UUCN UK Universities Climate Network

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Assessing climate risk and strengthening resilience for UK Higher Education Institutions

KEY MESSAGES

- **Incorporate climate risk indicators into risk registries** as the first step towards acknowledging their importance and identifying and managing existing and anticipated climate risks and priorities for adaptation including consideration of risks to overseas activities.
- **Prepare for current and future climate impacts through resilient net zero planning** by taking a twin-tracked approach to climate mitigation and resilience that recognises the interconnected nature of protecting against climate risks whilst also reducing climate change.
- **Consider climate risk exposure beyond the physical footprint of the campus or site(s),** including climate risk assessment and the development of adaptation and resilience plans for neighbouring communities and critical infrastructure, transnational educational offerings, field work, international research collaborations and international supply chains.
- **Identify co-benefits and trade-offs amongst climate actions** because climate risks may interact with one another and with other non-climatic risks in the register.
- **Anticipate and manage transition risks** linked to evolving legal, policy, investment, market, and technology contexts under climate change, including the potential for stranded assets and reputational damage.
- **Draw on the skills and knowledge of different groups making up the institutional community when undertaking climate risk assessment,** recognising the process as both a technical and social endeavour.
- **Approach resilience building as an ongoing, open-ended process** requiring regular monitoring and evaluation to support reassessment of risks and ongoing development of adaptation plans.
- **Recognise that Higher and Further Education Institutions have important roles in building resilience to climate beyond their own operations and in terms of people and places** through their work and status as anchor institutions in local communities and regional economies.
- **Share insights and lessons learned about how to move to resilient net zero** with other institutions and sector, through forums such as the Alliance for Sustainability Leadership in Education (EAUC) Climate Risk Community of Practice and Universities UK fora.
- **Call on Government to give more attention to risks to education in the forthcoming Climate Change Risk Assessment (CCRA4)** and subsequent National Adaptation Plan, plus accelerate the release of data held by Government agencies and funded bodies to enable local climate risk assessment and adaptation planning.

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This working paper and accompanying case studies aim to support UK Higher Education Institutions (HEIs) to develop processes to assess their current and future climate risks, put in place plans to adapt to these risks, and identify opportunities to strengthen their resilience. This guidance summarises the latest evidence in line with national climate risk assessment and adaptation planning, and is intended to support decision makers, senior leaders, sustainability practitioners and risk experts within HEIs to undertake this urgent work. Potential activities are identified for key actors and communities including sector bodies and government.

Although the focus is on HEIs, the recommendations and approaches covered are applicable to Further Education Institutions (FEIs), albeit at more local scales and with less onus on research considerations.

INTRODUCTION

The UK Climate Change Risk Assessment 2022 (HM Government)[1] starts with a clear statement that *'climate change is happening now'*. All sectors and areas of society urgently need to understand the risks they face from climate impacts and build resilience to current and future risks under global climate change. The UK Higher Education sector, like all other sectors, will be *'subject to a range of significant and costly impacts unless significant action is taken now'* (HM Government, 2022)[1]. For many in the UK, these concerns were brought to the fore by the record-breaking temperatures of over 40°C experienced during summer 2022 which led to widespread disruption to services, property damage and 3271 excess deaths in England and Wales (ONS, 2022)[2]. In order to ensure that HEIs remain capable of delivering their core business of research, innovation and education under a changing climate, institutions must urgently undertake climate risk assessments, develop adaptation plans and put in place strategies to strengthen their resilience alongside delivering on their net zero emissions commitments.

UNDERSTANDING RESILIENCE FOR HEIs

The 2021 UK Climate Change Risk Assessment technical report (CCRA[3]) defined risk as *'the potential for consequences where something of value is at stake and where the outcome is uncertain'*[3], which can include both negative and positive outcomes. This definition recognises that the opportunities embedded in assessing and managing climate risks are not just about protecting against harmful impacts from climate change but can also unlock benefits to HEIs from increasing resilience.

What do we mean by resilience in the HEI context? In part, we understand the term resilience to be the process of identifying, then managing risks, since risk and vulnerability assessments are a vital part of building resilience. This process requires more than quantitative assessments of risk – it also involves an inclusive dialogue about acceptable levels of risk and loss, the objectives and measures of resilience, and agreed principles for undertaking resilience strengthening (such as inclusivity, fairness, shared decision-making, and cooperation).

DEFINITIONS OF KEY TERMS[4]:

Risk: The potential for adverse consequences for human or ecological systems resulting from changes in weather and climate leading to impacts on people, buildings and infrastructure, operations, essential services and supply chains.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Exposure: The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected by extreme weather and climate risks.

