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# Built Environment Climate Resilience and Adaptation

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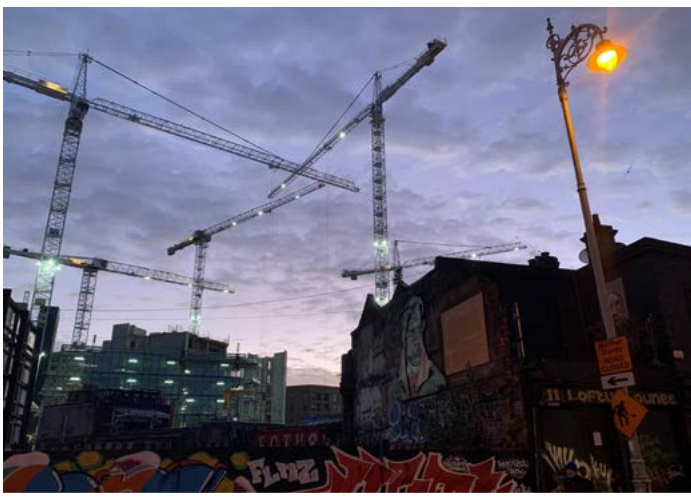

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**EPA RESEARCH PROGRAMME 2021–2030**

# Built Environment Climate Resilience and Adaptation

# (2019-CCRP-DS.21)

# EPA Research Report

Prepared for the Environmental Protection Agency

by

School of Architecture, Planning and Environmental Policy

University College Dublin

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This report is based on research carried out/data from March 2020 to June 2021. More recent data may have become available since the research was completed.

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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# Executive Summary

Climate change risks present a clear challenge for Ireland's built environment, with the potential to cause enormous damage to housing, commercial property and critical infrastructure, imposing significant financial costs and posing risks to health and well-being. At the urban scale, vulnerability to flooding (fluvial, pluvial and coastal), coastal erosion and heat stress will increase due to anticipated climate change. At the building scale, building fabric is at increased risk because of increases in precipitation (increased water penetration and indoor moisture content); subsidence (more variable water content in soil); more intensive freeze–thaw cycles; damage from wind and increased storminess, including structural damage and increased weathering due to driving rain; and impacts on indoor air quality and thermal comfort. These risks are systemic issues in that development patterns and decisions can compound and entrench future risks, for example building on floodplains or increasing impermeable surface cover in cities.

Adaptation is the critical second pillar of climate action, alongside mitigation. At the national level, Ireland's National Adaptation Framework sets out the key principles for adaptative action, calling for a whole-of-government and whole-of-society approach. The National Adaptation Framework's actions are to be mainstreamed using sectoral adaptation strategies and local adaptation strategies. There is no explicit sectoral guidance for the built environment; however, local adaptation strategies are invariably focused on protecting the built environment in terms of homes, businesses, critical infrastructure and cultural heritage, with an emphasis on resilience-in-place. The National Adaptation Framework promotes the advancement of grey, green and soft adaptation approaches, providing a suitable framework for built environment interventions.

In relation to the built environment and climate action, currently much greater emphasis is placed on mitigation measures than on adaptation measures. There is significant scope for advancing a greater policy coherence on adaptation through the planning system and building control, and on regulations through considering a broader set of anticipated climate risks and by integrating mitigation and adaptation actions (and avoiding maladaptation). While there is good awareness of a portfolio of policy and design approaches for adaptation, through a survey and interviews with key stakeholders, we found a gap in policy implementation and barriers to taking holistic action. In relation to building design, these barriers included a lack of client interest in green adaptation; a tendency to construct to minimum standards; a gap between building design and actual building performance; the behaviour of building occupants in relation to building performance; and a lack of monitoring and review. In relation to planning and local adaptation, barriers included a lack of adequate resourcing, institutional silos and/or inertia and the absence of specialist knowledge. Enhanced knowledge, training, continuing professional development and institutional capacity-building offer key paths towards more ambitious adaptation within Ireland's built environment sector. This extends beyond existing local authority-level capacity-building initiatives to embrace the whole sector from third-level education to professional design practice and construction, while also addressing public sector resourcing deficiencies.

In this report we propose a series of 28 Built Environment-Resilient recommendations under four headings to enhance policy and practice. Key priorities are:

1. Mainstreaming adaptation in the built environment. This includes prioritising adaptation as a critical second pillar of climate action; focusing on the full range of climate change risks (not simply flooding); integrating built environment adaptation with the wider land use system; capturing mitigation and adaptation benefits through holistic approaches; and focusing on the whole built environment and not only new-builds.
2. Evidence and uncertainty in decision-making. Adaptation of the built environment requires a robust and geographically tailored evidence base; there is a need for granular and useable information on climate impacts. Uncertainty strengthens the case for early investment and points to adopting the precautionary approach,

and further research is needed in relation to costs, responsibilities of key stakeholders, behaviour of building occupants and social vulnerability in relation to climate risks.

3. Co-designing of adaptation interventions. This includes collaborative stakeholder engagement, the inclusion of climate scenarios as part of statutory public consultation and the testing of novel public engagement methods.
4. Capacity-building requirements. This includes improving resourcing and institutional capacity, adopting new ways of working to avoid traditional siloed thinking and continued professional development and training for elected representatives.

