

Innovate UK

Technology Strategy Board



The business case for adapting buildings to climate change: Niche or mainstream?

Executive Summary

by Matt Thompson, Ian Cooper
& Bill Gething

Endorsements

Marks & Spencer has been actively managing climate change risk in our supply chains and property estate since 2010, as part of our sector - leading Plan A strategy, and our participation in the Design for Future Climate programme has enabled us to enhance our bank of knowledge and share our insights.

For too long, the issue of climate change resilience and adaptation in buildings has been seen as a subject of special professional interest. In this report Innovate UK recognises that adapting buildings to climate change needs a higher place on the agenda of businesses and their boards if the UK is to continue to be competitive in a commercial world.

This report sets out, with clear evidence, references, quotes, ideas and best practice from the Design for Future Climate programme, why and how we should consider adaptation. It brings together, with concision and accuracy, multi-sector viewpoints that deal with every angle of any issue relating to climate change risk in building design and leaves no stone unturned.

It moves the case for change several steps forward in a single effort – and that means that it will be an invaluable tool not just for those who currently understand the issue, but also for those whom we must still persuade.

Sylvie Sasaki

Property Plan A Project Manager
Property & Store Development, Marks & Spencer



Continuing to design for yesterday's climate is exposing our buildings and their occupants to significant risks.

Hot summers and heat waves, as well as floods and drought, are expected to become more common with climate change. In many cases simple, low cost design changes can make all the difference – creating better spaces in which to live and to work, able to safeguard peoples' health and productivity, and cope more readily with weather extremes. The Design for Future Climate project is an excellent resource, with lessons from experience and practical advice for both policymakers and practitioners on how to design buildings fit for the decades ahead.

Daniel Johns

Head of Adaptation
Committee on Climate Change



Cover image: Ebbw Valley School entrance shows how careful consideration of orientation and glazing can allow sunlight to enhance spaces without leading to overheating (Building Design Partnership for Blaenau Gwent County Borough Council)

Foreword

The Design for Future Climate legacy - kickstarting innovation

Innovate UK's Design for Future Climate, Adapting Buildings (D4FC) programme generated a substantial body of evidence for how different buildings exposed to different climate risks can best be adapted for a changing UK climate.

The design teams involved developed ingenious approaches and fresh thinking tailored to their buildings' unique circumstances, demonstrating the depth and excellence of the UK built environment professionals' capacity for innovation.

These design teams are now innovators in the field, putting them at the absolute cutting edge of climate change adaptation thinking and thus first in line for commercial adaptation work.

They also leave a handsome legacy of publicly funded open-access knowledge for the benefit of the rest of the building design industry. The information in the D4FC projects' final reports, along with several summary reports, contains a rich seam of intellectual capital that can be used to establish a consensus for future practice. These reports are freely available from <https://connect.innovateuk.org/web/design-for-future-climate/projects-outputs>.

The full version of this report can be downloaded from <https://www.gov.uk/government/organisations/innovate-uk>.

The subject is complex and full of uncertainties, but for firms who respond it seems likely that there will be early adopter commercial advantages as climate hazards become more prevalent and as pressure on clients to consider adaptation grows.