Transition risk: Risks resulting from changing social, economic and political actions taken to mitigate climate change such as changing energy costs.

Compound risk: The combination of multiple drivers and/or hazards that contributes to societal and/or environmental risk.

Cascading risk: The propagation of one societal and/or environmental risk into another risk.

Climate vulnerable receptors: These may be individuals, households, or communities; natural systems; physical assets, businesses and campuses; sectors, cities, regions or nations that are exposed to physical climate risks and/or extreme weather hazards.

However, resilience has potential to be much more than the ability to cope with climate risks, as it also offers various co-benefits – greener spaces, improved mental and physical wellbeing, more localised decision making and sourcing of goods and services, as well as greater agency in deciding the future, which is particularly relevant to young people. As such, resilience defined this way is not only about enabling a given system or place to better cope with harmful weather and climate conditions, but also ensuring the ability of those entities to 'bounce forwards' and transform. The examples provided by the case studies, which accompany this working paper, illustrate the potential range of co-benefits for HEIs, their staff, students, partners and local communities.

Through their work and status as anchor institutions in local communities and regional economies, HEIs have important roles in building such resilience to climate impacts in terms of people and places. Collaborating with other key actors in the places they are based to drive adaptation actions and build resilience should be seen as a civic responsibility of HEIs. Examples of initiatives supporting this collaborative planning and action include the Climate Ready Clyde of which University of Strathclyde is a member (see Box 1)[5] and Newcastle's Local Action Alliance of which Newcastle University is a member[6]. HEIs need their campuses and communities to be resilient to extreme weather and other risks, but they also have responsibilities in helping young people become better prepared for the challenges ahead. What that means must in large part be determined by them.

Finally, it is necessary to recognise that resilience building is an ongoing process and that, unlike achieving net zero, has no clear end point. Beginning a conversation and the process of co-exploration is, in part, what this paper aims to achieve.

CONNECTING RESILIENCE AND MITIGATION

The relationship between building resilience and climate mitigation efforts to reduce emissions across HEIs might appear problematic, insofar as the focus on resilience could divert attention and resources from the essential process of HEIs achieving net zero emissions. However, an approach that recognises the clear links between the two strands of climate action, and the benefits of harmonizing efforts, can support HEIs in achieving their climate targets. Taking a twin-tracked approach to climate mitigation *and* resilience helps to resolve any tensions and maximise benefits of aligning plans across these two domains.

Universities can only truly prepare for the future – and to an extent, the present level of climate impacts – through *resilient net zero planning*. This should be the goal of all HEIs, as it recognises the interconnected nature of protecting against climate risks whilst reducing climate change. Crucially, this also makes practical sense in terms of the on-the-ground solutions HEIs can deploy, which can often deliver on multiple objectives at once. For example, Oxford Brookes University are redeveloping a student village with high performing buildings to reduce energy demand from heating and cooling whilst also building resilience to higher summer temperatures.[7] The University of West London have invested in renewable energy systems on their campus, building their energy resilience and making significant emissions savings (Box 2).[8]

UNDERTAKING A CLIMATE RISK ASSESSMENT

Climate poses both physical and transition risks. This paper focuses on physical risks, including extreme weather events that impact people, operations and facilities across the HEI sector. Risk assessment is the first step towards identifying most significant weather-related threats and priorities for adaptation.

BOX 1: CLIMATE READY CLYDE – WHY CITY AND REGION COLLABORATION FOR CLIMATE RESILIENCE WORKS[5]

Climate Ready Clyde is a cross-sector initiative to enable climate adaptation for the Glasgow City Region. The 15 members include the eight local authorities in the Glasgow City Region, Glasgow's large universities, Scottish Government agencies and private sector partners. The initiative enables access to data, knowledge and common understanding of the climate change risks faced by the region and the options for building resilience and adaptation planning.

The partnership has been transformational for University of Strathclyde and helped the institution to develop its own Climate Adaptation Plan. The University collaborated with Climate Ready Clyde partners to understand and respond to climate risks for its operational assets, leading to the implementation of a range of projects to enable climate resilience, including green roofs, interpretive rain gardens, and sustainable drainage.

This is fundamentally a proactive rather than reactive approach to managing both existing and anticipated climate risks.

One of the first climate risk management frameworks was developed by the UK Climate Impacts Programme (UKCIP). This followed a sequential and iterative approach that has been adopted by most frameworks since (see Figure 1). Most start by defining the intended outcomes of the climate assessment, then proceed to identify options for managing climate risks to people, assets, and operations as well as maximising any benefits from climate change over the specified time horizon(s). It is also important to begin the process with a clear specification of the primary units of interest such as physical sites, policies, or activities.