# 1 Introduction

## 1.1 Introduction

Climate change is one of the most challenging scientific and political issues of our time. From a scientific perspective, the evidence on human-induced warming of the climate system is unequivocal (IPCC, 2014). For example, based on analysis of global climate models undertaken by the Intergovernmental Panel on Climate Change (IPCC), anticipated climate change means not only changes in global average temperatures but also changes in the frequency and intensity of extreme weather and climate events such as severe flooding, high precipitation events and storms, droughts and heat/cold waves, in addition to threats posed by sea level rises (DCCAE, 2018a). While there is an overwhelming scientific consensus that human-induced climate change is happening, translating this knowledge into action remains a challenge. While mitigating climate change and transitioning to a low- or zero-carbon society is paramount, policymakers are increasingly promoting adaptation strategies as a means of coping with climate change risks, future uncertainties and continuing high levels of carbon emissions. Indeed, even if emissions are stopped immediately, temperatures will remain elevated for centuries because of the effect of greenhouse gases (GHGs) from past human emissions already present in the atmosphere (Zickfeld *et al*., 2013). In this context, Ireland's National Adaptation Framework (NAF) defines adaptation as an "approach for addressing the current and future risks posed by a changing climate. The aim of adaptation is to reduce the vulnerability of our environment, society and economy and increase resilience" (DCCAE, 2018a, p. 9).

The built environment represents a key "opportunity space" for creating climate-resilient pathways in Ireland, with the spatial planning system, building regulation performance requirements, industry standards and building design specifications providing key decision points that can potentially erode or build future resilience. While there is a growing policy emphasis on built environment adaptation, translating and mainstreaming climate policy goals into sustainable practices, design interventions, regulations and industry standards within the built environment represents a significant challenge. In line with the NAF, this report aims to contribute new knowledge in relation to "soft adaptation" (e.g. regulations, technical building standards, plan time frames), "grey adaptation" (e.g. physical interventions, design solutions) and "green adaptation" (e.g. nature-based solutions) approaches to the built environment. The aims of this report are:

1. to provide a review of climate change impacts on the built environment in Ireland;
2. to examine resilience and adaptation as policy concepts and to review international, national, sectoral and local adaptation actions;
3. to provide a review of current mechanisms and policies aimed at mainstreaming climate adaptation in the built environment;
4. to identify "pathways for change" for transitioning towards a more adaptive built environment.

## 1.2 Research Context

At the global level, the impacts of climate disruption are potentially catastrophic, including widespread displacement of people as parts of the globe become less habitable because of excessive heat, drought or inundation from sea level rise. For example, in a study published in *Nature Communications*, Kulp and Strauss (2019) estimate that under a moderate-emissions scenario, consistent with 2°C warming, "sea levels projected by 2050 are high enough to threaten land currently home to a total of 150 million people to a future permanently below the high tide line" and that "a total of 360 million people are [currently living] on land threatened by annual flood events in 2100" (pp. 2–3). Under a high-emissions scenario, Kulp and Strauss (2019) estimate that up to 630 million people worldwide currently live on land below projected annual flood levels for 2100. This indicates a complex interaction of political and ethical issues that requires scrutiny to identify, understand and provide informed solutions to the challenges posed by climate change. Moreover, it is imperative to understand how these processes and

climate risk interact with urbanisation, and the role of wider adaptive urban governance in dealing directly with the increasing "hazardousness of place" (Black *et al*., 2011).

### *1.2.1 Climate change risks and Ireland*

Ireland's climate is changing. The scale and rate of change observed are consistent with trends observed globally and regionally, and the Irish climate will continue to increasingly change in the future. Despite mitigation actions taken to limit climate change, and even if all GHG emissions ceased immediately, many drivers of change are "locked in" to the climate systems, and the effects will be felt for many decades as a result of the "inertia", or slow response time, of the system. In line with global trends, Ireland's temperatures have increased by nearly 1°C (0.8°C), increasing at a rate averaging 0.07°C per decade since 1900. Both temperature and precipitation are predicted to increase gradually, and it is possible that there will also be abrupt shifts in climate behaviour due to reaching unpredictable "tipping points". Global sea levels are rising as a result of global heating and the melting of glaciers and ice sheets. The risks associated with sea level rise are both the level creeping upwards and storms leading to ocean/sea surges (Desmond *et al*., 2017).

Global sea levels are projected to rise by 0.5 m by the end of this century, along with expected increases in storminess and wave heights leading to sea/ocean surges. Current rates of coastal erosion will be exacerbated. Ireland's coastal areas will be at serious risk from this projected combination of rising sea level and storm surge height (Climate Ireland, n.d.). Sea level rise, ocean/sea surges and changes in patterns of precipitation can combine to form a significant threat. Sea level rise will enlarge estuaries, and tidal flow will penetrate further upstream in rivers. Noting the placement of Ireland's major settlements on the coast and/or by rivers, Climate Ireland states that both coastal and inland flooding are projected to significantly increase, potentially with serious social and economic consequences for Irish settlements, industry and critical infrastructure. A recent audit of coastal erosion in Ireland identifies approximately 800 properties at immediate risk from projected sea level rise and storm surges, a figure that will increase substantially over the next 50–100 years (MaREI Centre, 2019).