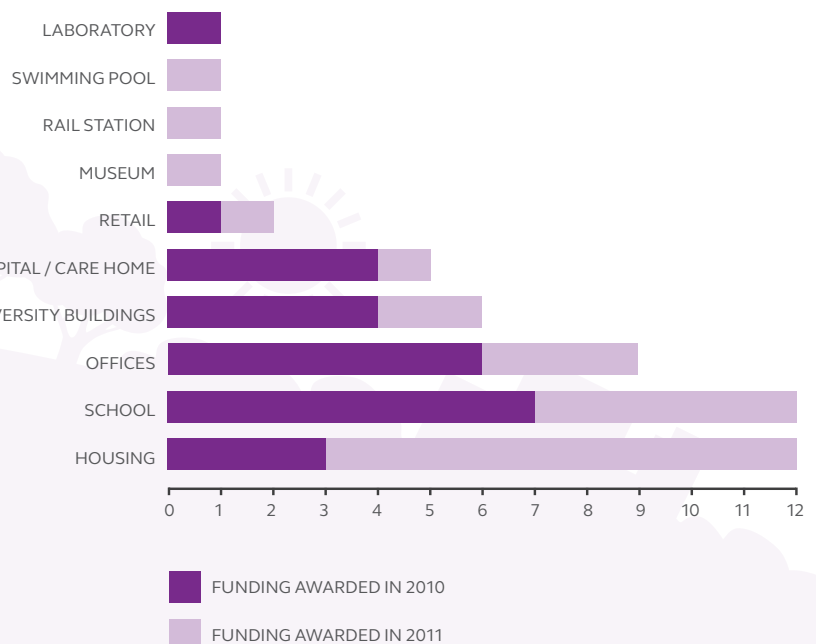
Properly managed and exploited, the momentum gained should put the UK at the forefront of the dawning international market for adaptation services in the built environment, which grew by over 5% last year.



Mark Wray

Innovate UK

Project breakdown by building type



Introduction

This report analyses the drivers that affect the market for professional building design services to ready buildings for the changing climate. Recent Intergovernmental Panel on Climate Change (IPCC) reports confirm the climate trends that make adaptation important and urgent.

Even small increases in average temperatures and their consequent effects on the intensity and frequency of extreme weather events can have far-reaching direct consequences for the built environment; complex indirect consequences will exacerbate the situation.

The technical challenge of adapting to future climate change in the built environment is to optimise building design now for the most effective phased transition to what will be needed in the future. Since the lives of buildings are measured in decades, this means anticipating the future and developing a gradual adaptation strategy that makes use of maintenance cycles for timely, effective and proportionate upgrades.

Extreme weather in the UK?

2005	Flooding	2009	Flooding	2013	Hot weather
2006	Drought	2009	Snow and ice	2013	Storms
2006	Heatwave	2010	Flooding	2013	Flooding
2007	Flooding	2010	Snow and ice	2014	Flooding
2008	Flooding	2012	Drought	2014	The wettest January and driest September on record in the UK
2008	Snow and ice	2012	Flooding		

Source: Climate UK

However, some aspects and elements of buildings – such as their location, orientation, foundations, ceiling heights, glazing ratio, and so on – cannot easily or viably be adjusted in maintenance cycles but are nonetheless fundamental to a building’s ability to cope with future climate. If these fundamental design features cannot cope, buildings risk becoming ‘stranded assets’. A single such stranded asset is a private concern for the owner or

occupier. However, a large number of stranded assets in all economic sectors across the UK is a public concern.

At the moment, the UK market for adaptation services from building designers is limited, constrained by, among other things, a return on investment for clients that is perceived to be poor, how distant the risks are in time, and uncertainty. Even prior experience of severe climate impacts appears not to motivate clients, indicating a ‘lightning won’t strike twice’ inertia in the market.

The reluctance from construction clients dampens the professional building design sector’s motivation to get involved. Investing in adaptation skills looks like a poor bet given the number of stronger markets for building design services.

However, there are some signs that pressure is mounting on clients from other sources, notably the insurance industry, investment institutions and, of course, other financial stakeholders, many of whom retain long-term interests in buildings after the construction client has moved on.

Also, many construction clients are waking up to the opportunities presented by climate change. As impacts hit and public awareness grows, resilient buildings will become important for maintaining a commercial advantage over business competitors and for demonstrating corporate social responsibility.

Finally, climate scientists are steadily amassing evidence that makes the changing climate increasingly difficult to ignore, improving certainty and paving the way for new professional design standards.

“The intensity and frequency of extreme weather can have far-reaching effects on buildings.”

