (2) 'Enablers' - which support, or help to facilitate greater integration, or synergies, between mitigation and adaptation; (3) 'Framings' - different ways participants described, defined or interpreted the issue of integration; (4) 'Importance' – the extent to which participants thought that integrating mitigation and adaptation was important; and (5) 'Feasibility' – or how possible integration is. We conclude that unless all five factors are fully addressed by researchers and decision-makers when tackling and understanding heat risks, new problems may emerge.

Highlights

- Limited research considers integrating mitigation AND adaptation for heat risk resilience
- Mitigation and adaptation integration considered important and feasible by key heat risk practitioners

- Climate adaptation and mitigation integration typically not implemented in practice
- Enablers and challenges exist when considering integration in context of heat risk
- “Climate resilient net zero” framing is more effective than “integration”, for engagement

Key words
Heat risk; Adaptation; Mitigation; Integration; Resilience; Climate Resilient Net zero

1. Introduction

Historically, climate action has been driven by efforts for mitigation aimed at reducing greenhouse gas (GHG) emissions, with adaptation to climate risks often lagging (Reckien et al., 2018; Watts et al., 2018). The world is already experiencing a 1.1°C global increase of temperature (Tollefson, 2021) having seen limited progress in significantly curbing GHG emissions (IPCC, 2022a). However, adaptation to current climate impacts remains insufficient, and risks are projected to become more frequent, pronounced, complex and difficult to manage (IPCC, 2022b). There is now a great need to consider adaptation and mitigation to be “complementary activities” (IPCC, 2014a, 2014b), yet, local and national governments, institutions, businesses and third sectors have typically developed mitigation and adaptation strategies separately with the two processes often treated in isolation (Göpfert et al., 2019; Lee et al., 2020; Reckien et al., 2018). This fragmentation not only exists in the conceptualisation, research and discussion of adaptation and mitigation processes, but also in how they are funded and implemented, with different government departments often responsible for adaptation and mitigation. In the UK, for example, mitigation is the responsibility of the Department for Energy Security and Net Zero (DESNZ), and adaptation is led by the Department for Environment, Food and Rural Affairs (Defra) and whilst Defra is responsible for the National Adaptation Programme, adaptation is also a matter for the devolved nations (Scotland, Wales, Northern Ireland) which also tend to separate mitigation and adaptation.

Integrating adaptation and mitigation can help to reduce GHG and build climate resilience simultaneously, while improving the cost effectiveness of implementing climate responses (Hamin and Gurran 2009; Landauer et al. 2015; C40 Knowledge Hub 2018; Grafakos et al., 2019) and helping to avoid possible ‘maladaptation’ (where measures can exacerbate negative climate impacts or lead to other problematic outcomes, Barnett & O’Neill, 2010a). Highlighting the co-benefits of climate action to other (climate and non-climate) issues of concern to society can also increase public support for those policies (Jennings et al., 2020). Similarly, considering the co-impacts (benefits and negative consequences) of measures in planning and decision-making can incentivise stakeholders to collaborate in a more integrated way, garnering support for more ambitious policy and actions, and linking local, regional and national-level policies and actions (Chastin et al., 2021).

Heat risks related to climate change, such as heatwaves, have increased in frequency, duration and magnitude and, with high confidence, are a globally important future risk (IPCC 2022b). Heat risks related to climate change have led to deaths on every continent (IPCC, 2022b; Vicedo-Cabrera et al., 2021) and in the UK, where temperatures have now exceeded 40^{o}C for the first time on record, extreme heat has led to thousands of excess deaths in recent years (GOV.UK, 2020, 2021; ONS, 2022). Effective responses to heat risks may facilitate and provide benefits for both adaptation and mitigation responses simultaneously. For instance, green urban infrastructure and construction, energy efficiency, and buildings are identified as sectors with potential to synergise mitigation and adaptation (Grafakos et al. 2020). Measures include cool pavements and heat sensitive building design, development and maintenance of urban parks, green roofs and walls, and increasing tree cover (C40 Knowledge Hub 2018; House of Commons 2018; BEIS 2021). Nevertheless, research that explores the social and governance dimensions of integrated responses to heat risk is limited.

To critically explore this, we utilise the Climate Policy Integration (CPI) literature. Simply put, CPI is "the collaboration of actors from two or more policy domains in order to integrate aims and concerns derived from one policy domain into another" (Tosun and Lang 2017: 553) and examines how climate change policy can be embedded across other policy sectors (Ahmad 2009). It has been described as a process and a goal simultaneously (Cejudo and Michel, 2017). More frequently, CPI is understood as taking place either in terms of reaching one or more long-term climate goals (Dupont and Oberthür 2012) or being a continuous process of adjustment through reflexivity and learning (Biesbroek 2021). While it can be thought of as "mainstreaming" (Ahmad 2009), CPI is an emerging concept focused on engaging a narrow set of sectors to enable them to work together to meet specific goals, rather than expansive integration across all policy sectors (Adelle and Russel, 2013).

The literature on CPI thus focuses on the integration of one policy within another, particularly as a goal or a process. It lacks, however, a more granular approach to directly address how broader adaptation and mitigation approaches can be integrated within themselves at a conceptual level when considering advancing knowledge on climate action (e.g. such as responding to heat risk). It is therefore essential to find a way to rationalise the decision-making involved in climate action, and importantly, coordinate actions to address the challenges alluded to above. To that end, CPI holds promise, offering a conceptual lens through which decisions and practices on mitigation and adaptation can be aligned across international, national and/or local policy and planning scales. Despite efforts to implement CPI, there remains a lack of understanding around the appetite of different actors for it, evidence about how it works and can be implemented, and the extent to which it solves the problems it set out to resolve. Moreover, it is unclear whether CPI should be the gold standard used to tackle all types of climate problems, focused only on specific climate concerns and/or scales, or to serve as a lens through which to distinguish when it is more effective to combine mitigation and adaptation or treat those actions separately. Our aim in this article is to further illuminate and understand how CPI of mitigation and adaptation can be operationalised in practice by various stakeholders, through a focus on preparedness to extreme heat.

A range of factors can promote integration between adaptation and mitigation, many of which have the potential to underpin heat risk measures. For example, efforts to improve energy efficiency of residential properties can lead to calls to fund insulation for homes. While heat retention may help turn cold homes into warmer ones, the same factors that allow this to happen can turn homes into heat traps during the summer when natural ventilation is unavailable and/or insufficient. Installation of air conditioning may then be the only viable adaptation, but this comes with increased energy usage, which sits at odds with efforts to reduce energy consumption of non-renewables. CPI has, therefore, the potential to produce robust and joined-up decisions aligned with a 'climate resilient net zero' agenda, whereby plans for delivering net zero targets are consciously framed with an outcome being climate *resilient* societies, and plans for building resilience to climate impacts do so in unison with net zero priorities, leading to a climate changed, resilient and prepared society.

While there is a growing literature surrounding integration, few studies have assessed which factors play a direct role in relation to real-world decision-making contexts, such as integrated heat risk responses. Combining calls for greater emphasis on integration with the pressing need to respond to heat risks in the UK, we add new empirical and theoretical insights into how integration can be enhanced, while also building increased heat risk resilience at the local level. To do this, we consider the following research questions:

- To what extent do stakeholders directly involved in extreme heat risk responses on the ground consider the integration of adaptation and mitigation to be important and feasible?
- What are the main enablers and/or challenges in integrating mitigation and adaptation according to stakeholders?

- To what extent do stakeholder insights align with existing academic theory and frameworks on integration?