Over the last 100 years there were increasing likelihoods of both extremely hot summers and extremely wet winters, and these likelihoods are projected to increase further. Murphy *et al*. (2019) observe that the significant changes that occurred in seasonal temperatures and rainfall in the second half of the 20th century would have been considered exceptional in the first half of the century, that these increasing changes are "largely consistent with climate model projections of future Irish climate" and that "such events are likely to become less the exception and more the norm as further warming is experienced" (pp. 29 and 30). Projections of increasing heat and decreasing precipitation in the warmer months indicate increased evapotranspiration, increased algal growth and low river flows (exacerbating water pollution); increasing precipitation in the winter will place flood-prone areas at increasing risk and will put places not currently prone to flooding at risk of it (Climate Ireland, n.d.). The risks associated with climate change are likely to have dramatic impacts across Irish society, profoundly affecting food and energy security, biodiversity and natural capital, and health and well-being. In the next section, however, we focus on the built environment.

### *1.2.2 Climate change: the built environment dimension*

Because of changing temperatures, changing patterns of precipitation, an increase in extreme weather events and sea level rise, the built environment is expected to be profoundly affected by climate change (Desmond *et al*., 2017). Environmental hazards related to current and future climate change have the potential to cause enormous damage to the built environment, housing and commercial property, and critical physical and social infrastructure, imposing significant social and financial costs. Across Europe, climate change has led to detectable changes in weather patterns (e.g. heatwaves, intense precipitation), increasing exposure of people and the built environment to climate disruption (*disaster damages*) and leading to an observed increase in economic losses (*disaster losses*) (EEA, 2017). According to a report by the European Environment Agency (EEA) published in 2010, extreme temperature events across Europe

between 1998 and 2009 caused over 77,000 fatalities, while flooding and storm events were the most costly hazards, accounting for €96 billion in losses (primarily damage to property and critical infrastructure). Reflecting such dynamics, the EEA (2017) notes that "climate change is not isolated; it is strongly intertwined with socio-economic factors that make it a systemic challenge" (p. 16). In relation to the hazardousness of place, this includes property markets, property rights, residential consumer choices and mobilities, and management and regulation of land use, construction and urbanisation. In other words, vulnerability in Europe to sea level rise, fluvial and pluvial flooding, heat stress and storms increases not only through a changing climate but also through continued urban development in inappropriate locations (e.g. on floodplains) or the design of our cities (e.g. through the intensification of urban heat island effects); that is, development patterns increasingly interact with a changing climate to erode resilience and to increase people's vulnerabilities to risk. At the same time, past and current development patterns will establish path dependencies for future decision-taking regarding climate change adaptation, such as construction on floodplains or incremental development along coastlines that are vulnerable to erosion.

At the urban scale, vulnerability to flooding, coastal erosion and heat stress will increase because of anticipated climate change combined with current development patterns. For example, Bertilsson *et al*. (2019) state that floods are aggravated by increasing amounts of impermeable surface in the built environment, which modifies flow paths, noting that "Floods are part of a natural process, but when they occur in urban watersheds, they produce negative consequences for the people inhabiting these areas, both in terms of damage to properties and threat to human health (and lives, in the extreme situation)" (p. 970). As flood risk increases, the built environment will have to be adapted and communities better equipped to cope with flooding to ensure that they can recover quickly after flooding, that people can continue to travel freely and safely, and that our economy continues to function (Hamin *et al*., 2018). More than 50% of Ireland's population resides in coastal environments, the majority in urban centres of varying size. Ireland's largest towns and cities, Cork, Galway, Limerick and Dublin, are all coastally located and are all situated on rivers with associated estuaries. Many important urban centres are already vulnerable to flooding. Changes in precipitation patterns and the frequency of severe weather events increase this risk, which is further increased by other parameters such as land use and urban fabric (Desmond *et al*., 2017). In relation to heat stress, Hamdy *et al*. (2017) state that "During the sweltering summer of 2003, which was the hottest summer in the last 500 years, over 35,000 people died across Europe from heat-related causes" (p. 307). Although overheating has not always been associated with the Irish climate, observed data indicate that the annual average surface air temperature in Ireland has increased by approximately 0.9°C over the last 120 years, with a rise in temperature being observed in all seasons. This is in line with the global average temperature increase, which is estimated to be 1.1°C above pre-industrial levels, with 15 of the top 20 warmest years on record in Ireland having occurred since 1990 (Cámaro García *et al.*, 2021). As the climate progressively warms, there will be a rise in heat-related mortality as the incidence of heatwaves increases. During the summer of 2003, for example, climate change increased the risk of mortality due to excessive heat by 20% in London, which was estimated to cause 315 deaths; mortality risk in central Paris increased by *c*.70%, and there were an estimated 735 resulting deaths (Desmond *et al*., 2017).

Ireland's towns and cities will be increasingly affected by the urban heat island (UHI) effect as a result of the rising temperatures. This effect is particularly noticeable on summer nights and is indicated by the differences between urban and rural temperature peaks. The causes of urban overheating and the UHI effect are well established and relate to multiple factors, including heat production from buildings (particularly from those with air-conditioning), low winds, air pollution, the form of the built environment (including the choice of building materials), the lack of green infrastructure and the design of the urban space considered on all scales. Urban overheating and UHI consequences can be serious, and can cause extreme discomfort and mortality, particularly among the elderly and the very young. By 2040, an additional one million people will live in Ireland, almost a quarter of whom will be over 65 (double the current levels) (Department of the Taoiseach, 2019). Urban overheating can result in an increase in energy use as air conditioners are

used to mitigate the effects of the heat, an example of mitigation leading to maladaptation (Dhalluin and Bozonnet, 2015).