Seven key messages

- The market for design services to adapt buildings to future climate change remains very limited
- The limited market is not an excuse for building design professionals to do nothing
- Construction clients risk procuring stranded assets if they do not heed climate change risks
- The Government must signal that adaptation in the built environment is a critical issue
- At present, the construction and property industries have no adaptation plan to tackle climate change
- Clients and professionals urgently need educating in climate change adaptation for buildings
- There is a need for a programme of monitoring and evaluating the performance of climate adapted buildings.

Recommendations

Clients

- Clients should adopt appropriate procurement strategies and look to appoint competent building designers to manage the risk from climate change of stranding the assets they build.
- Clients should collaborate with building designers to produce new advice for developing briefs that emphasise the needs of all financial stakeholders.
- Construction client bodies, with the help of academic researchers and commercial suppliers to the industry, should develop construction client decision-making tools that accommodate future uncertainty.

Building design practice

- Professional institutions in the built environment should raise climate change adaptation up their list of priority concerns, and promote continuing professional development, lobbying and advances in professional knowledge and codes of practice.
- Professional institutions should update standard terms and conditions for professional contracts and project management practice to account for climate change adaptation services.
- Industry should develop an authoritative index of climate-readiness for buildings that allows clients to promote their buildings' credentials.
- Building design firms should incorporate the adaptation design process into their project management in the same way that tabs are kept on, for example, regulatory compliance or health and safety.

The construction industry as a whole

- Professional institutions in the built environment and academic researchers should develop a protocol for assessing the risk to buildings from climate change hazards.
- Professional institutions in the built environment, academic researchers and commercial suppliers to the industry should develop computational tools to standardise the way that climate change projections can be used by building designers.
- Professional institutions in the built environment, academic researchers and commercial suppliers to the industry should develop and maintain a simple set of ratios for different building types as a shorthand to understand the relationship between capital expenditure and operational expenditure.

Policy makers

- Avoiding completely new legislation, Government should co-ordinate the updating of standards, planning and Building Regulations to accommodate climate change adaptation as soon as possible. The use of future weather data should be required by the Building Regulations at their next revision, and could mandate a key role for phased adaptation plans as a way to allow for phased adaptation.
- The Government should maintain research into climate change to reduce the uncertainty of future climate impacts, particularly those aspects that affect the built environment.
- Government should support strategic action by industry to monitor, disseminate and promote climate change adaptation information about the built environment to developers, clients, design professionals, constructors, facilities managers and tenant organisations.
- Government should require public building procurement and maintenance regimes to consider future climate change and the development of buildings with adaptive capacity.
- In partnership with Government, industry should establish a programme of longitudinal demonstration projects, monitor their performance and publish the results openly.
- In partnership with Government, industry should establish a programme of research to reduce the uncertainty of future climate impacts on the built environment at the local site-based scale.

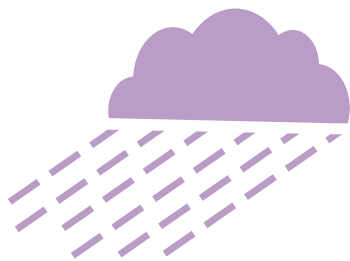
The context

This legacy report from the D4FC programme responds to the Government's National Adaptation programme and considers adaptation to climate change at the scale of individual buildings. It identifies that the need to have a plan for adapting the UK's stock of buildings is already urgent.

Climate change in the UK has consequences for the built environment, chiefly health impacts (including loss of life), economic losses, the level of internal environmental 'comfort', increases in energy demand, and productivity losses.

Unfortunately, the steps needed to assess the risks from climate change and then to design appropriate responses are complex and beset by uncertainty. Also, climate change risk is just one class among many risks affecting buildings.

Clients increasingly recognise the issue but, in relation to other business or operational concerns, climate change impacts seem still too distant, too uncertain, and adaptation currently may not carry a compelling return on investment. There are many other, smaller barriers to clients commissioning adaptation services.