2. Climate Policy Integration in the context of heat risk

2.1. Climate policy integration: current thinking

Climate Policy Integration (CPI) has been explored in a variety of contexts. These include EU renewable energy and gas pipelines policies (Dupont and Oberthür 2012, Rietig 2013, Kettner and Kletzan-Slamanig 2020), climate policy integration in spatial planning and governmental budgeting across nations (Mickwitz et al., 2009), land use (Di Gregorio et al. 2017), applications across the global South (Garcia Hernandez and Bolwig 2021), green infrastructure, buildings, energy systems, and transportation (Sharifi 2021). Furthermore, broader synthesis work has explored the imperative for CPI, the state of current understanding, and proposals for implementation at the national policy scale (Ahmad 2009). Discussing Indonesian land use context, Di Gregorio et al. (2017) found that, in addition to internal and external climate policy coherence between mitigation and adaptation, there also needs to be 'vertical policy integration' to mainstream climate change into sectoral policies, and 'horizontal policy integration' by overarching governance structures for cross-sectoral coordination.

There are multiple types of relationships between adaptation and mitigation, four of which best characterise this process-driven interaction (Klein et al., 2007):

1. **Lock-in:** When adaptation actions impede mitigation efforts (e.g., increased use of air conditioning to adapt to heatwaves leading to increased GHG emissions);
2. **Viability:** When mitigation actions affect the capacity to adapt or limit what adaptation actions are possible (e.g., urban planning, building design and recycling aimed at reducing emissions which have benefits for adaptation);
3. **Focus/priorities**: When trade-offs are necessary between adaptation and mitigation actions (e.g., public-sector funding and budgetary processes that allocate funding to both adaptation and mitigation); and
4. **Poor planning:** When decisions or sequential processes do not explicitly consider their trade-offs or synergies (e.g., perception of the impacts and limits to adaptation motivate mitigation efforts and vice versa).

The literature further characterises and conceptualises different relationships between adaptation and mitigation ranging from the enhancement of adaptation and mitigation within the relationship between them (e.g. integration, inter-relationship, synergies, harmonising, complementarity, mainstreaming, holistic approach), the negative relationship that can emerge (e.g. conflict, trade-off, maladaptation), and the nature of the interaction between them (e.g. co-benefits, co-impacts, trade-off, ripple effects, win-wins, synergies, resilience) (Landauer et al., 2015; Klein et al., 2007; IPCC, 2022b; Atkins et al. 2012; Barnett and O'Neill 2010; Chastin et al. 2021; HM Government, 2022).

There are a range of conditions and factors that support or limit the extent to which CPI has been achieved, as well as means to improve implementation. At a structural governance level, there are key processes and reasons why governments pursue integration - such as aligning with existing institutional systems, logics and capacities to enhance chances of success (Biesbroek 2021), or ensuring policy harmony and the co-existence of core issues like energy security, rural economic development and climate action (Rietig 2019). A range of indicators of CPI have been identified such as political commitment, functional overlap, policy instruments, weighting between policies, and a long-term time perspective (Kettner and Kletzan-Slamanig, 2020). Using this framework, energy policy objectives are generally synergistic with climate policy, yet CPI appears to be more complex when examined in relation to other areas, such as

sustainable development, and when other indicators are considered (e.g. environmental protection, social and economic development; and justice/participation) (Rietig 2013).

The type of approaches taken in policymaking and governance at a broader, strategic level, may also help or hinder integration. Neufeldt et al. (2010) discuss the need for innovative approaches to policymaking to help increase synergies, while different sources have discussed the importance of "mainstreaming" both adaptation and mitigation throughout risk assessments and policy planning (Hamin & Gurran, 2009; HM Government, 2022; Revi, 2008). Research, in turn, has highlighted how differing policy goals, regulations and laws can hinder integration, along with conceptual divides between adaptation and mitigation (Landauer et al., 2015). For instance, in the UK, a move towards urban densification has benefits for energy consumption (mitigation), but there are inevitable trade-offs for urban flooding (adaptation) and urban blue and green space (mitigation and adaptation) (McEvoy et al., 2006). Consequently, policies not foresighted with integration objectives can often lead to conflicts, such as building designs that are optimised for performance reasons that undermine potential synergies between adaptation and mitigation (Barbhuiya et al., 2013).

Despite the existing literature, CPI is a nascent concept that has received insufficient attention (Adelle and Russel, 2013) and remains contested (Plank et al. 2021). Even in relatively climate-friendly areas (e.g. renewable energy), CPI is lacking when it comes to long-term climate policy objectives. For example, CPI is virtually absent in the EU's gas import pipeline policy (Dupont and Oberthür 2012) and to date the CPI literature has not explicitly addressed heat risk policies. Nor have extensive links been made between the CPI literature on the one hand, and the often pragmatic and applied literature on the other hand, which focuses on conditions related to synergies and trade-offs between mitigation and adaptation (e.g. Landauer et al. 2015; Göpfert et al. 2019). Despite this, there are clear opportunities in bringing these literatures together - for instance, in terms of common advocacy about the need for vertical ("to mainstream climate change into sectoral policies") and horizontal ("by overarching governance structures for cross-sectoral coordination") integration and governance structures to benefit CPI (Di Gregorio et al. 2017: 35).

2.2. Climate Policy Integration on heat risk in the UK

Policies at the international, national, and local levels are reported to influence (directly and indirectly) the extent of integration between mitigation and adaptation achieved in practice and can directly enable synergistic approaches to heat resilience. For instance, enforcements and regulations for building and urban design can minimise energy requirements and maximise thermal comfort (Barbhuiya et al., 2013), or ensure that developer's factor in urban greening features (House of Commons, 2018). Policies such as tax breaks may also help to support measures such as urban greening at the local level (Laukkonen et al., 2009). In this sense, specific synergistic measures related to heat resilience can be legislated for, regulated, or promoted through policy development at different scales.

When considering the issue of integration, the UK provides an interesting focal point for research. In the UK, examples of CPI include local authorities' policy ambitions for tree planting and urban greening which provide benefits of localised cooling as well as carbon sequestration (House of Commons 2018). Of interest, amongst the 885 EU cities that have mitigation and/or adaptation plans and 17% of UK cities have a joint adaptation and mitigation plan (Reckien et al., 2018). However, most of the UK cities with integrated plans only score a 'moderate' level of integration and only 3% of UK cities are considered to have 'advanced' integration plans, while 19% are 'early-stage' (Grafakos et al., 2020). This suggests that while the UK may have a relatively strong focus on integration compared to other nations, more work is needed to improve planning and joint implementation. This is also reflected in national government policy documents,

which detail clear ambition for integration, but provide little in terms of the specifics of how this will be achieved (HM Government, 2022).

Policies may also support integration in an indirect way, such as via top-down influences of national policies where adaptation can have a positive influence in cities with mitigation policies that incorporate monitoring systems, rather than mere mitigation commitments (Lee et al., 2020). Similarly, UK policy implementation is independently reviewed by the Climate Change Committee (CCC) and their consideration or assessment of integration could further support integration in practice. But in relation to heat resilience in England, there is poor integration of winter cold and summer heat policies. Although this has been recently attempted in the new UK Adverse Weather and Health Plan, the plan nevertheless still includes two separate approaches for heat and cold weather (UKHSA, 2023). Evaluations have also found additional issues that undermine heat policy development, such as a lack of reference to concepts including overheating and the urban heat island effect within the National Policy and Planning Framework (House of Commons, 2018) and inadequate temperature thresholds which fail to acknowledge heat-related mortality before these temperature thresholds are met (Williams et al., 2019). Locally, funding issues have been cited by four fifths of local authorities as being a barrier to greater climate action (LGA, 2021).

When it comes to preparing for the impacts of extreme heat, a more tailored approach to policy may be desirable for integration (Wolf et al., 2010), one where policies are made appropriate to the contextual circumstances of populations, and grounding policies in a fuller understanding of the individual and societal characteristics of vulnerable populations, such as the elderly. At a broader level, until recently, mitigation and adaptation have been thought of as separate processes, with mitigation primarily thought of as an issue for developed countries, and adaptation a priority for the global South (Ayers and Huq 2009). The two processes may also involve different conceptual interpretations in terms of the temporal dimensions, physical scales, sectors and personnel involved (Landauer et al. 2015; Landauer et al. 2019; Göpfert et al. 2019).