Hazards faced by UK HEIs include flooding from water courses and heavy rainfall, heatwaves, droughts and storms. These can affect human and animal health, damage critical infrastructure, buildings and biodiversity, as well as disrupt transport systems, supply chains, research, teaching and sports activities. Extreme weather events can also interrupt essential services – such as food, water, and energy – supplied by third parties to HEIs. Case studies from Cranfield University[9], Loughborough University[10] and Newcastle University[6] illustrate the impact of flooding on HEIs and actions that are being taken to adapt and build resilience to future flood related risks.

Systematic risk evaluation frameworks typically identify:

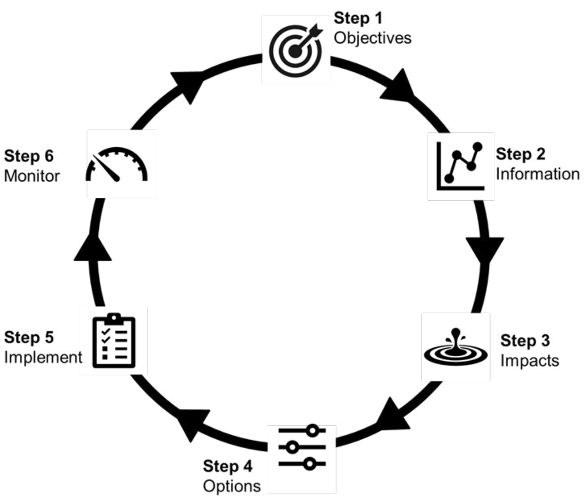
- Climate vulnerable **receptors** and units of interest;
- Climate and socio-economic **scenarios** of future conditions;
- Tools and **methodologies** for appraising consequences of climate hazards;
- Climate impact **indicators** that are relevant to decision-makers;
- Criteria for rating the **urgency** of anticipated risks and opportunities.

BOX 2: BUILDING ENERGY RESILIENCE IN A CHANGING CLIMATE[8]

The University of West London (UWL) has invested in renewable heating and ventilation systems to ensure long-term energy supply security and resilience to potential future climate risks to national energy infrastructure whilst improving biodiversity on its campus.

UWL secured £5.1 million of funding from the government's Public Sector Decarbonisation Scheme to install air, ground source heat pumps and solar photovoltaic-thermal panels. Installation of ground source heat pumps required the drilling of boreholes to extract heat from below the surface, and after completion of the work, rather than re-turfing the space, a garden was created to enhance biodiversity and access to greenspace on campus.

During the lifetime of the heat pumps and solar panels the generated renewable energy on campus will save estimated emissions equivalent to 4.7 years worth of UWL's cumulative scope 1 and 2 emissions.



Step 1: Set adaptation objectives (such as disruption or damages avoided) that align with national and sector plans for climate action.

Step 2: Gather contextual information to establish baseline knowledge and activities plus depth of analysis that is practically feasible.

Step 3: Evaluate climate risks to vulnerable people, services and assets (including for mitigation actions) under present and expected climate variability and change.

Step 4: Identify adaptation options that manage or transfer identified climate risks.

Step 5: Prioritise and implement adaptation actions using defined criteria, then schedule preferred options within planning pathways.

Step 6: Monitor evolving climate risks and evaluate adaptation outcomes.

Figure 1: A framework for evaluating climate risks and adaptation options. Source: Asian Development Bank (2023)[11]

Identifying climate vulnerable receptors

There are many types of climate vulnerable receptor. These can include vulnerable groups of people, critical sites and/or infrastructure, specific activities, animal welfare and habitats. Receptor scales may span from highly localised environments with endangered species, individual rooms and buildings, a campus with student/staff travel routes, through to international supply chains and overseas facilities. Hence, it is important to consider climate risk exposure beyond the physical footprint of the HEI. This may take a few iterations: beginning with a high-level view of climate risks to operations at the institution (such as to teaching, research, student experience), before then evaluating risks to critical assets, specific activities and off-site interests. Moreover, there may be compounding and cascading risks to HEIs – such as when a flood impacts a power supply which, in turn, causes failure of IT systems.

Referring to climate change scenarios and storylines

Anticipation of climate risks involves imagining plausible scenarios of climate and socio-economic change for exposed receptors. This may draw on information from national climate change scenarios, such as the 2018 UK Climate Projections (UKCP18) of rainfall and temperature (and other weather variables) which can be 'downscaled' to local places of interest. Other lines of evidence about local climate risks may come from scientific literature, stakeholder engagement or expert opinion. It is also important to contextualise these physical climate hazards using storylines. For HEIs, such narratives might refer to expected numbers of students and staff on campus, planned developments and upgrades to existing facilities, new technologies and changes in behaviours. For example, Cranfield University have undertaken focus groups with staff and students to prioritise risks and to recommend adaptation actions (Box 3)[9].