Client profiles

Although very important, commissioning building work is not the only logical response to climate change risks. Valid alternatives for clients include accepting the risks, transferring them, avoiding them altogether, and behavioural or management measures.

There are many different kinds of client, and the extent to which they might be interested in adaptation varies enormously. Of course, the client is not the only financial stakeholder in their building: insurers, investors, tenants, for example, hold some sway over design decisions. The design brief should seek to protect their interests as well.

Although less influential than the business case barriers, some factors will make clients more likely to consider

“The need for a plan to adapt the UK's stock of buildings is already urgent.”



100 City Road, London, an optimal solution based on owner and user adaptation measures (Arup)

adaptation strategies. For example, having suffered several previous climate impacts, already being engaged in the topic, being concerned about reputation and corporate social responsibility, having financial stakeholders pushing them to do so, or gaining a competitive advantage or exploiting new business opportunities by doing so.

“The design brief should seek to protect client, insurers, investors and tenants.”

Rules of thumb

Building designers can use the following rules of thumb to profile their clients' interest in adaptation.

Clients' financial approaches

The business case for adaptation becomes stronger:

- if costs and benefits over time can be taken into account in establishing initial capital expenditure
- if adaptation gives the client genuine competitive advantages and allows them to exploit new opportunities
- if all the project's financial stakeholders can be shown to favour it
- the more the client's business processes and decision-making are integrated, and able to respond to new factors, and involve fewer people.

Clients' levels of engagement

The business case for adaptation:

- becomes stronger the more enduring the client's stake in the building
- is boosted when the client's fundamental purpose or core business objectives encourage it to engage with the issue
- becomes stronger the more impact adaptation has on the common good, especially if the adaptation is very visible.

Vulnerability of clients' buildings and operations

The business case for adaptation becomes stronger:

- the more vulnerable and likely to be affected the client's priorities are
- the more frequently and seriously the client has experienced the consequences of extreme weather events
- with more certainty of future risk.

Clients' decision-making

The business case for adaptation:

- is more willingly accepted by clients the more robust the rationale is and the more convincingly it is communicated
- becomes stronger when the decision-making processes can make sense of underlying uncertainty.

Clients' attitudes to design

The business case for adaptation becomes stronger:

- when the measures' technology is tried and tested, and the cost-benefits are pronounced
- the more robust evidence there is that it carries on working over time
- the more amenable the client is to innovation and the better the design team is at allaying clients' real or misplaced fears
- the more the client can see that it is part of the building designer's normal service and well established in-house practice.



Building designer profiles

Building designers have a professional duty to understand the potential implications of climate change, discuss them with clients, and act accordingly. Over time, it seems likely that liabilities will arise for building designers to take reasonable account of future climate change. As a consequence, building designers should at least inform clients about climate change risks, and record the outcome.

“Designers have a duty to understand the impact of climate change and discuss it with clients.”

All building designers have their own unique strengths, special interests, and particular characteristics that determine the kinds of projects they are suited to. This reflects their overarching design philosophy and experience, and shapes the kinds of clients they attract and the emphasis they put on different issues.

To be capable of offering adaptation services, building design firms need to be:

- **open to innovation:** willing trying new things on live projects and committed to voluntary research and development and continuing professional development
- **enthusiastic about the subject:** knowledgeable about climate change science, clear-sighted about its impact on buildings, and good at communicating the issues
- **interdisciplinary:** designing from first principles, considering impacts holistically, and having the enthusiasm and skills to work collaboratively with other members of the team
- **aspiring to best practice:** the opposite of merely delivering regulatory compliance or only doing the minimum that reduced fees permit.

There is a micro-market for adaptation services, suited to only a few types of building design firm. Business models are restricted by adaptation’s innovative status and are either rolled up with or bolted on to standard service. For the majority, however, exploiting the opportunity is currently hard to justify in the context of other design issues, the still tentative economic recovery, and the reluctance of clients.

