

National Infrastructure Commission

The Impact of the Environment and Climate Change on Future Infrastructure Supply and Demand

Adaptation and Resilience in the Context of Change (ARCC) Feedback

The ARCC network

The ARCC network (funded by EPSRC) is a UK knowledge exchange network (<http://www.arcc-network.org.uk/>) working with researchers and stakeholders involved in adaptation and resilience to technological, social, climate and environmental change in the built environment and infrastructure sectors. Our overall aim is to facilitate the uptake and use of research so as to inform policy and practice, but also to inform that research through engagement and dialogue between researchers and policy and practice communities. We deliver on this by building community cohesion to develop in-depth understanding and synergies across the network; providing and integrating knowledge to inform policy, practice and research based on the available evidence; and enhancing accessibility and uptake of relevant and credible research outputs.

The ARCC network is staffed and managed by the UK Climate Impacts Programme and hosted by the Environmental Change Institute at the University of Oxford. I am pleased to see that the Commission has included a discussion paper on the environment and climate change as part of its series examining drivers of future infrastructure supply and demand.

I am responding as I see this as an opportunity to further inform the development of this discussion paper and in so doing the further analysis that will underpin the National Infrastructure Assessment.

General Feedback

The paper provides a useful discussion of the environmental and climate change drivers and particularly the impacts on infrastructure. The extent of the considerations, particularly around the interactions between infrastructure and the environment, and the inclusion of green infrastructure, contributes to putting forward a more comprehensive picture of the relationships and implications for our infrastructure.

In the context of seeking to enhance the robustness of the paper, the following feedback is offered:

1. I would have expected more on exploring the interdependencies and cross-cutting themes, potentially drawing on the [UK CCRA 2017](#) evidence report. I would particularly point to the chapters on Infrastructure (Chapter 4) and on Cross-cutting issues (Chapter 8), but also references in those chapters including those based on related research undertaken within the Infrastructure Transitions Research Consortium (ITRC) and [ITRC Mistral](#) (The Next Generation of national infrastructure planning), [International Centre for Infrastructure Futures \(ICIF\)](#), and [iBUILD: Infrastructure Business Models, Valuation and Innovation for Local Delivery](#)
2. I would have expected some consideration of the risks associated with responses to environmental and climate changes (e.g., see UK CCRA Chapter 8). These risks should not be ignored and although not extensively studied are recognised as playing a strong role in the sustainability and resilience of

our infrastructure. These response risks are to a large degree associated with the dependencies and interdependencies of our infrastructure. Further on this point, I agree that care should be taken to fully understand the possible spectrum of environmental consequences when planning the infrastructure of the future, as long as the possible spectrum also includes those consequences as a result of actions taken to ameliorate unwanted consequences.

3. The use of UKCP09 (and UKCP18 when available) is essential, but recent evidence is suggesting that there is also a need to understand the robustness of our infrastructure in light of dangerous climate change (i.e., beyond globally 2°C, including in the nomenclature of UKCP exploring the robustness under H++ scenarios), especially for those aspects of our infrastructure that are long-lived.
4. In looking at these drivers of change, I would suggest that there is a need to consider the implications of actions that are being taken at the international level as a result of the trilogy of international agreements – Paris Agreement, Sendai Framework and SDGs and Agenda 2030. These agreements are seen as working together (e.g., see the global adaptation goal within the Paris Agreement) and their implementation will have implications within the UK, particularly in terms of how we assess and address risks. The UK has ratified the Paris Agreement (18th November 2016).
5. There are opportunities for the UK to be a leader in putting appropriate infrastructure in place as part of its response to climate change. In addition to having sustainable and resilience infrastructure and the social, economic and environmental benefits that come with such, there are other benefits that are linked to the growing adaptation economy with UK plc potentially benefiting from the associated innovations and marketing these globally
6. I was somewhat disappointed that the section on Adapting to climate change primarily focused on climate change scenarios / projections and impacts. I would suggest that there is a need for this information within the paper, but it should have a more appropriate title (e.g., climate change and its impacts). I would also suggest that there is a need for a subsection on adapting to climate change that focuses on the challenges and opportunities associated with adapting our existing and future infrastructure in the context of climate (and other) changes. There is a wealth of literature available on adapting infrastructure to climate change, including that resulting from recent research, and presenting these within this paper (including introducing points 1 and 2 above, and 8. 9. And 10 below) would greatly enhance its value.
7. As mentioned above, the inclusion of a section on green infrastructure adds to the value of the paper. Consideration within the paper of the implications of environmental and climate change for green infrastructure would further enhance the value of that section of the paper. Considerations will need to be given to the sustainability and resilience of green infrastructure in the context of climate and other changes, including the need for green infrastructure to continue to adapt in response to projected or actual changes (this is beyond continuous maintenance of that green infrastructure that should be part of an implementation plan).
8. There are four linked aspects of adaptation that should be recognised within this paper. To a large extent these aspects require looking at the infrastructure as part of a system within a social, environmental and economic system that will require continuous improvement (more than implement and then job done as our target should be to be adapting well). Climate risks have system implications (e.g., flood risks) and the response should be consistent with the risks:

- When looking at potential adaptation measures (including the potential contributions of green infrastructure) there is to understand and reflect in those measures the barriers to successful implementation. These barriers are often linked to institutional and organisational limitations and fragmented efforts (sometimes resulting from the institutional and organisational limitation).
- The adaptation options being assessed should build on an understanding of response capabilities of that system (based on social, cultural, economic and political context)
- There is value in adopting an adaptive management (or adaptation pathways) approach. This type of approach involves incremental planned adaptation options for which implementation is triggered by thresholds associated with risk and changes in knowledge and technology, as well as changes in social, cultural, economic and political considerations – decision points.
- Fragmented and piecemeal responses will not succeed as they fail to recognise and reflect: the nature and scope of the risks and of the responses and their impacts; and the need for targeted continuous improvement across the system of systems (often linked to monitoring and evaluation of the responses and the risks)

Failure to consider adaptation as such can lead to failure of the implemented measures, failures being introduced into other dependent and interdependent elements of the system or maladaptation. All three of these can have significant impacts on existing and future infrastructure supply and demand.

The ARCC network is willing to contribute further in this context, including through seeking further guidance from its members.

Roger Street

PI, ARCC network

Senior Research Fellow, University of Oxford