Appraising climate risks

Formal appraisal of climate risks can begin with light touch scoring of risks (likelihood and consequence) before more detailed systems modelling and multi-scenario analysis. The former is an effective way of rapidly assessing and ranking risks using look-up tables (e.g., Table 1). Likelihood levels may be defined in terms of the frequency of occurrence of the hazard, such as 1 year in 20 years (rare event) through to nearly every year (almost certain). Consequence levels can be assessed in various ways, such as the number of people, species or area of habitat affected, duration of service interruption, or costs. Importantly, local definitions of likelihood and consequence can be developed by each HEI.

For example, an institution might give an initial risk score of 9 to surface water floods that occur on a campus once in 5 years, each time causing damages of £10,000s (i.e., likelihood 3 x consequence 3) (Table 1). Climate changes leading to more frequent floods (say once in two years), but the same damages would be assigned a risk score of 12 (i.e., likelihood 4 x consequence 3). This approach can be applied to each physical climate risk to identify priorities for action.

Developing climate change indicators

Climate change indicators are helpful for benchmarking existing risks and for quantifying future changes in risk. The 61 indicators used in CCRA3[3] offer a useful starting point for HEIs when reviewing risks to people, natural assets, infrastructure, operations and the international dimensions of climate change (Annex 1). For example, CCRA3 indicator H1 is *'risks to health and wellbeing from high temperatures'*. This might be tracked using historic temperature records from local weather stations (for past and present), monitoring of temperatures within offices, laboratories, animal accommodation, teaching spaces, and student residences, and heat indices such as cooling degree days from UKCP18 (for the future). The portfolio of indicators should reflect the unique circumstances of each HEI.

BOX 3: DEVELOPING A UNIVERSITY CLIMATE CHANGE RISK ASSESSMENT AND ADAPTATION STRATEGY[9]

As part of a student project, a climate change risk assessment for Cranfield University was drawn up. This outlined climate change risks for the University and suggested opportunities for adaptation. Focus groups were undertaken with various stakeholder groups from across the University to prioritise risks, opportunities, and controls for climate change risks and to develop a list of recommended adaptation options.

Since the project to develop the risk assessment and strategy was completed in 2019, Cranfield University has committed to officially publish its adaptation strategy in 2023. Several adaptation measures have been carried out for new builds on campus, such as the installation of sustainable drainage systems to mitigate flood risk. Cranfield University is now also monitoring and recording extreme weather events and associated damage on campus, to continue tracking climate change risks.

Climate risk	Likelihood level	Consequence level				
		Nuisance costs (£100s)	Minor costs (£1000s)	Moderate costs (£10,000s)	Major costs (£100,000s)	Catastrophic costs (£1,000,000s)
		1	**2**	**3**	**4**	**5**
Description		Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain (most years)	**5**	5	10	15	20	25
Likely (1 in 2 years)	**4**	4	8	12	16	20
Possible (1 in 5 years)	**3**	3	6	9	12	15
Unlikely (1 in 10 year)	**2**	2	4	6	8	10

Table 1: An example of a scoring matrix used for rapid appraisal of climate risk likelihood and consequence expressed here in terms of cost (£) of damages/interruptions.

HEIs should consider what resources can be allocated to smaller and more "light touch" projects around climate risk assessment. The complexities of climate risk assessment can lead to a proliferation of guidelines, regulations, and data sets that may not always fulfil their intended purposes. If climate risk assessment is allowed to develop as a highly technical and inaccessible specialism, this will be at the expense of broad stakeholder engagement. Conversely, light touch climate risk assessments can involve students, staff and wider communities, plus lead to rapid identification of most climate vulnerable receptors and priorities for action.

Assigning urgency levels and actions

Having gathered evidence about vulnerable receptors and expected climate risks, the final step is to assign urgency categories and hence the type of action that should be taken by HEIs. CCRA3[3] recommended that risks be assigned to one of four categories of urgency (from greatest to least): (1) more action needed; (2) further investigation; (3) sustain current action; and (4) watching brief. More action may be needed when there are time-limited opportunities for implementing activities that yield benefits now, regardless of projected climate risks – such as reducing exposure to heat when retrofitting buildings. Action can also be urgent when there is a risk of 'lock-in' or narrowing of future options – such as developing a site that is prone to flooding.