The skills and competences for delivering adaptation services are extensions of existing practice, informed by new principles. That said, lack of regulation and standards – consensus – hinders practice. There are other difficulties for building design professionals. For example, the underlying data informing adaptation design decisions are presented in an unfamiliar probabilistic format that is not easy to understand and communicate.

Adaptation services currently add time to the programme and are potentially inefficient. However, there are opportunities to streamline it significantly, especially if the Building Regulations and standards are updated to account for future climate conditions.



D4FC: Technical Hub at EBI, Cambridge, showing detailed solution for reducing solar gain / glare (Aecom)



New business competences for building designers?

Building designers should favour passive adaptation design measures to avoid compromising efforts to mitigate climate change. However, they should recognise that these may not be sufficient to cope with climate change from mid-century onwards when, for instance, active assistance may be needed for cooling.

The key deliverable from a climate change adaptation service is the phased adaptation plan. For maximum effectiveness, adaptation should be considered as early as possible in the project life.

There is no prescribed standard for climate change risk assessment, but Bill Gething's adaptation matrixes (see Appendix 3 of the full report) are nonetheless a useful basis for assessing buildings' vulnerability to and risks from climate change. Equally, the UK Climate Impacts Programme (UKCIP) Adaptation Wizard sets out a useful framework for building designers to develop adaptation strategies.

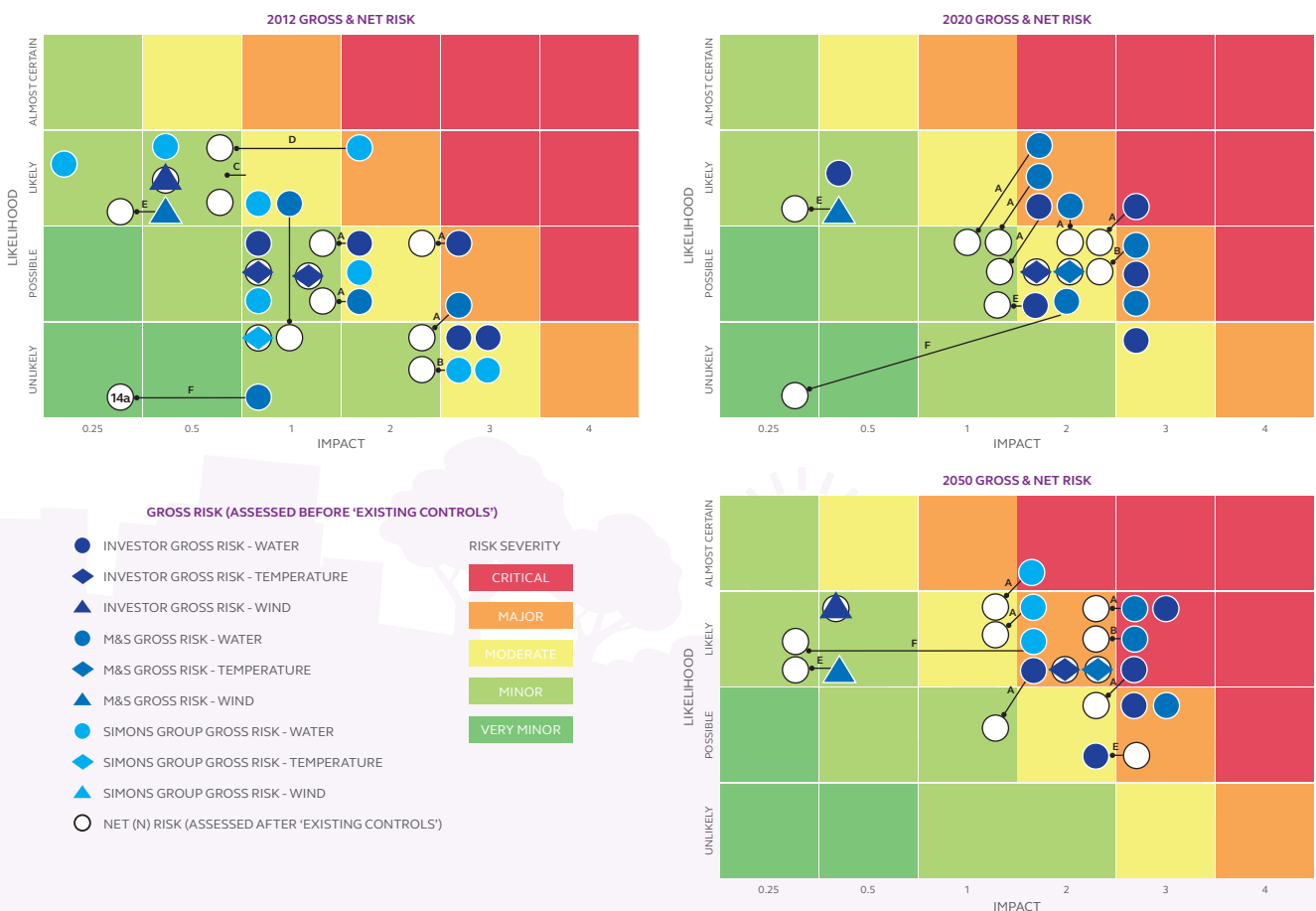
Adaptation demands skilful and specific communication, especially to engage the client, agree assumptions and