At the building scale, climate change risks relate to the following factors (Hertin *et al*., 2003; Sanders and Phillipson, 2003; Chalmers, 2014; Kovats and Brisley, 2021):

- Increases in precipitation. The risks associated with increased precipitation are water ingress into building fabric after heavy rainfall events, water penetration of vertical walls in dwellings and increased indoor moisture and mould growth, which is detrimental to the health of the occupants (with requirements for increased ventilation).
- Subsidence. This can be due to increasingly variable water levels in soil, warmer summers and evaporation effects and transpiration from vegetation, leading to soil shrinkage and swelling.
- Freeze–thaw cycles. Repeating freeze–thaw cycles between day and night in Ireland can have a significant impact on construction materials. For example, if concrete blocks become saturated in the outer leaf and are subsequently subjected to repeated freezing and thawing, the water in the blocks will expand as it freezes and the blocks may have a tendency to disaggregate (Expert Panel on Concrete Blocks, 2017). Repeated freeze–thaw cycles (e.g. during a cold spell with fluctuating day/night temperatures) could be expected to result in the deterioration of concrete blocks.
- Wind impact. Wind action on buildings (from increased storminess) causes dynamic structural loading by pressure forces. This leads to structural damage, from individual roof tiles being removed through to the uplift of flat roofs. The risk of chimney stacks or trees collapsing onto buildings, causing structural damage, also increases, suggesting the need for increasing safety features to cope with 50-year events.
- Driving rain. Exposure to large amounts of driving rain generally leads to more weathering and higher maintenance requirements to ensure that buildings remain weathertight throughout their expected life. Render systems, pointing of masonry and sealants around openings all require more frequent maintenance following severe exposure to reduce the risk of loss of property value.
- Air quality and thermal comfort within buildings. High temperatures within buildings in the summer affect the comfort of the occupants, particularly within domestic buildings, and can lead to night-time discomfort. Higher internal humidity increases the chance of mould growth, which is associated with health issues, e.g. asthma. Thermal discomfort is often accompanied by a rise in demand for air conditioners, which leads to increased energy demand (see Box 1.1).

These risks cause potential harm to occupants' health and well-being and create the financial burden of additional repair costs for property owners. These vulnerabilities may overlap or reinforce wider socio-economic inequalities; for example, low-income groups are less likely to have adequate home insurance and renters may have less influence on timely building repairs.

To preserve and enhance people's quality of life in our urban, rural and coastal communities, we will have to adapt the places where we live and work in order to cope with the changing climate. This will require buildings to be designed to cope with the intensity of a wider range of extreme weather events and our critical infrastructure to be more resilient in the context of unexpected and extreme weather events (Wolsink, 2010). As noted by Lord Stern (2006), *anticipatory* adaptation is more cost-effective than *reactive* adaptation and retrofitting (e.g. after an extreme weather event), while a business-as-usual approach will further entrench unsustainable path dependencies (e.g. building on floodplains), which will prove more costly to adapt in the future. Moreover, built environment adaptation measures can be designed to produce ancillary or co-benefits. For example, urban green infrastructure addresses flood risks and urban cooling, while also providing benefits for health and well-being and biodiversity (Lennon *et al*., 2019).

## 1.3 Research Approach and Structure of Report

This research was funded as a desk-based study, drawing on existing academic work and secondary sources, such as policy documents, reports and guidance. In addition, an online survey of key stakeholders was undertaken to identify current barriers to and opportunities for built environment

**Box 1.1. Overheating risk factors in Irish dwellings (source: AECOM, 2019)**

A study into the risks of overheating in dwellings in Ireland (based on historical and future weather data), commissioned by the Sustainable Energy Authority of Ireland, suggests that standard design does not present a high risk of overheating; however, the aggregated impacts of certain design parameters can significantly increase risk, notably:

- net solar gains in the dwelling, which are a function of glazed areas, orientation, window *g*-values and shading;
- ventilation rates, which, in the case of naturally ventilated dwellings, are a function of opening windows and the ability to cross-ventilate.

The study notes that, while advanced building fabric performance is one of the factors that contribute to overheating risk, it is not the dominant factor. Importantly, the impact of noise, security risk and other site constraints may limit the ability to open windows for extended periods of time, thus increasing overheating risks. In these cases, window restrictors should be assumed when calculating effective air change rates for dwellings with windows on the first floor and above. Additionally, the report notes that the choice of weather data when assessing overheating risk is extremely important. Locational differences across Ireland, including differences in external temperatures, diurnal range, wind speed and solar radiation, will affect overheating risk. The weather data used to assess compliance should help ensure that dwellings are designed to be fit for purpose over a significant proportion of the building's life and are resilient to the future impacts of climate change. The study therefore highlights the need to develop future weather datasets for major cities in Ireland to provide more granular evidence for decision-making.

adaptation. The surveys gathered data from 228 stakeholders, including councillors ($n = 92$), architects ($n = 51$), engineers ($n = 45$) and public sector planners ($n = 40$). These survey results informed a series of semi-structured in-depth interviews with key informants ($n = 27$) to identify possible pathways to a more resilient built environment. The remainder of the report is structured as follows. Chapter 2 examines key concepts used in this report, focusing on resilience and adaptation. Chapter 3 discusses how these concepts are advanced through international, national and local frameworks for adaptation. Chapter 4 turns to examining wider policy and regulatory frameworks that shape the built environment – spatial planning (national, regional and local levels) and building regulation and control. Chapter 5 draws on the online survey data and interviews with key informants to identify barriers to, opportunities for and pathways to enhancing built environment adaptation; this is followed by conclusions and recommendations in Chapter 6.