Further to this, few links have been made between the issue of integrating adaptation and mitigation responses on the one hand, and worsening heat risks, such as a proliferation of heatwaves and extreme temperatures. Limited literature has focused on the integration of adaptation to heat risks and mitigation efforts. A keyword search within Web of Science (WOS) returned only three evidence sources concerning the UK on that topic (Hall et al., 2010; McEvoy et al., 2006; Sarkodie & Strezov, 2019), even without refining to focus on the issue of extreme heat.[1] This is problematic given the heat risk crisis faced by the UK (Howarth et al., 2023; ONS/UKHSA, 2022). To our knowledge, only one peer-reviewed social science paper has focused on integration specifically in relation to UK heat risks (Wolf et al., 2010) but this only indirectly addresses integration. Other related papers focus on physical or engineering concerns (e.g. Barbhuiya et al., 2013).

3. Methodological approach

Given the complexity of integration as an issue and the exploratory nature of this research, our paper adopts a mainly qualitative mixed methods approach. To answer the questions, this paper combines findings from semi-structured interviews and focus groups with senior stakeholders directly involved in responses to the 2022 heatwaves in the UK to assess the feasibility, importance, enablers and challenges of adaptation and mitigation integration. Interviews allowed

[1] The search in WOS used key terms ('mitigation', 'adaptation', 'integration'), which were truncated to allow for variations. The search for articles published between 1964-2022 combined a mix of title (TI) and topic searching (TS), which was refined through piloting until most returns were relevant to the issue of integration. The search string "(((((TI=(adapt*)) AND TI=(mitigat*)) AND TS=(integrat*))))" returned 276 results, which were then refined by a search for "United Kingdom" within these results.

participants to explore, examine, reflect on and discuss the topic of integration in the context of heat risk, and focus groups in particular are well suited to topics that may be unfamiliar to participants, allowing collective sense-making more deeply and openly. Through critical assessment of the importance and feasibility of adaptation and mitigation integration in understanding heat risk response, and empirically locating the main enablers and challenges of this, we present a theoretical framework for end-users that highlights the convergence of key elements integral to realising effective CPI in the context of preparedness to extreme heat.

3.1. Semi-structured interviews

A total of 38 semi-structured interviews were conducted between October and December 2022 focusing on locations which experienced extreme high temperatures during the 2022 heatwaves and provided perspectives across different scales: national (England), Regional (Yorkshire and Humber) and city (London and Manchester). These were conducted online, using a video-conferencing platform, with audio data recorded and transcribed verbatim. The interviewees' roles covered local and national Government and Agencies, First Responders, Utilities and Civil Society, with geographical representation from London, Manchester, the Yorkshire and Humber region and England-wide (Table 1). Interviewees were approached due to their senior role in responding to extreme heat events and in particular the 2022 UK summer heatwaves at the England-level as well as regional (Yorkshire and Humber) and city (London and Manchester) all of which were impacted by the heatwaves in different ways reflecting the myriad of ways these climate risk will affect the country in future.

Table 1: Sample characteristics for interviews

	Government and agencies	First responder	Utilities	Civil society	**Total**
England	7	1	0	1	**9**
London	6	4	0	2	**12**
Yorkshire & Humber	2	2	3	2	**9**
Manchester	3	2	1	2	**8**
Total	**18**	**9**	**4**	**7**	**38**

Interviewees were asked a series of questions relating to their experience of responding to the 2022 UK summer heatwaves and they explored the topic of integration through the following question: "*To what extent do you think mitigation (emissions reductions) and protecting ourselves from impacts of climate change (adaptation) should be prioritised equally in the context of heat?"* The open-ended nature of this question allowed participants to explore different issues around integration, while also making links to heat resilience specifically. Interviewers were permitted to ask follow-up questions to prompt and interrogate interesting avenues of discussion. Ahead of analysis, transcripts of interviews were created from the interview recordings. Anonymity was important as many interviewees held senior positions across a range of organisations. Only the project team had access to the transcript files with interviewee data fully anonymised, and in order to further ensure anonymity interviewees are identified by stakeholder type (e.g. "Policy 1", "Responder 1", etc.).

3.2. Focus groups

Building on the interviews, four focus groups were conducted online in November 2022 via a video-conferencing platform, each lasting 90 minutes and were recorded. Each focus group represented one of the regions corresponding with the interview samples (England-wide, London, Yorkshire & Humber and Manchester). Participants (N=21) were selected to represent a range of sectors in each region, covering government & agencies, first responders, water utilities, and civil society (Table 2).

Table 2: Sample characteristics for focus groups

	Government and agencies	First responder	Utilities	Civil society	**Total**
England	3	0	0	1	**4**
London	5	2	0	0	**7**
Yorkshire & Humber	1	1	2	2	**6**
Manchester	2	1	0	1	**4**
Total	**11**	**4**	**2**	**4**	**21**

The focus groups explored the topic of integration through the following three questions: (i) *How have you considered integration of adaptation and mitigation in your work? (ii) When thinking of responses to heatwaves, how possible/feasible is it to integrate adaptation and mitigation? What are the barriers and enablers to integration? (iii) What can we do to ensure there are more synergies between mitigation and adaptation when responding to heatwaves? Is this happening on other policies/climate issues?* A transcription service was also utilised to write-up the focus groups audio data verbatim, ahead of analysis. The focus groups included other lines of questioning relating to heat risks that are not analysed in this paper.

3.3. Analysis method

We utilised a thematic analysis, which involved a process of reviewing the transcript data, double coding by two researchers to ensure consistency, re-coding, arranging codes into themes and sub-themes, further review and re-coding (Braun & Clarke, 2013). In addition, we quantified some aspects of the data, such as frequency of coded data by theme and sub-theme in MS Excel. While focus groups and interviews were coded in the same way and findings are combined for the analysis and discussion below, we suggest readers interpret findings as being from the interview data predominantly and triangulated by the focus groups. This is because the interviews had more participants and allowed greater room for in-depth reflection, compared to the focus groups with enabled group discussions. Not all lines of transcript were necessarily coded, and on occasions the same text could be coded in multiple ways, and this is reflected in any frequencies of codes reported.

4. Analysis and discussion

In this section, we provide an overview of the key themes and sub-themes that emerged from the interviews and focus groups and constitute the principal elements of the new framework for applying CPI to heat risk preparedness. The five key themes that emerged from the data with respect to integration of adaptation and mitigation are listed here, and analysed in subsequent sub-sections, with frequencies reported in Figure 1 and visualised in Figure 2.

- **'Challenge'** - Issues that may hinder, undermine, or act as a barrier to the integration of mitigation and adaptation.
- **'Enabler'** - Factors which support, or help to facilitate greater integration, or synergies, between mitigation and adaptation.
- **'Framing'** – The different ways that participants described, defined or interpreted the issue of integration.
- **'Importance'** – The extent to which participants thought that integrating mitigation and adaptation was important, reasoning for this and any related issues.
- **'Feasibility'** – How practical, or, possible integration is, and comments relating to this.

We found that *challenges* with integration were the most frequently discussed theme by participants in interviews and focus groups, constituting half of all 343 coded responses (49.6%). This was followed by discussion of integration *enablers* (19.5%), the importance of integration (9.6%), framing (8.5%) and feasibility (5.5%) of integration in the context of heat risk (Figure 1).