Actions to manage climate risks can take many forms, including: new or upgraded infrastructure (e.g., flood defences and green roofs); changes to the use of existing infrastructure or rescheduling of activities (e.g., to avoid hottest parts of the day); improved maintenance regimes (e.g., more frequent de-silting of drainage networks); spatial planning and land use zoning (e.g., to control development in flash flood areas); applying more stringent building and design codes (e.g., to withstand higher temperatures or more intense rainfall); raising awareness and changing behaviour (e.g., about heat health risks); natural resource management and planning (e.g., to reuse water or reduce demand); financial instruments (e.g., tariffs to reduce demand, or insurance to spread risk); or new information and technology (e.g., early warning systems to improve preparedness for heatwaves, droughts, and floods).

WIDER CLIMATE-RELATED RISKS AND CONSIDERATIONS

Transition risks

In addition to physical climate risk, there are also transition risks from the changing economic and social environment in which HEIs operate. Some general areas to watch include legal and policy, investment, market, and technology risks. For example, institutions deeply invested in research for carbon-intensive industries could face loss of grant income or redundancy of test facilities. Flood zones may be adjusted to reflect increased risks and thereby constraining future development options or stranding assets. Impacts may also become material to HEIs through stigmatisation or reputational damage (such as missing net zero milestones or ranking low in university sustainability league tables).

Risk multipliers, co-benefits and trade-offs

Climate risks may interact with one another and with other risks in the register, so when assessing climate risks, it is important to be mindful of risk multipliers, as well as any co-benefits or trade-offs. This includes co-benefits or trade-offs with an overall net zero strategy. For instance, measures to reduce energy consumption might involve improving building performance by insulation. This would reduce winter energy demand but could have unintended consequences in terms of raising indoor temperatures during summer heatwaves, which may lead to greater use of air conditioning, offsetting gains with respect to emissions reductions.

Some climate risks may be connected, such as drought impacts on water supplies, outdoor sports surfaces, and wetland habitats. Hence, the possibility of trade-offs with climate mitigation initiatives and simultaneous, cross-cutting impacts across multiple receptors should always be considered. High-level tools such as the Climate (Co)benefits Portal[12] may be helpful in initiating conversations around these issues.

Net zero deserves special consideration in relation to risk management and hard limits to adaptation. It is already well recognised that net zero underperformance can transmit to financial risk for HEIs via channels such as regulation, litigation, and reputation (including student and staff recruitment). However, decision-making must adopt a longer horizon and look to the existential threats posed by high emissions and rapid climate change to HEIs and the wider educational sector.

Considering climate risks for UK HEIs overseas

UK HEIs have increasingly global outlooks and operations, meaning that the footprint of UK higher education extends beyond its geographical borders. A recent report from the Royal Anniversary Trust (2023)[13], calculated that emissions from international student and business travel equated to 15% of the total carbon footprint of the further and higher education sector in 2020 – 2021 (18.1 Megatonnes of carbon dioxide equivalent ($MtCO_2e$)). The majority of these travel related emissions were contributed by the Higher Education sector, indicating the significant scale of international activities from HEIs.

Transnational education (TNE) is now a key strategic component for most UK universities. In the 2020/2021 academic year, more than half a million students were registered with UK HEIs in 225 countries outside the UK. Many of these students were concentrated in a handful of countries. China, Malaysia, Sri Lanka, Singapore, Egypt and Hong Kong hosted 43% of all UK TNE students.[14] These countries are expected to be at greater risk due to climate change with extreme conditions arising from heatwaves, droughts, tropical storms and sea-level rise.

Universities have research partnerships and collaboration across the globe which are critical to the delivery of high quality and impactful research. Recent bibliometric analysis by UK Universities International (2022)[15] found that a greater proportion of UK research publications (60.4%) is produced with international co-authors than any other top-10 research-producing system, and that international co-authorship correlates with more highly cited research.

From the perspective of climate risk assessment and strengthening resilience of the delivery of HEIs' core business of research, innovation and education, consideration of the risks to an institution's international activities and operations are imperative. In assessing these risks and developing adaptation plans, UK HEIs must look to how they maintain their duty of care to protect staff and students undertaking activities overseas as the risks from climate change become more severe. HEIs must also consider the impact of disruptions to international supply chains on the delivery of their core business by understanding the risks to the commodities, components and services delivered by international organisations.