# 2 Resilience and Adaptation

## 2.1 Introduction

This chapter examines the concepts of resilience and adaptation and how these relate to the built environment. The chapter begins with a discussion of resilience and its emergence as a key policy narrative to deal with uncertainty. We examine two common conceptions of resilience: equilibrium resilience, which emphasises the ability of a system to "bounce back" following a shock or disturbance, and evolutionary resilience, which places more emphasis on transforming the system to reduce future risks. This is followed by a discussion of resilience applied to the built environment. The chapter then focuses on adaptation as a policy concept and how this relates to the built environment. We discuss the grey, green and soft adaptation framework advanced by the EEA and by the NAF (further discussed in Chapter 3) and its application to the built environment. Finally, the chapter examines the literature surrounding the costs of action/inaction on adapting the built environment to climate change risks.

## 2.2 Understanding Resilience

The term "resilience" was first coined within systems ecology (e.g. Holling, 1973) to evaluate ecosystem functions based on assumptions of non-linear dynamics of change in complex, linked systems, in which resilience describes the ability of a system to absorb or accommodate disturbances without experiencing changes to the system. Subsequently, resilience has also been applied to examine social–ecological systems, particularly concerning how communities and societies cope with or respond to environmental crisis and risk, such as climate change, flood risk and ecosystem degradation (see Adger, 2000; Folke, 2006). Since the early 2000s, there has been a wave of interest in applying resilience thinking to a range of social science and policy disciplines, including disaster planning, economic geography, business and management studies, spatial planning and community development. A rich body of work also emerged in the wake of the global financial crisis in 2008–2009, whereby commentators increasingly transferred resilience thinking to understand how local and regional economies coped with an economic crisis and instability (for an overview, see Martin *et al*., 2016). While this interest in resilience suggests a conceptual utility, its application across a range of social science disciplines (and its translation from ecology) also points to its emergence as a fuzzy or elastic concept (Faulkner *et al*., 2020), in which the term's substantial meaning becomes diminished or is mobilised to support competing policy agendas. To unpack resilience further, the chapter will now turn to two divergent conceptualisations of resilience in practice: the *equilibrium* approach and the *evolutionary* approach.

### *2.2.1 Equilibrium resilience*

Often referred to as engineering resilience, this approach is defined as the ability of a system to absorb or accommodate shocks and disturbances without experiencing changes to the system (Holling, 1973). In this perspective, both the *resistance* to disturbances and the *speed* at which the system returns to equilibrium is the measure of resilience (Davoudi *et al*., 2013). This approach is particularly common in disaster management, in particular managing responses to geo-environmental hazards, terrorist threats or disease outbreaks (Barr and Devine-Wright, 2012), whose preferred goal is the ability to "bounce back" to a pre-disaster state in a rapid fashion. However, a number of limitations can be identified in relation to equilibrium resilience. For example, Davidson (2010) questions whether an ability to absorb or accommodate disturbances without experiencing changes to the system should be the preferred option. In this regard, the so-called normal system may itself produce risks (e.g. construction on floodplains) or may be underpinned by socio-spatial inequities. For example, vulnerability to the Hurricane Katrina disaster in New Orleans was determined by class and race (Forester, 2009). Fundamentally, therefore, the equilibrium approach does not allow for reform and transformation as a response to crisis, largely ignoring distributional and normative concerns in favour of aligning with or reinforcing existing power structures and relations. This suggests a potential

tendency within bounce-back conceptions of resilience to depoliticise, normalise or indeed naturalise environmental crises or so-called natural disasters that are underpinned by human behaviour, institutions, rules and ideologies. A "bounce back quickly" approach also raises questions over the resilience of *whom*, particularly in terms of transferring risk to the individual.

### *2.2.2 Evolutionary resilience*

In contrast to equilibrium-based approaches, evolutionary resilience rejects the notion of single-state equilibrium or a "return to normal", instead highlighting ongoing evolutionary change processes and emphasising *adaptive behaviour* and *adaptability*. These themes have been explored within the evolutionary economic geography literature in particular (e.g. Bristow and Healy, 2020). As outlined by Pike *et al*. (2010), an evolutionary analysis emphasises the "path dependent unfolding of trajectories of change, shaped by historically inherited formal and informal institutions" (p. 62). Therefore, a key departure point in this analysis is that development proceeds not along a single path but along multiple pathways (some of which may be suboptimal). By embracing the inevitability of evolution, resilience thinking from this perspective emphasises the role of *adaptation* as a response to shocks and disturbances, enabling a more optimistic and potentially more transformative notion of resilience. In summary, bouncing back to a perceived normal state following a shock need not be the only response. Instead, evolutionary resilience places significance on *transformation*, whereby social systems (through individual or collective agency) can adapt or search for and develop alternative development trajectories.