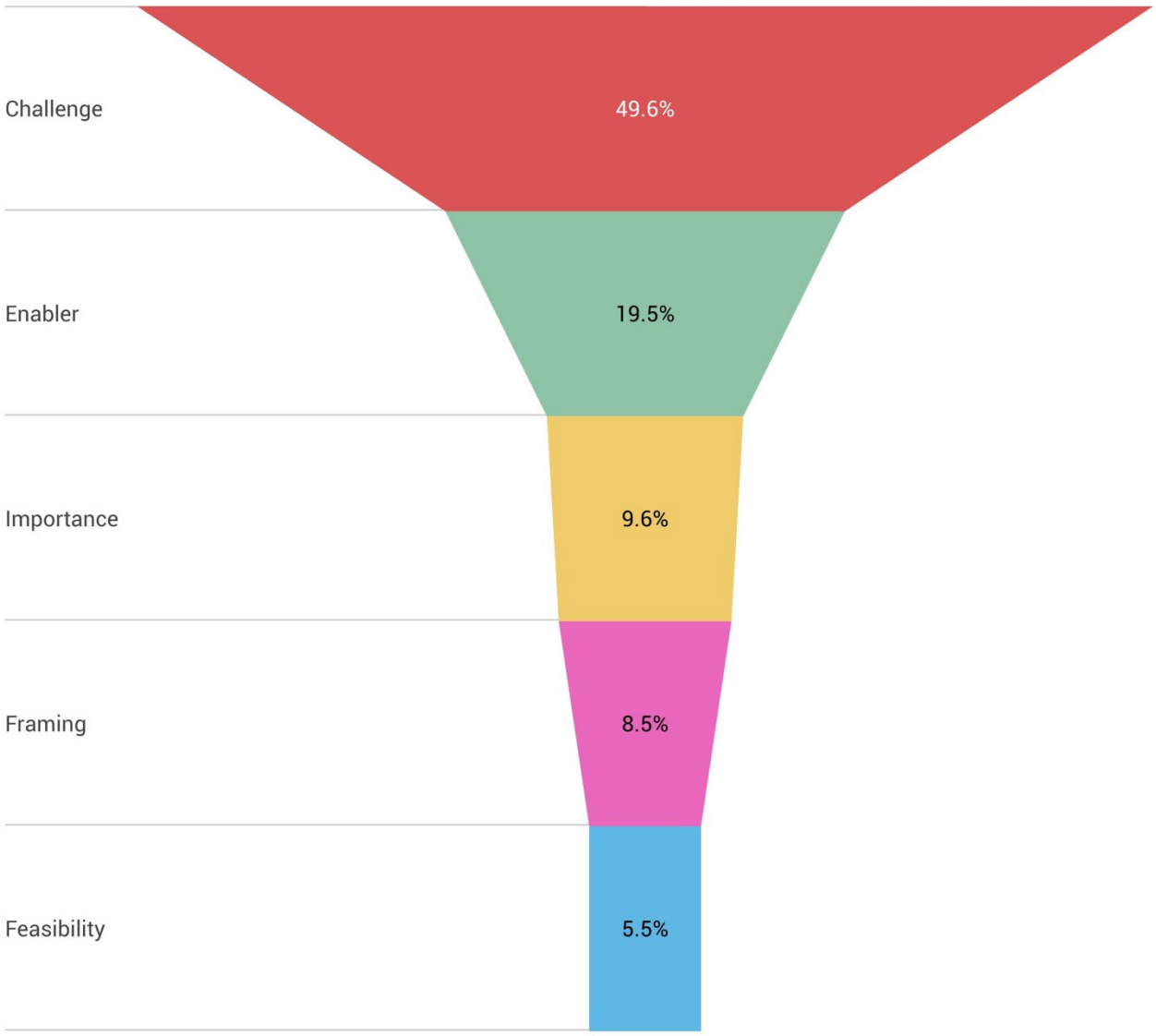

Figure 1. Funnel chart showing the percentage breakdown of all 'coded responses' (i.e. the textual codes derived from thematic analysis of transcripts) organised by major theme emerging from the interviews and focus groups (total number of codes represented = 343).

A complex range of sub-themes emerged within these higher-level categories (Figure 2). The presence of sub-themes within themes in some cases were not mutually exclusive, for instance, the same sub-theme could emerge as both an enabler and a challenge. Participants discussed institutional inertia, whose speed and capacity does not keep pace with the need to address the climate crisis. The emphasis of public bodies on statutory responses, and how an imbalance in favour of statutory targets for mitigation with no equivalent for adaptation in England (Porter et al. 2015), means political attention concentrates the former. Lack of leadership on adaptation, further entrenched this mindset, evidenced further by the UK Climate Change Committee's Adaptation Subcommittee (CCC, 2023).

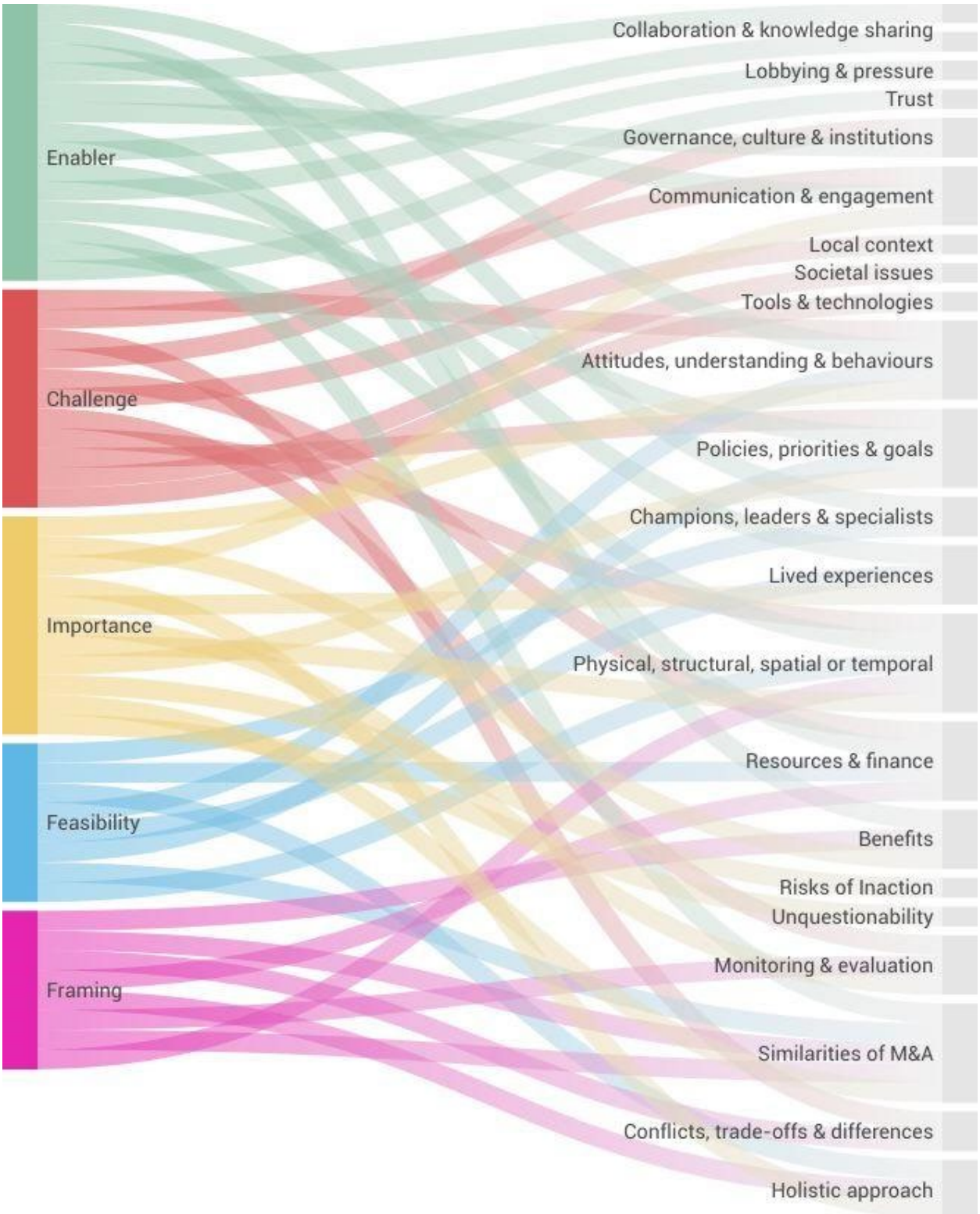

Figure 2. Thematic map, showing linkages between key themes (left) and sub-themes (right) derived from the interviews and focus groups. Please note that while this schematic does highlight sub-themes that emerged in relation to more than one overarching theme, the lines and linkages here are not intended here to represent the frequency or saliency of themes, subthemes or coded responses.