There are five main areas of climate risk to consider and capture within institutional risk registers in relation to international activities:

1) **Risk to staff and student wellbeing** caused by physical damage to accommodation and living facilities, workspaces, loss of personal possessions and health issues associated with extreme weather events and climate change.
2) **Risk to in-person teaching, learning and assessment** resulting from physical damage to teaching spaces and local transport infrastructure by extreme weather events and evolving climate conditions.
3) **Risk to academic quality assurance, research delivery and reputational damage** if staff travel between the UK and the partner institution/ branch campus is restricted or communication infrastructure becomes unserviceable due to climate impacts.[16]
4) **Risks to international fieldwork, research facilities and collaborations** due to damage and disruption by the physical hazards, especially in places with increasing heat, cyclone, and coastal flood risk.
5) **Risks to international supply chains** of commodities, components and services consumed by HEIs.

As a consequence of the Covid-19 pandemic, many HEIs had to adapt and build resilience. For continuity of teaching and learning, universities have strengthened virtual learning resources and designed processes to transfer in-person teaching to synchronous and asynchronous remote, virtual learning. However, the robust and effective provision of remote student wellbeing services remains a challenge for the sector because it is difficult and costly to replicate service provision at overseas locations. International collaborative research also adapted to a virtual working environment but the pause on international fieldwork, visits and conferences had significant impact on many projects and collaborations, and networking and career development opportunities, especially for early career researchers.

Strengthening the resilience of HEIs requires continued consideration of how to adapt and build resilience of international activities. The process of climate risk assessment and the development of resilience, adaptation and business continuity plans at overseas partners/branch campuses should be a formal part of the validation and approval of TNE provision. However, there is currently no legal or regulatory obligation and the number of institutions that include this as part of the process is not recorded or monitored, and therefore unclear. Likewise when developing strategies for international research activities institutions must consider the increasing likelihood of extreme weather events and the impact on their capacity to deliver research commitments and ensure staff and student safety and wellbeing.

STRATEGIES AND BARRIERS TO BUILDING RESILIENCE

There are at least four strategies for building institutional resilience:

1) **Flexibility or substitutability** – where there is more than one supplier of a commodity or service, backup system, network, or asset.

2) **Distributed or modular assets/services** – where business critical operations are not centralised for efficiency but instead are dispersed to enable some level of continuity and recovery from shocks.

3) **Diversification** – where critical services are spread across multiple suppliers and pathways.

4) **Redundancy** – where there is some contingency and operations are not fine-tuned for 'just-in-time' efficiencies.

Across the sector, there is scope for more sharing of good practice and experiences on climate resilience via forums, conferences, professional bodies and training. An accreditation scheme could be devised to incentivise and recognise progress made by institutions in gathering baseline information, evaluating risks, planning and implementing climate actions, and monitoring outcomes. To really encourage uptake, there might be an expectation that such a bronze, silver or gold standard of 'preparedness' would be reported within the institutional environment statements of any future Research Excellence Framework (REF) scheme. Organisations such as The Alliance for Sustainability Leadership in Education (EAUC) could host repositories of guidance and other resources, including briefing documents, primers, webinars, and horizon scanning articles.

Meanwhile, steps should also be taken to reduce obstacles to adaptation. One of the key internal barriers to resilience is the institutional structure of HEIs, especially when decision-making power and operational responsibility are split across divisional boundaries. Trade-offs between higher capital costs to build resilience and resultant operational costs, which are typically lower and deliver additional benefits, are harder to capture and evaluate in such environments. Silo working can be a significant barrier to change. For example, when considering choices around new campus buildings, removal of green space and biodiversity may run counter to an Environmental Strategy that has been approved at Senate level. Trade-offs may also exist around attracting more students to generate revenue versus developing green spaces and other habitats plus associated increased resource consumption. This balance can also be seen with examples from HEIs declaring a Climate Emergency but then not taking commensurate action to halt investment in funds which are directly involved in fossil fuel extraction. Competing agendas can sometimes lead to delay and inaction, or contradictions between high-level mission statements and practice.

Research is needed to understand what a 'good' resilient net-zero HEI looks like. While recognising resilience is an ongoing process, what are we trying to achieve through increased resilience? What are the priorities and where are the acceptable trade-offs? This is likely to vary by HEI due to the influences of its academic priorities, its student body, and the wider context of people and place that the HEI is situated in. In the most recent CCRA[3], the Climate Change Committee cited *'a vision for a well-adapted UK'* as the number one principle for good adaptation. The Department for Environment, Food and Rural Affairs (Defra), as the government lead department for the national adaptation effort, have started to respond to this by, for example, commissioning public dialogues around the topic of 'good adaptation'. Similar work needs to take place for the sector and at greater granularity to ensure that our adaptation response to risk assessments aligns with people's priorities and preferences, and to avoid maladaptation.