metrics, to explain measures, and secure investment. Modelling is often necessary and can be carried out against baseline comparisons or with worst-case scenarios. The resulting data need to be carefully filtered and summarised before being presented to clients.

The concept of regret is important in the client's decision-making process, and should be taken into account by building designers. Options should be evaluated by reference to the UKCIP's decision-making framework, distinguishing no-regret, win-win, low-regret, under-adaptation and over-adaptation measures. Cost-benefit analysis, especially with whole-life costing, is important to help clients to decide on measures.

“The key deliverable from a climate change adaptation service is the phased adaptation plan.”

Example of a stakeholder's needs assessment matrix



The Marks & Spencer Glandford Park Retail team used a simple matrix to assess financial stakeholders' needs (Deloitte)

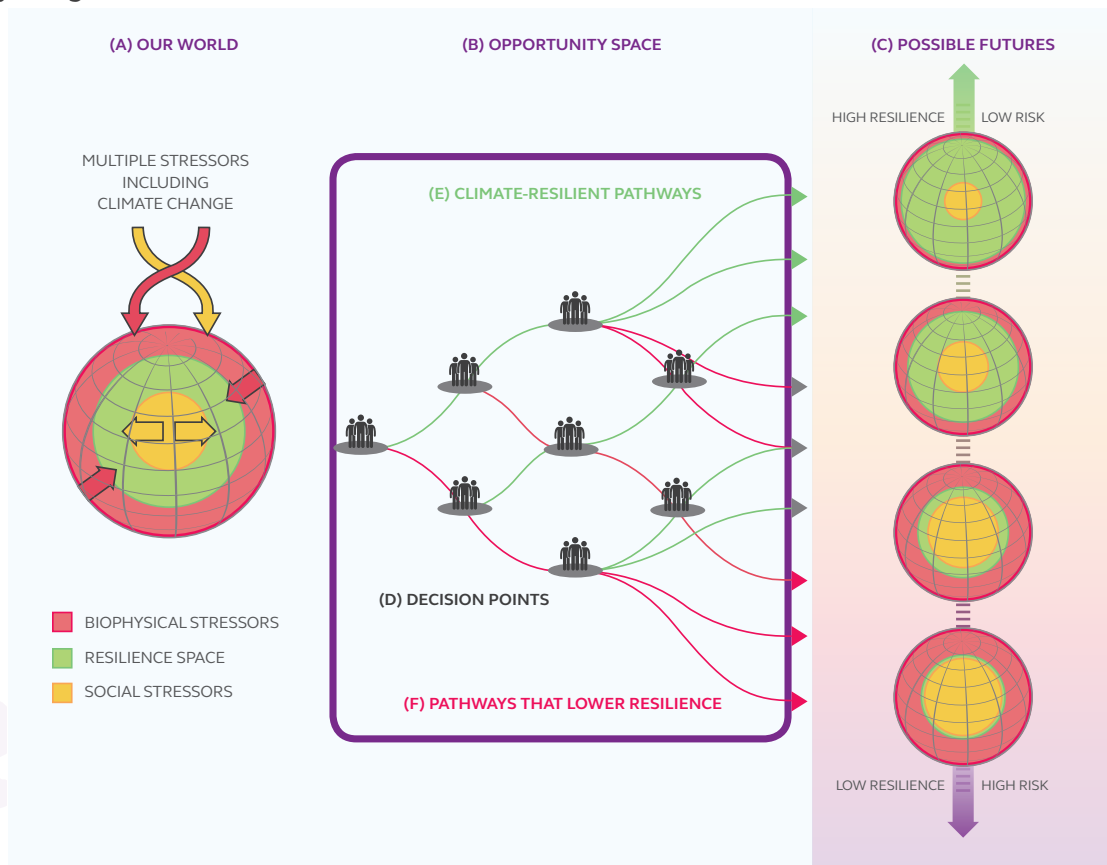
Preparing for an uncertain future

The concluding section of the report considers how adaptation services might become mainstream, identifying possible market and policy failures and summarising the case for intervention, including by central Government.

The D4FC programme sought to stimulate clients and designers to prepare the UK's built environment for climate change by developing phased strategies for adapting new and existing buildings for the climate in 2030, 2050, or even 2080. Some of the funded projects were very successful in identifying adaptation measures which clients were willing to implement. Others were not.