4.1. Challenges in integrating adaptation and mitigation

A broad range of integration *challenges* were discussed by stakeholders (Figure 3), some of which were the same factors as enablers (see section 4.2) but with their role reversed. The most frequently discussed challenge related to priorities in government, organisations and in society where mitigation takes priority over adaptation. It was generally felt that: "*there is just not currently the same drive for mitigation and adaptation, even, well formally through targets there is a lot more emphasis placed on mitigation than adaptation"* (Civil 10). This was reinforced by mitigation's prominence in climate emergency declarations, clear carbon reduction targets, measurable metrics, global impact and funding availability.

> *"So, there's been far, far too much weight given to mitigation so far, but people do understand that you have to think about them both [...] Up until now, up until this year, most of our attentions were placed on mitigation. I think because it's the sexy one with the big machines that make energy and the big projects, and it's easy to understand because there's just one number, whereas adaptation is not one thing." (Policy 5)*

Participants also showed concerned that climate and heat risk responses do not receive enough political attention: *"I think adaptation, [and] in particular heat, is often a Cinderella add-on to mitigation. So, I'm always saying: "What about overheating? What about overheating?" (Policy 1)*

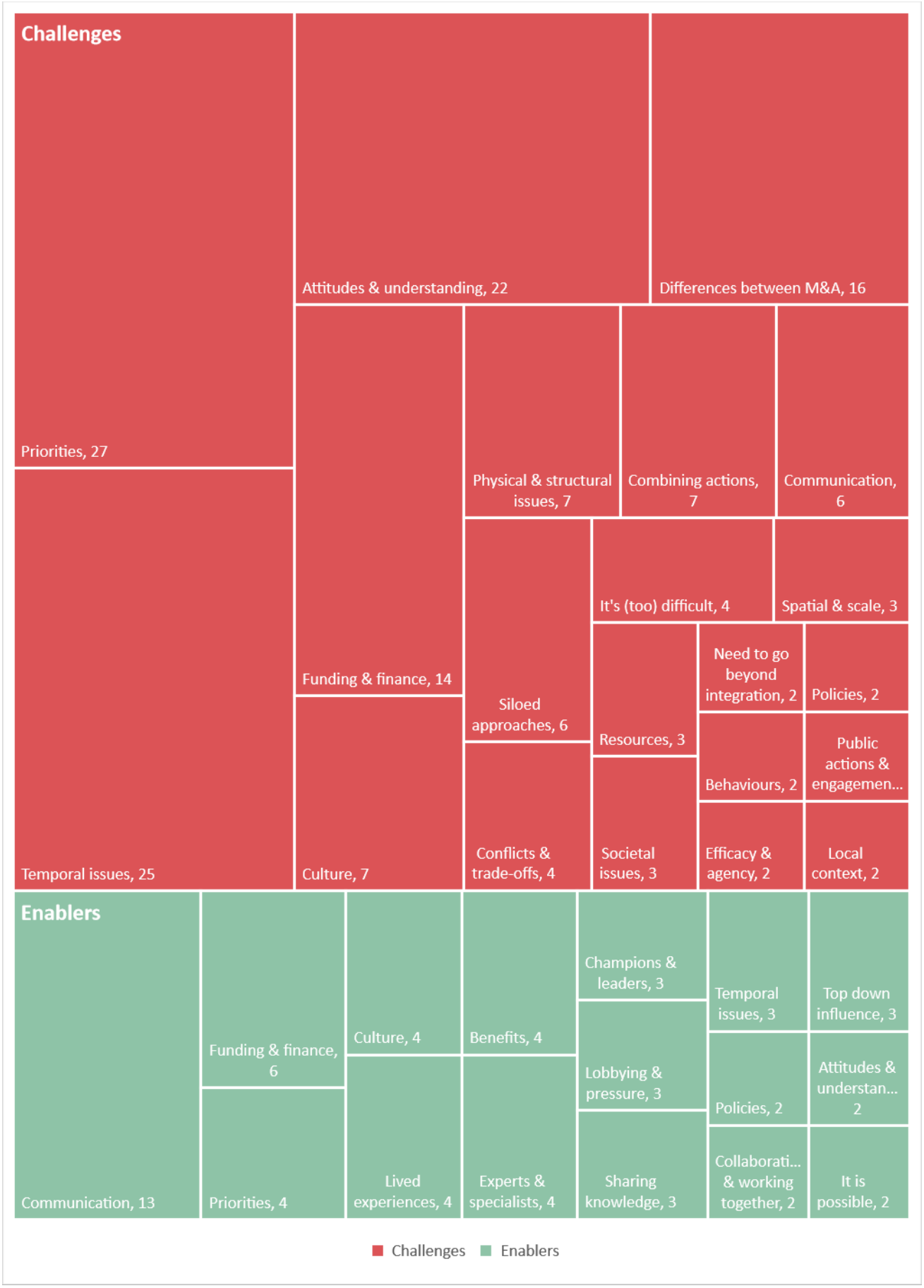
Challenges
Attitudes & understanding, 22
Differences between M&A, 16
Priorities, 27
Funding & finance, 14
Physical & structural issues, 7
Combining actions, 7
Communication, 6
Siloed approaches, 6
It's (too) difficult, 4
Spatial & scale, 3
Resources, 3
Need to go beyond integration, 2
Policies, 2
Behaviours, 2
Public actions & engagemen...
Temporal issues, 25
Culture, 7
Conflicts & trade-offs, 4
Societal issues, 3
Efficacy & agency, 2
Local context, 2
Enablers
Champions & leaders, 3
Temporal issues, 3
Top down influence, 3
Funding & finance, 6
Culture, 4
Benefits, 4
Lobbying & pressure, 3
Policies, 2
Attitudes & understan... 2
Communication, 13
Priorities, 4
Lived experiences, 4
Experts & specialists, 4
Sharing knowledge, 3
Collaborati... & working together, 2
It is possible, 2
Challenges
Enablers

Figure 3: Tree Map showing sub-themes within the 'challenges' (red) and 'enablers' (green) themes. The relative saliency of each sub-theme is represented by the box size, which relates to the number of codes that were allocated to each sub-theme during analysis. Values shown are the number of code responses within each sub-theme. Note that, to improve presentation, any sub-themes which only contained one code were not included in this visualisation. Note also that some sub-themes (e.g., 'communication', and 'priorities') appear within each higher-level theme.