Drawing on Hudson (2010) and Pike *et al*. (2010), the key advantage of an evolutionary perspective is its potential to reveal:

- The importance of both exogenous and endogenous shocks intertwined with "the unfolding of broader, longer-run and slow burn processes" (Pike *et al*., 2010, p. 63), including long-term socio-spatial and economic restructuring processes. In relation to built environment adaptation, this suggests examining not only "shock" events, such as widespread flooding in a city, but also incremental "slow burn" processes of change, such as coastal erosion, incremental temperature rises in cities and long-term regulatory maladaptation.
- The importance of path dependencies in shaping resilience, adaptation and adaptability, which may be weakened by entrenched path dependencies. For example, this may relate to inherited political institutions and entrenched interests or to past urban development (e.g. building on floodplains or other vulnerable areas).
- The potential of "lock-in" development paths to compromise place resilience, whereby formal and informal institutional culture and relationships may inhibit adaptive behaviour and capacity. Similarly, the process of "de-locking" may be central in "creating paths" towards a more sustainable future.

A key component of evolutionary resilience is therefore *adaptation*, i.e. how a system responds and transforms in the face of a crisis or exposure to a new vulnerability. This includes the capacity to respond, based on pre-existing attributes such as good governance and adaptive capacity, i.e. the response of a place contributing to its ability to recover from the impact of a shock or disruption (Faulkner *et al*., 2020). The essence of adaptive capacity is that it embodies positive change, irrespective of whether that change is short term or long term (Havko *et al*., 2017). In relation to the capacity to respond, significant barriers to developing effective adaptation strategies at local authority level may include a lack of institutional capacity and knowledge; a siloed approach to tackling climate change, characterised by a lack of interdepartmental working; and a focus on short-term priorities, particularly housing delivery (TCPA and RTPI, 2021).

## 2.3 Built Environment Resilience

The built environment represents a key "opportunity space" for creating climate-resilient pathways in Ireland, with the spatial planning system, building regulations standards and building control providing key decision points that can potentially erode or build future resilience. While there is a growing policy emphasis on built environment adaptation, translating and mainstreaming climate policy goals into sustainable practices, design interventions and regulations for the sustainable management of the

built environment represents a significant challenge. Buildings and infrastructure are expensive, and they have a long lifetime. This lifetime, of 50–100 years or more, corresponds to the expected dramatic changes in climate: buildings and infrastructure constructed today are required to both reduce the GHG emissions burden placed on current and future generations and simultaneously persist and perform to a high standard in both the current and future climate (De Wilde and Coley, 2012).

### *2.3.1 Resilience for infrastructure*

Resilience requirements on the scale of critical infrastructure require robustness and adaptability. Robustness in this context indicates existing, pre-disturbance structural and functional integrity, and redundancy in the system. Redundancy in the system indicates structural adaptability. The "bounce-back-ability" engineering definition of resilience is relevant to infrastructure. The maintenance of functionality of critical supply systems, or the return to functionality in as short a time as possible, is extremely important for the functionality and health of the built environment as a whole, and it is one indicator of the overall robustness of the entire complex built environment system. Substantial robustness in infrastructure indicates a lack of vulnerability. An example of vulnerability in this context is reliance on an old water delivery system that has not been periodically and systematically reviewed, updated and improved over time, a lack of attention to known faults in the system, such as leakage and structural decay, and a lack of redundancy in the system because of its design, its capacity or both. There are two types of adaptive capacity in single-function infrastructure resilience; the first, as mentioned previously, is the structural adaptability built into a system that has an adequate level of redundancy. The equally important second type is adaptation capacity and willingness on the part of the people who finance, administer, design, construct, manage and maintain the system. Adaptive management involves improving the response to a system disturbance/failure with every occurrence, incorporating adaptive learning into the process, and resisting any tendency to being "locked in" to doing the same things in the "same way we've always done them". It involves diversity of approach, flexibility and an understanding that the challenges facing systems are guessed at but ultimately unknown, requiring a mental shift from a "fail-safe" goal to the consideration of "safe-to-fail" systems (Bertilsson *et al*., 2019).

### *2.3.2 Resilience for individual buildings*

On the scale of an individual built system, for a place that individuals live in or occupy for other reasons (workplaces, schools, etc.), resilience requires a different conceptualisation: these built systems must serve the needs and requirements of their inhabitants/users, protect them from harm and keep them comfortable. The built systems must have the ability to structurally persist and serve their current purpose or possibly a different purpose in the future. The inhabitants and users of buildings require a healthy, comfortable environment. Both the existing building stock and new buildings need to be adaptable in order to maintain this environment as the outdoor climate changes, with no increase, or preferably a decrease, in energy consumption (van Hooff *et al*., 2014). Robustness (including redundancy) is important, but in the context of individual built systems this may refer less to the lack of damage incurred after a disturbance/shock and more to residual functionality (Cerè *et al*., 2017), i.e. the system does not cease to function for a time until repaired/restored but continues to function, and adaptations are made to both address the effects of the disturbance/shock and prepare for further, possibly more extreme, anticipated disturbance/shocks. Thus, fail-safe is the goal, and to consider these structures safe to fail is to risk the well-being, even the lives, of the individuals who inhabit/use them. Building resilience for these systems involves responsiveness, monitoring, willingness and capacity to learn, and anticipation (Hollnagel, 2014). Resilience for these systems includes the possibility of bouncing back, but it also extends beyond, leaning towards the evolutionary conceptualisation of "resilience". Following a disturbance, the system may take a different form and may function in a different way.