Government can support HEIs in other ways, such as by funding research programmes that build the evidence base on climate risks and adaptation for the education sector – thereby strengthening the fourth national Climate Change Risk Assessment (CCRA4) too. Indicators could be devised to track sector wide preparedness by reporting numbers of HEIs undertaking risk assessments and with adaptation plans or amounts of investment in climate resilience measures. Above all, government is best placed to strengthen the enabling environment for adaptation by improving access to climate and impacts data held by agencies, plus investing in improved climate resilience of critical national infrastructure and services. More local support could be given to HEIs and their communities via a resilience fund akin to the Public Sector Decarbonisation Scheme.

SUGGESTIONS FOR ASSESSING RISK AND STRENGTHENING RESILIENCE IN UK HEIS

Climate risk assessment should bring together the skills and knowledge of different groups making up the HEI community.

Undertaking a climate risk assessment is as much a technical as social endeavour. Contextualising physical climate hazards using 'storylines' is an important tool in climate risk assessment. These storylines should be developed from scenarios of climate and socio-economic change alongside other forms of evidence such as scientific literature, stakeholder engagement or expert opinion. Using different forms of evidence facilitates a risk assessment process which takes account of people's priorities and preferences, and helps to avoid maladaptation.

Table 2 suggests ways in which different groups making up the HEI community and stakeholders could support planning and practical action on climate resilience.

Table 2: Suggestions for actions from different groups making up the HEI and FEI community and stakeholders to support planning and practical action on climate resilience.

Stakeholder group	Suggested actions
HEI and FEI sector and sector bodies	• Develop sector briefs, guidance and training on climate risk assessment and management • Develop an accreditation scheme for institutional climate preparedness • Establish forums for the exchange of knowledge and good practice between education institutions on climate mitigation and adaptation • Develop position and policy statements around sector-wide issues such as security of supply chains, overseas sites and managing transition risks
Senior management	• Mainstream climate risks within the institutional risk register, business continuity planning, routine monitoring and reporting protocols • Align working groups for resilience, net zero and sustainability planning • Provide resources commensurate with the complexity and scale of the work • Assign clear roles and responsibilities for climate actions • Develop policy around responsible purchasing to consider Environmental Social Governance • Develop and resource training and education for staff and students in the skills needed for a resilient net zero transition • Drive action and accountability for climate risk and resilience by raising questions in senate
Professional staff	• Integrate physical and transition risk management to avoid asset stranding • Factor resilience into major infrastructure and procurement decision-making and financial reporting • Set up monitoring, evaluation and learning frameworks, recognising that climate risk assessment is an open-ended and iterative process • Publish climate risk indicators where they are visible and accessible, and actively seek engagement from the wider community • Openly share learning (both good and bad) with others in the sector and beyond
Academics and researchers	• Offer technical support on data gathering, climate risk assessment and hazard forecasting • Advocate strategies for decision-making under uncertainty • Identify low-regret adaptation options (i.e., those that yield benefits now and under climate change) • Support horizon-scanning activities for early uptake of new technologies, tools and frameworks for climate adaptation • Raise awareness of compound and cascade risks within your own institution and the wider sector • Embed student-centred climate change education including climate risk and resilience in all courses[17]
Students	• Participate in your HEI climate strategy through projects, fieldwork and citizen science initiatives • Raise awareness of climate risks and adaptation actions through student groups, societies, unions, residency representatives and campaigns • Support voluntary work to protect local biodiversity and blue-green spaces • Showcase your own actions to build resilience and reduce carbon emissions • Lobby senior management to raise ambition on climate risk management, just and resilient net zero transition • Form student-staff working groups to explore climate risk management, and drive rapid change • Act as links to communities and organisations outside the HEI, and support knowledge exchange and collaboration

Table 2: (continued)

Stakeholder group	Suggested actions
Communities	• Engage with community-HEI partnerships to raise awareness and achieve shared local benefits of climate action • Co-host public outreach and education events on climate change in local schools, clubs and communities • Encourage and participate in stakeholder engagement processes to ensure that climate risk assessment and management reflects the community's visions and values
Government	• Fund research programmes on climate risk and resilience for the educational sector to develop a knowledge base • Support long-term investment in climate resilient infrastructure (estates, digital infrastructure) akin to the Public Sector Decarbonisation Scheme • Develop schemes and incentives to support sectoral collaboration on climate action including resilience building, especially for smaller HEIs • Give more attention to risks to education in the scope of CCRA4 and subsequent UK Government National Adaptation Plan • Support the release of national data archives held by agencies and funded bodies to enable greater access to critical information needed to support climate risk assessment and adaptation planning • Develop a set of national indicators to track progress in climate resilience across the educational sector, such as the number of institutions that acknowledge climate in their risk registers

Annex 1: Risks assessed in the CCRA[3], highlighting those most relevant to HEIs and FEIs.