Across the country, the downside risks of not doing so are potentially severe and so the precautionary principle should apply. For example, the D4FC projects discovered that current Building Regulations and standards use historic climate data and, in a changing climate, are inevitably not fit for today's climate, let alone what may come in the future.

IPCC's opportunity space and climate-resilient pathways diagram



There is an opportunity cost in any delay to following green pathways, and the longer one delays, the less resilience is possible. If a significant proportion of the country's building stock fails to be adapted in a planned way over time it is a matter for government intervention. (IPCC)

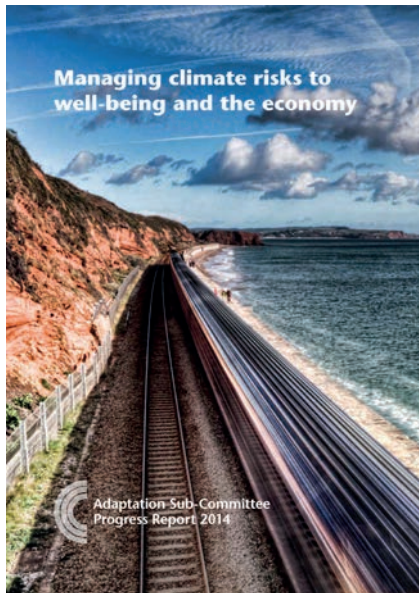
The market for adaptation services is currently weak but the passage of time will improve it. However, left to market forces as recommended in current policy, adapting the UK's built environment is likely to be reactive and possibly too late to avoid the downside risk. The existing barriers to creating a viable market for building design adaptation services constitute both market and policy failures, legitimate justifications for Government intervention.

The steps to creating the market – mainstreaming adaptation services – are to improve knowledge, leadership and policy. The effect on professional design fees is uncertain and depends on the potential to streamline adaptation to fit in with current practice. Innovators and early adopters are likely to benefit the most from the growth of the adaptation market.

“The market for adaptation services is weak but the passage of time will improve it.”

New regulation for adaptation?