### *2.3.3 Resilience for the wider built environment*

Resilience in the context of an entire built environment requires a different level of resilience thinking. For analytical purposes, Desouza and Flanery (2013) reduce the city to its basic elements, stating that this is the only way to "grapple with the issue of designing, planning and managing for resilience" (p. 91). There

are physical and social spheres that interact with each other, and each has subcomponents. The physical sphere, with which this report is primarily concerned, comprise the "ingredients", i.e. the physical resources, and the "processes" that organise and distribute the resources; together they form the human-made city elements. The social sphere comprises individuals, institutions and activities that occur in the urban environment. Johnson and Blackburn (2014, pp. 48–49) propose four key components that are essential for built environment resilience, outlined in Box 2.1. Resilience thinking on this scale of the built environment is holistic, with adaptative capacity and preparedness being fundamental features of the resilient city.

## 2.4 Understanding Adaptation

To build resilience, adaptation and mitigation are adopted as complementary policies. The aims of mitigation are to eliminate (or reduce as far as possible) GHG emissions and consolidate and increase carbon sinks, thereby reaching "net zero", a balance between emissions and removals of GHGs by the middle of this century (UN, 2016; O'Dwyer *et al*. 2018). Without mitigation, the effects of climate change will be greater, thus requiring increased measures and levels of adaptation. The IPCC (2018a) report states that "Adaptation is more likely to contribute to sustainable development when policies align with mitigation and poverty eradication goals" (p. 51). In an Irish context, Dekker and Torney (2020, p. 28) observe that "The 2019 Climate Action Plan … has a single chapter on adaptation, which is treated as separate of mitigation. However, adaptation and mitigation actions overlap and can have multiple benefits." Murphy *et al*. (2019) further state that:

> Too often mitigation and adaptation are treated as independent strategies; in reality, even if we could somehow stop all greenhouse gas emissions right now, some degree of warming will still result. Additionally, even at 1.5°C and 2°C warming, impacts will still be felt. Therefore, it is critical that society adapts to future impacts of climate change. (p. 1)

The IPCC (2018a) report defines adaptation as follows:

> Climate adaptation refers to the actions taken to manage impacts of climate change by reducing vulnerability and exposure to its harmful effects and exploiting any potential benefits. Adaptation takes place at international, national and local levels. (p. 51)

Adaptation means "anticipating and planning for the effects of climate change and taking appropriate actions to offset or minimise the adverse impacts of these changes while taking advantage of any opportunities that they might bring" (O'Dwyer *et al*., 2018, p. ix). Dekker and Torney (2020) further add

**Box 2.1. Four components of built environment resilience**

Resistance: reducing potential impacts of disturbance/shock.

Coping capacity: the ability to continue functioning "without permanent damages to livelihoods, health or well-being … enabled both by the total level of accumulated resilience in the city as well as the effectiveness of preparedness measures".

Recovery: related to coping capacity, "facilitated by the strength of local economies and the diversification of livelihoods".

Adaptive capacity: "This is particularly important in the context of climate change. High adaptive capacity requires mechanisms for institutional learning, such as institutionalized channels that allow the latest scientific knowledge to feed into policy. Investment in hazard research is important, as is collaboration between all relevant stakeholders so that adaptation is coordinated and complementary across sectors and scales. Adaptive capacity is also a function of the wealth and resources available in the city, and requires proactive governance with sufficient political will to drive this".

Source: Johnson and Blackburn (2014, pp. 48 and 49).

that “Adaptation involves the changes humans make to the system such that the system is optimised to meet their needs”, and note that the changes depend on the type of threat, and that ultimately those changes enable the system to continue in its function to support human beings (p. 3). Spanning long-term temporal and spatial scales, adaptation “facilitates planning through learning by doing” (Kopke *et al*., 2018, p. 1), indicating the need for adaptive capacity, defined by the IPCC (2014) as the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. Built environment resilience requires flexibility in the complex system to adapt to the changing conditions resulting from climate change. This requires institutional learning, feeding the latest scientific research into policy, which is then acted upon. Adaptive capacity is also evident in the financial and other resources available to fund adaptation actions (Johnson and Blackburn, 2014). Feedback cycles of planning, implementation and learning, informed by risk knowledge, are indicative of adaptive capacity (Cerè *et al*., 2017). Aylett (2015) notes that built environment adaptation strategies require the coordination of policy responses across multiple sectors, that “we are faced with the challenge of *mainstreaming* responses to climate change both within and across existing urban systems” (p. 7; emphasis added).

## 2.5 Adaptation in the Built Environment: Grey, Green, Soft

The world is facing a triple challenge that combines elements of climate change resilience, energy security and long-term sustainability. The existing building stock is a major player in both the cause of and the solution to all three challenges (Kelly, 2009, p. 196). Adaptation measures for the built environment may be categorised as *grey*, *green* and *soft* (EEA, 2013; DCCAE, 2018a). Adopting a range of adaptive measures indicates adaptive capacity, which includes flexibility and diversity and is essential to the sustainable development of the built environment (Erixon *et al*., 2013). Desmond (2018) states that a “full range of approaches (grey, green and soft) should be considered in all future plans” and that “responsibilities and timelines for implementation should be clearly identified” (p. ix).