	Natural Environment and Assets
N1	Risks to terrestrial species and habitats from changing climatic conditions and extreme events, including temperature change, water scarcity, wildfire, flooding, wind, and altered hydrology (including water scarcity, flooding and saline intrusion).
N2	Risks to terrestrial species and habitats from pests, pathogens and invasive species
N3	Opportunities from new species colonisations in terrestrial habitats
N4	Risk to soils from changing climatic conditions, including seasonal aridity and wetness.
N5	Risks/opportunities for natural carbon stores, carbon sequestration from changing climatic conditions, including temperature change and water scarcity
N6	Risks to and opportunities for agricultural and forestry productivity from extreme events and changing climatic conditions (including temperature change, water scarcity, wildfire, flooding, coastal erosion, wind and saline intrusion).
N7	Risks to agriculture from pests, pathogens and invasive species
N8	Risks to forestry from pests, pathogens and invasive species
N9	Opportunities for agricultural and forestry productivity from new/alternative species becoming suitable.
N10	Risks to aquifers and agricultural land from sea level rise, saltwater intrusion
N11	Risks to freshwater species and habitats from changing climatic conditions and extreme events, including higher water temperatures, flooding, water scarcity and phenological shifts.
N12	Risks to freshwater species and habitats from pests, pathogens and invasive species
N13	Opportunities to freshwater species and habitats from new species colonisations
N14	Risks to marine species, habitats and fisheries from changing climatic conditions, including ocean acidification and higher water temperatures.
N15	Opportunities to marine species, habitats and fisheries from changing climatic conditions
N16	Risks to marine species and habitats from pests, pathogens and invasive species
N17	Risks and opportunities to coastal species and habitats due to coastal flooding, erosion and climate factors.
N18	Risks and opportunities from climate change to landscape character
	Infrastructure
I1	Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures
I2	Risks to infrastructure services from river, surface water and groundwater flooding

Annex 1: (continued)

I3	Risks to infrastructure services from coastal flooding and erosion
I4	Risks to bridges and pipelines from flooding and erosion
I5	Risks to transport networks from slope and embankment failure
I6	Risks to hydroelectric generation from low or high river flows
I7	Risks to subterranean and surface infrastructure from subsidence
I8	Risks to public water supplies from reduced water availability
I9	Risks to energy generation from reduced water availability
I10	Risks to energy from high and low temperatures, high winds, lightning
I11	Risks to offshore infrastructure from storms and high waves
I12	Risks to transport from high and low temperatures, high winds, lightning
I13	Risks to digital from high and low temperatures, high winds, lightning
	Health, Communities and the Built Environment
H1	Risks to health and wellbeing from high temperatures
H2	Opportunities for health and wellbeing from higher temperatures
H3	Risks to people, communities and buildings from flooding
H4	Risks to the viability of coastal communities from sea level rise
H5	Risks to building fabric
H6	Risks and opportunities from summer and winter energy demand
H7	Risks to health and wellbeing from changes in air quality
H8	Risks to health from vector-borne disease
H9	Risks to food safety and food security
H10	Risks to water quality and household water supplies
H11	Risks to cultural heritage
H12	Risks to health and social care delivery
H13	Risks to education and prison services
	Business and Industry
B1	Risks to businesses from flooding
B2	Risks to businesses and infrastructure from coastal change from erosion, flooding and extreme weather events
B3	Risks to business from water scarcity
B4	Risks to finance, investment and insurance including access to capital for businesses
B5	Risks to business from reduced employee productivity due to infrastructure disruption and higher temperatures in working environments
B6	Risks to business from disruption to supply chains and distribution networks
B7	Opportunities for business from changes in demand for goods and services
	International Dimensions
ID1	Risks to UK food availability, safety, and quality from climate change overseas
ID2	Opportunities for UK food availability and exports from climate impacts overseas
ID3	Risks to the UK from climate-related international human mobility
ID4	Risks to the UK from international violent conflict resulting from climate change overseas
ID5	Risks to international law and governance from climate change that will impact the UK
ID6	Opportunities from climate change (including Arctic ice melt) on international trade routes
ID7	Risks associated with international trade routes
ID8	Risk to the UK finance sector from climate change overseas
ID9	Risk to UK public health from climate change overseas
ID10	Risk multiplication from the interactions and cascades of named risks across systems and geographies

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The working paper represents the views of its authors and not necessarily that of every university or institution participating in the network. For more information about the UK Universities Climate Network, please visit uucn.ac.uk or contact ukclimateuniversities@imperial.ac.uk.

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