Participants raised several 'temporal issues' - where there was a mismatch in long versus short term thinking, lack of time to implement, or where joining up measures or timescales were problematized somehow: *"it's hard enough to get people to focus on mitigation and actually reducing emissions, than getting them to actually take a long term view of their service area or their provision five, 10, 15, 20, 30, 80 years in the future."* (Policy 18). This also included different perspectives on the temporal nature of mitigation and adaptation:

> *"[...] because of the situation we've created we have to respond to local emergencies at the same time. And I don't think that the stuff that we're doing here will impact quickly enough for us to feed it into our local response, if that makes sense. I think in tandem, but two very different things." (Civil 2)*
>
> *"The mitigation side is probably more of a long game, really, because you can't really put people at risk now by taking away the ability to keep places cool and look after people now." (Policy 2)*

The statement by "Policy 2" highlights how the cost-benefit analysis of action is weighted towards immediate returns, and not necessarily the effectiveness of that action. In other words, keeping places 'cool' is an effective strategy to manage overheating, however, that action is dependent on creating 'cool' spaces, which means planting trees or creating shaded areas, which could take 5-10 years before that action is usable and/or effective. In turn, they point out a tension: that people need 'cool' places now, which means greater demand for immediate solutions such as air conditioning, but this goes against the mitigation aims of reducing GHG emissions. The challenge therein is how to reconcile adaptation and mitigation aims when they seem to come into conflict with one another. Participants did highlight the differences between mitigation and adaptation as challenges, where these are viewed from different frames: "*Adaptation is something that… it's a different way of quantifying and looking at climate change. Mitigation is very numerical: "we're going to reduce by 20%." Adaptation, you have to use a different framing to talk about it […]."* (Civil 6). Similarly, "*adaptation is a harder sell. […] it's easy to make the case for mitigation if they think they're going to save money by, you know, improving insulation, or putting solar panels on the roof. Whereas they're much less aware of the co-benefits of making adaptation measures. So, it's a much harder sell."* (Civil 9). Here an incommensurability emerges over the different languages, measurement systems, and logics used to make sense of climate actions, and in turn, points to an inherent tension wherein the compatibility of adaptation and mitigation actions is questioned or integration within a CPI framework leads unequal treatment.

Issues concerning problems with existing cultures were also cited, often related to organisational cultures, attitudes and/or understandings. There was acknowledgment that a shift in mindset was needed, and sometimes this was linked to temporal issues and prioritisation:

> "*It's really, really hard because it's a different mindset. To be honest most local government workers aren't in that space because that's not how we work. We're providing a service and so that strategic long-term point, it's quite difficult to get people to focus upon. We have done it in the past through adaptation risk assessments but trying to keep*

the momentum going has been really difficult. Because it's how you embed that adaptation culture and review into it so it's almost – that becomes almost – it needs to be part of… a service business planning process." (Policy 18)

"*But culturally, it's not acceptable somehow to have outside shutters, or people don't think about it. So there are a lot of solutions that are not as expensive, and also not as bad for the climate as, like air conditioning units. But for some other reasons there are barriers for people adopting that, and – so it's quite frustrating I think that there are lots of solutions how to do this in a more kind of passive way that is not – OK, you have usually upfront investment, but often not that much*." (Policy 4)

All focus groups mentioned the challenge of limited resources, including constrained financial budgets resulting in lack of funding for adaptation and difficult choices during prioritisation. A challenge cited across the focus groups was lack of funding for dedicated posts for adaptation, resulting in climate resilience considerations often being an 'add-on' to a low-carbon focused position. While also considered to be an enabler, resources and funding were seen as a key challenge too where there needs to be "*flexibility around funding"* (Policy 7), with investment in the process needed: "*I think honestly, some real genuine investment at national [level is needed], and it's not all about money so I mean investment in time* " (Responder 2), as well as in directly supporting integration of adaptation and mitigation funding for preparedness to extreme heat: "*So the state's funding regime is focussed upon improving energy efficiency of the building, but nowhere in any of the guidance or information is there mention of adaptation and adapting to heat*." (Policy 18). Unclear roles and responsibilities for climate within organisations were cited by multiple attendees. At a more systemic level, design and policy mandates were highlighted as not supportive enough of adaptation. Challenges around funding and culture were also linked to silo working and fragmentation across and within organisations:

"[I]n central government. It's still extraordinarily siloed in the thinking, and that is not necessarily people's fault, but it's to do with the roles that they have and the way that the financing and governance is managed. It's just very inflexible. There is a real issue with taking action around shared outcomes for this and lots of other parts of government. So there is fundamentally an issue with the way we manage our centralised government. So hopefully, that's why it's local and [the] city will do it better." (Policy 7)

4.2. Enablers of integrating mitigation and adaptation

A wide range of integration 'enablers' were identified (also shown in Figure 3). Most frequently discussed were communication-based enablers, which were mentioned twice as often as the next most popular enablers (funding and prioritisation). Subthemes included the need for more and better communication, "*articulating it*" (Policy 12), raising awareness of extreme heat, it's impacts and vulnerable individuals, throughout all seasons, targeting receptive audiences: *"really raising the awareness amongst the public, putting it into media forums, really making it known that we really have a problem [...] it's our responsibility to keep communicating it… I mean, I'd love to see (…) the Mayor to start saying "warmer homes and cooler homes," that is my ambition to get a communication across so you know, there's so much promotion about warmer homes and rightly so, and let's start promoting cooler homes as well, in other places, so we begin the narrative, there's that communication constantly, we don't forget it in the winter but it's there all year round."* (Policy 8).

"you need to [do] more [to] appeal to the emotional aspects of it. And I think the sort of synergy between mitigation and adaptation is a really good example because there you

can sort of probably showcase what the benefits are from doing one for the other." (Policy 4)

Stakeholders also referred to the role of policies, top-down influences, and the resources needed to implement measures for enhancing resilience to heat that align with net zero goals. Whilst funding and finance was seen as a key challenge (see Section 4.1.) it was simultaneously viewed as an integration enabler. This included an acknowledgement of the need for funding for measures and dedicated personnel, but also discourse around the cost-effectiveness of integrated responses:

> *"For us in the NHS, it's going to have to come from the government. That's where our money comes from…"* (Responder 7)

> *"I think it would just be funding for dedicated posts to kind of bring this all together and then for us to have a clear response on what we're doing and who's leading on it. It's just the starting point for everything that is a new area of responsibility or initiative but it's obviously a hugely important one and I think it just needs to start with… just a local authority coordinator that was responsible for delivering on this"* (Policy 8)

Related to this, stakeholders referred to the priorities of government, organisations and society as existing or potential future enablers of synergies and integrated measures. Contrary to concerns about prioritisation previously raised (see Section 4.1), some participants felt that when considering heat risk responses, mitigation and adaptation *"absolutely should be equal priority"* (Responder 1), which would help bridge gaps faced by each approach:

> *"by setting standards for building works and by prioritising nature-based solutions wherever you can, you're immediately starting to bridge that gap, that divide between adaptation and mitigation." (Policy 5)*

This further built on a broad acknowledgement of the need for *cultural shifts, particularly* in the UK where whilst awareness of heat risk may be growing, behavioural and cultural responses to not mirror the severity of the threat. Embedding this integration within wider social practices, as an important enabler: "*For me, effective adaptation – whether that's to do with the physical environment where the person lives or operates or works in – all the advice, it's getting that embedded so that when it happens, the impact is reduced and the crisis management, I suppose, is flattened*." (Policy 18). Stakeholders also referred to attitudes and understanding, and having the belief that integration is possible, alongside the importance of trust, sharing knowledge, collaboration and working together:

> *"But then through initiatives like carbon literacy, you can start to, at an organisational level, if there's strategic buy-in from the senior leadership of an organisation to roll out something like carbon literacy across the organisation, then the collective small actions of people – like your bottle tops initiative – can actually start to make a big difference and start to change a culture."* (Civil 7)

Other key enablers included the role of expert knowledge in highlighting similarities between adaptation and mitigation approaches, addressing knowledge gaps and common misperceptions that can hinder progress, were seen as essential to validating the need for and potential benefits of implementing integration approaches: "*It will do mitigation and adaptation all at the same time. People just don't know. So, more experts in more places with more information can help break down that barrier."* (Policy 5). Growing concerns relating to the increased likelihood

that the UK is likely to experience more episodes of extreme heat, provides a platform through which the application of integration in practice could provide a useful and much needed way to simultaneously address both adaptation and mitigation priorities.