The Adaptation Sub-committee's progress report¹, published in July 2014, echoes many of the conclusions of this D4FC report. It compiles evidence for the sub-committee's first statutory report to update the Government's National Adaptation Programme, due in 2015.



As well as flooding, the sub-committee highlights the risk of overheating. In particular, it says that there is a 'fundamental need to adapt the existing building stock and design new buildings to be safe and comfortable in a hotter climate'. It recognises the existing market failure: 'Including passive cooling measures in buildings at the design stage is more cost-effective than retrofit, but the health benefits of these measures will fall to the householder while the developer incurs the up-front costs.'

Significantly, the sub-committee identifies that the Building Regulations 'do not account for the health risks from overheating now or in the future', and therefore concludes that 'a standard or requirement is needed in order to ensure new homes are built to take account of the health risks of overheating now and in the future'. It calls on Government to review the evidence and evaluate options for a standard or other requirement on overheating. It also recommends that DECC reviews the Standard Assessment Procedure in relation to overheating.

The sub-committee also identifies other roles for Government in raising awareness and providing information, including:

- the Government should consider how to build awareness of options for reducing internal heat gains in housing and encourage their uptake through better information to householders. At the request of Government, the Zero Carbon Hub is currently developing a project to assess the case for action on dealing with overheating in homes
- the Care Quality Commission should consider setting standards for maximum temperatures in hospitals and make sure staff can control internal temperatures
- more information is needed to be able to assess preparedness for other health impacts including those related to ground level ozone, UV radiation and pathogens, and the resilience of health sector buildings such as hospitals and care homes to flooding and subsidence
- tackling flood risk will be the most cost-effective and sustainable approach to keeping flood insurance affordable in the long term. The Government should introduce without further delay the Flood and Water Management Act provisions to require sustainable drainage in new development, also recommended by the Pitt Review
- the Government should consider how best to encourage businesses to enhance their resilience to flooding.

“We need to adapt existing and new buildings to be safe and comfortable in a hotter climate.”

¹ Adaptation Sub-committee (2014). *Managing climate risks to well-being and the economy: progress report*. London: Committee on Climate Change. www.theccc.org.uk/wp-content/uploads/2014/07/Final_ASC-2014_web-version.pdf

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Acknowledgements

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David Gale – Gale & Snowden Architects

Rachael Grinnell – Loughborough University

Rajat Gupta – Oxford Brookes University

Peter Halsall – Good Homes Alliance

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Sources of further information:

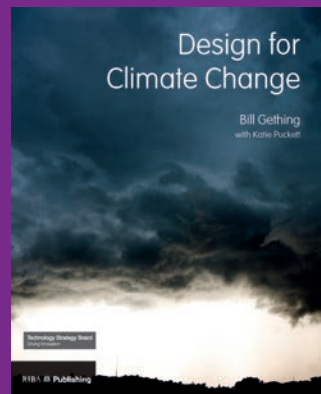
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Climate group – all project outputs
connect.innovateuk.org/web/design-for-future-climate



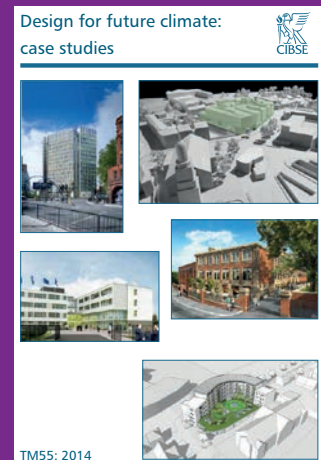
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Change – summary D4FC design guidance
www.ribabookshops.com



CIBSE TM55 D4FC –

Case Studies from the D4FC projects
www.cibse.org



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The Technology Strategy Board is an executive non-departmental public body sponsored by the Department for Business, Innovation and Skills, and is incorporated by Royal Charter in England and Wales with company number RC000818. Registered office: North Star House, North Star Avenue, Swindon SN2 1UE.

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