> *"One of the things we discovered, everyone assumes that nature-based solutions are going to be more expensive, but the truth is, they're quite dramatically cheaper. The only reason we don't know that is because we never had an expert before. So if we get more experts in more places telling people the facts about how it's being used, trees to shade if we use some bioswales instead of concrete channels that they use, permeable flooring instead of tarmac, not only will it help with climate adaptation and improve educational performance, but it will also be cheaper."* (Policy 5)

4.3. Framing, importance and feasibility of integrating mitigation and adaptation: Towards "Climate Resilient Net Zero"

Participants framed the issue of integration in different ways and discourse often focused on 'combining actions' in some way. Most often participants mentioned how mitigation and adaptation: "*do go hand in hand"* (Gov 1) linking with prior work suggesting that people often engage with these concepts as effectively two sides of the same coin (Corner et al., 2020) although in practice these tend to occur in silos. This demonstrated the plethora of ways in which adaptation and mitigation are understood and used separately and the challenges of adequately framing the integration of adaptation *and* mitigation.

> *"I think there's things that can be done on the adaptation side that then will loop back into the mitigation side. So, I think they both go hand in hand."* (Gov 3)

Others spoke about a "juggling" or "balancing" act of the two measures, as well as *"[B]ridge that gap, that divide between adaptation and mitigation." (Gov 5)*, while some spoke about them as "dual strategies" where *"Efforts to, for example, plant trees that can capture carbon, but also provide cooling and shading, we need to think about those dual strategies"* (Civil society 2).

> *"[W]ell they're all priorities, aren't they? It's just a juggling act and a balancing act"* (Civil society 2)

Discussion with stakeholders led to the emergence of 'Climate Resilient Net Zero' (Table 3) as a more effective way to move beyond linking mitigation and adaptation action through frames such as 'adaptigation' (Göpfert et al., 2019) that have been used in the literature. Going further than 'adaptation' and 'mitigation' terminology towards more policy and practice-relevant terms such as 'resilience' and 'net zero', widely used in climate governance globally, emerged as a tangible and salient way to "*get to Net Zero in a climate resilient way*" (Gov 1). This combination of the concept of resilience (i.e. capacity to cope with climate and non-climate impacts) with that of Net Zero (i.e. reducing greenhouse gases to zero on balance, through emissions reduction and removal) provides a more detailed approach to integrating adaptation and mitigation approaches within themselves. This goes beyond resilience to a specific risk, such as heat, for instance. Some participants spoke about 'building in resilience' to net zero efforts or getting there in a 'climate resilient way', while others referred to 'keeping cool in the most environmentally friendly way' possible as shown in Table 3:

Table 3. "Resilient net zero" framing, supporting quotes

Quote	Interviewee/ focus group participant
"So how are we going to get to Net Zero in a climate resilient way?"	Gov 1
"I think in and around they should definitely be prioritised equally because it's a false economy to invest in Net Zero in a way that's not resilient."	Policy 1
"if you put your solar panels in for net-zero, you've built your resilience in as long as you've got the battery storage in to support and collect that energy. So the measures, in general, are one and the same; it's about proving how they work together to help support any organisation through that. And I think it's maybe just a bit of spin as to what we need to do and how to encourage that kind of resilience to be built in, really."	Responder 1
"keeping cool in the most environmentally-friendly way possible, if that's the education we're delivering, that's the message we're delivering, that's the message people will remember"	Responder 2
"So what I've been hearing from local authorities is, obviously, net-zero's a big push at the minute and they're doing a lot of things around making their estates and their social housing more energy-efficient. And part of this whole conversation around heat is that when they're doing that, they want to make sure that they're not making the heat issue worse by doing those energy-efficient measures for the mitigation side of things. So I think there is more of a consideration around both and making sure that what actions they take around net-zero and energy efficiency don't then exacerbate the heat problem.	Policy 3
"I think we've got to frame that in a way it's a positive change because adaptation's seen as something you're taking away from people [...] I think they're both important but the messaging, it has to be done in a particular way."	Civil 6
"I think it is possible for the Ambulance Service to get there but what it needs is just a massive amount of infrastructure because then, this comes down to money"	Responder 6
One is mitigation can feel overwhelming on a personal level, farming level, organisation level. Adaptation works at those levels. It can work at the society level, community level, personal level, planning level.	Civil 8

There was widespread agreement by participants on the importance of integration in the context of heat risk responses. A number of times participants suggested there was an almost *unquestionable* nature to integration, with no debate to be had on the matter, and that *"Obviously, we have to integrate mitigation with adaptation. Like just – of course you have to do that. It's not an issue."* (Utilities 2). Some participants highlighted benefits of integration, while others highlighted risks of inaction where it was asserted that it was essential to respond to climate change through integrated measures to avoid negative consequences, while others highlighted not doing so could undermine net zero efforts:

> *"Unfortunately, from an emissions reduction perspective, we just have to take it now […] in a way, the heatwaves are a reminder of the urgency of decarbonising."* (Policy 2)

> *"they should definitely be prioritised equally because it's a false economy to invest in Net Zero in a way that's not resilient."* (Policy 1)

Despite there being varying understanding, or acceptance, of the concept of integration, some attendees queried what this meant in practice, and others warned of issues around prioritisation:

> *"I [...] object a little bit to say which do we need to prioritise more? Because it almost makes it sound like you have to do one or the other to some extent, and that's absolutely not true."* (Policy 9)

> *"...they both have to be really important but I really don't want anyone to see it as a zero sum game. You know? There is no reason we can't do both equally. But it is totally different agendas."* (Policy 9)

This further justified the need for a "Climate Resilient Net Zero" frame emphasising the balanced, non-siloed approach required to linking adaptation and mitigation approaches. In general, there was consensus across all interviewees and focus groups about the importance of integrating adaptation and mitigation and that integration was essential to maximise positive outcomes and minimise unintended consequences of climate action. Respondents felt it was feasible overall to integrate mitigation and adaptation and most believed it *was* possible to achieve a good level of integration, with stakeholders drawing on past successes to explain this:

> *"I think [integration] can be done. We have replaced all of our cars [with EVs] so we have cars, ambulances, we have lots of different [electric] vehicles. All cars are now electric so there are things that we can do."* (Responder 6)

> *"I do think it's doable, I do think we're getting there, and I do think there's much more openness to that, that we're starting to hear from senior colleagues."* (Responder 7)

While the majority of respondents understood the relationships between mitigation and adaptation conceptually, operationally they viewed this as far more challenging and often referred back to terminology such as 'resilient' and 'net zero'. Concerns were related to other's perceptions and understanding of what integration meant in practice, the need for leadership, there being a lack of prioritisation and temporal issues complicating linking up of measures (see 'challenges' section above). Whilst being supportive, some put forward a conditional view - caveating their belief in the feasibility of integration with qualifiers, such as the need for policies, time, money, and leadership.

> *"I think there's so many things that could change but it needs a driver from the top."* (Responder 7)

> *"Just to reassure [you] when you're looking at it, there's a lot of really committed officials who are looking at how you move that on – it just takes time."* (Policy 6)

5. Advancing Climate Policy Integration: a new empirically-based framework

Under the UK Climate Change Act 2008, a statutory duty exists to assess the risks and/or opportunities that the UK faces from climate change (Climate Change Risk Assessment) and to develop a policy response (National Adaptation Plan), every five years. All three CCRAs have consistently identified heat risk as an area of urgent concern yet the policy response has been indifferent thus far. Why is that? Part of the answer relates to the institutional fragmentation of climate change policy in the UK. In England, adaptation policies fit within the purview of the

Department for Environment, Food and Rural Affairs (Defra). However, responsibility for England's heat plan rests with the UK Health Security Agency (UKHSA). That heat plan only covers human health. Considerations about building regulations, which can help assuage heat problems falls under the jurisdiction of the Department for Levelling Up, Housing and Communities (LUHC), and policies related to mitigation are owned by the Department of Energy Security and Net Zero (DESNZ). This recent change of departmental name (February 2023) from the Department for Business, Energy and Industrial Strategy (BEIS) further reaffirms national climate policy institutionalisation of siloing mitigation and adaptation as policy imperatives, further enervating any notion of CPI being strategically planned for.

Not only is the problem of 'heat' fragmented in terms of what constitutes the actual problem (e.g., health, buildings, infrastructure etc), but also how the constituent policy imperative responsibilities of mitigation and adaptation are institutionally fragmented between different Government departments. This makes a coherent approach to CPI extremely difficult in practice, particularly in terms of management and accountability. That withstanding, a new warning alert system was tested in 2022 (Roberts et al., 2022), and updated guidance in the form of 'Beat the heat: staying safe in hot weather' was released to the public (GOV.UK, 2023). In turn, the compound nature of heat risks demonstrates the importance of taking a CPI approach to heat risk preparedness. Yet, measures to minimise overheating in newly built properties remains a 'principle' rather than a regulatory obligation. This is particularly concerning given the lifecycle of a newly built home (>150 years) and the promise to increase the number of new homes over the next few years.

The data collected and analysed in this paper highlights the convergence of key elements integral to realising effective CPI through the lens of a "Climate Resilient Net Zero", where both adaptation an mitigation are effectively linked, in the context of heat risk, which we use as the basis for developing a five-point framework encapsulating: (1) 'Challenges' - that may hinder, undermine, or act as a barrier to the integration of mitigation and adaptation; (2) 'Enablers' - which support, or help to facilitate greater integration, or synergies, between mitigation and adaptation; (3) 'Framings' - different ways participants described, defined or interpreted the issue of integration; (4) 'Importance' - extent to which participants thought that integrating mitigation and adaptation was important, reasoning for this and related issues; and (5) 'Feasibility' – or how possible integration is. We argue that all five factors must be fully considered and addressed when tackling heat risk to maximise effectiveness of responses to prepare to extreme heat in the UK and minimise possible issues around maladaptation. This is especially the case, firstly, to advance CPI's role in supporting policies that aim to prepare countries against the risks and impacts of extreme heat, and secondly, to mainstream heat risk preparedness into sectoral policies (vertical integration) and enabling cross-sectoral coordination (horizontal integration) (Di Gregorio et al. 2017: 35)

There were numerous occasions where responses by participants demonstrated that, while the concept of integration (and the more salient framing "Climate Resilient Net Zero") was widely accepted and understood, responses and interpretations often focused back on mitigation, or adaptation alone, rather than together. This re-emphasises the ingrained siloed thinking and approach to climate policy and action in the UK. We propose the term '*Climate Resilient Net Zero'* as a more appropriate way to affirm a combined target for mitigation and adaptation, where adaptation and resilience efforts are integrated into all measures taken to reach net zero. This builds on the acknowledged importance of language and framings for both climate change and heat risk engagement (e.g. Bruine de Bruin et al., 2021; Corner & Clarke, 2017; Kythreotis & Bristow, 2017; McLoughlin et al., 2023).

While analysing the data we also found ourselves asking critically "whether or not stakeholders are always truly speaking about integration?" On some occasions participants would slip into discussing either mitigation, or adaptation, and often lived experiences and real work examples offered by stakeholders were not related to the trade-offs or synergies between

measures. There was possibly a role of availability bias at play, but also, we acknowledge that integration between mitigation and adaptation is highly complex, and often discussed as an intangible topic in climate stakeholder circles. Therefore, by coining the term 'Climate Resilient Net Zero' we hope this will be more useful for helping different types of individuals and audiences engage more practically with the need to integrate mitigation and adaptation in their respective governance and policymaking domains, making a transition to CPI more accessible and easier than current formal policy frameworks allow.

6. Conclusions

While there is a growing literature on adaptation and mitigation integration, relatively few studies have made links to the value of such an approach to heat risk responses. This paper has attempted to address this gap, by contributing new empirical insights on the issue of integration of mitigation and adaptation in relation to heat risks in the UK. We drew on key stakeholders' perspectives in London, Manchester, Yorkshire and Humber and England-wide, with insights shared by first responders, government and agencies, utilities, and civil society. Stakeholders identified a large number of enablers, challenges and conditions related to integration, and also new framings related to integrated heat risk responses. Extant frameworks, such as Climate Policy Integration and literature related to integration can help to interpret and explain such findings. Integrated responses to climate change heat risks will involve a complex interplay of factors and require the heavily engrained non-integrated thinking to be challenged.

While the five-point framework we have derived from our thematic analyses of interviews and focus groups is by no means a panacea for translating CPI from theory to practice and action, its development does however illuminate current institutional (policy and practice) weaknesses in its potential application. We have highlighted that the CPI debate suffers from a myopic view of climate policy that (still) reduces adaptation to an add-on to mitigation policy in the UK and worldwide. This will have ever-serious repercussions as we experience even more extreme climate impacts related to heat (as well as other climate hazards). Indeed, CPI if implemented uncritically, can (unintentionally) introduce a new set of political concerns over which solutions are prioritised, which problems are solved, and who gets to decide this. We have also highlighted how the 'Climate Resilient Net Zero' framework, and its five key themes, can converge with one another to make the practice of CPI a more protracted and messy process. This is reason enough to catalyse other academics, climate policymakers and practitioners to think more clearly about how CPI can move away from being seen as a discursive theoretical trope to being incorporated more robustly into climate practice and policymaking for societal benefit.

From our research, it is clear that CPI holds much promise. Conceptually, CPI offers a lens which through diverse actors, working across different national and/or local policy scales and timeframes, can potentially align mitigation and adaptation actions both vertically (by helping to mainstream climate change into sectoral policies) and horizontally (by enabling cross-sectoral coordination) (Di Gregorio et al. 2017: 35). The co-benefits in terms of cost-savings and effectiveness of CPI are, therefore, evident. Moreover, participants in this study showed a clear appetite for integrating adaptation and mitigation throughout the process of planning for, and implementing, climate actions. Yet future research needs to determine not only the extent to which CPI leads to an unequal relationship between adaptation and mitigation (e.g. 70/30), but also if it's necessary for adaptation and mitigation measures to be on an equal-footing for effective climate action, and as a result, when and where is this important. In turn, researchers need to establish '*how'* CPI works in practice – both examples of good and poor practice. It also remains unclear *'who*' are the winners or losers from CPI. If CPI prioritises particular ways of understanding and responding to climate problems, for instance, how does this play out in terms of *'which*' actors can or cannot be involved, '*what'* actions are promoted (or downplayed), and over what scales do CPI work best.

We make several recommendations for advancing both conceptual considerations and practical applications of CPI in the context of heat. Firstly, in terms of governance, there is a clear need to establish new and robust governance structures and enable sufficient funding and finance to help enable greater integration between mitigation and adaptation in relation to heat risks in practice, with metrics (these can be qualitative as well as quantitative) to drive and measure adaptation in parallel to mitigation. Secondly, a shift away from what stakeholders perceived to be an over-prioritisation of mitigation over adaptation is required to move away from siloed approaches and potential unanticipated consequences and maladaptation. Finally, better framing of the concept using the term 'Climate Resilient Net Zero', would be helpful alongside a robust exploration of the synergies and trade-offs between measures. This must consider the global, national and local levels, while helping make mitigation and adaptation more locally relatable, visible and tangible, and breaking down siloed approaches to the communication of adaptation and mitigation.

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