### *2.5.1 Grey adaptation*

Grey adaptation measures involve technical or engineering solutions to climate impacts. Measures range from interventions to protect large areas of the urban environment, such as the construction of flood defences, including sea walls and tidal barrages (DCCAE, 2018a, p. 25), through to building-scale design modifications. Grey adaptation measures to protect people, buildings and spaces may be construed as primarily engineering responses, which produce “tangible adaptation outcomes … physically improving communities, spaces, and infrastructure, which are vulnerable to the effects of climate change” (Kim and Lim, 2016, p. 3).

Grey adaptation relates to both retrofitting existing structures and to new builds. The principle of “build back better” (UNDRR, 2015) extends to “build better” in the first instance. This may include a range of design interventions to reduce exposure to risk (Sanders and Phillipson, 2003). For example, foundations may have to be deeper than is currently the case or redesigned with increased stiffness to avoid damaging movements in foundations caused by subsidence. Wind loads on new buildings could be reduced by building more aerodynamically efficient structures that help minimise wind loads, such as by using curved corners. With anticipated increasing intensity of rainfall events, roofs, guttering and local infrastructure should be designed to cope with greater volumes of water and ensure that it is kept away from the building fabric. To avoid excessive solar gain during warm summers, structures and internal spaces can be designed to maximise the benefits of natural ventilation or incorporate the use of shading devices, such as roof overhangs (van Hooff *et al*., 2014). Retrofitting is a critical element in resilience building, including through grey adaptation. In the UK in 2009, 45% of all carbon emissions emanated from existing buildings: 27% from dwellings and 18% from commercial buildings (Kelly, 2009). Kelly notes that the 87% of buildings that are producing that 45% of emissions will still be in use in 2050, indicating that almost 90% of the mitigation/adaptation requirements are in the form of existing buildings.

### *2.5.2 Green adaptation*

Green adaptation measures seek to use ecological properties to enhance the resilience of human and natural systems to climate change impacts, e.g. the

reinstalment of dune systems to act as buffers against coastal storm damage (DCCAE, 2018a, p. 25). Green adaptation measures often rely on incorporating ecosystem services into the design of the built environment through the promotion of nature-based solutions (Scott *et al*., 2016a). These have the potential to contribute directly to built environment resilience in relation to overheating or flooding events; they also contribute to "resilience to the chronic stresses and gradual changes to which cities are exposed" and to the "slow-burn" effects of climate change (Bush and Doyon, 2019, p. 3). Bush and Doyon further note that, when compared with conventional, engineered "grey" adaptation measures, nature-based solutions are potentially more cost-effective. While planning for green infrastructure (GI) is now established practice, it may be viewed as "giving land over" to GI that could be used for alternative land uses, such as housing supply. Where demand for built space and green space are in opposition, trade-offs are entailed, "and currently green spaces often weigh lighter in that balance" (Erixon *et al*., 2013, p. 350). However, GI is not just a "network of green features"; it is also "a planning delivery mechanism", which provides critical infrastructure "that delivers multiple social, environmental and economic benefits, which are then managed strategically within an integrated network" (Hislop *et al*., 2019, p. 637). GI can be defined as an interconnected network of multifunctional green spaces – urban and rural – that conserves natural ecosystem values and functions, which are capable of delivering a wide range of environmental and quality-of-life benefits for local communities (Scott *et al*., 2016a).

Within urban areas, public GI includes parks, sports fields, riparian areas such as the banks of streams and rivers, sustainable urban drainage systems (SUDSs) and "rain gardens", greenways and trails, community gardens, street trees and nature conservation areas, as well as less conventional spaces such as green walls, green alleyways and cemeteries. Private GI assets include private gardens and the communal grounds of flats and corporate campuses (Wolch *et al*., 2014). Within the rural environment, green spaces may be more extensive, including greenways, blueways (e.g. river corridors, coastal paths), peatways, forests/woodlands and accessible trails (e.g. rights of way). These rural assets often provide important upstream benefits for the urban built environment, particularly in relation to flood control (see Box 2.2). GI interventions, when designed to maximise multifunctionality, provide opportunities for co-benefits to be derived from adaptation. For example, an urban greenspace designed to mitigate local flood risks or provide cooling benefits may also provide opportunities to enhance local biodiversity gain, provide opportunities for recreation and reduce urban noise and air pollution.

### *2.5.3 Soft adaptation*

Soft adaptation involves alteration in behaviour, regulation or systems of management. Examples are extending the time frames of plans further into

**Box 2.2. Example of upstream green adaptation to protect the urban built environment – Stroud, UK**

Situated *c*.16 km south of the city of Gloucester, Stroud is a town with a population of *c*.35,000 inhabitants. The Stroud District lies underneath the west escarpment of the Cotswold Hills. The River Frome flows through the town, carrying water to the River Severn, *c*.8 km to the west, and is prone to frequent flooding in the urban area. To address risks and reduce vulnerability of the urban built environment, the district council has been investing in upstream green adaptation measures. Since 2014, Stroud has been progressively implementing a rural sustainable drainage project, which uses natural flood management techniques to reduce risk while restoring biodiversity throughout the river's catchment area. This project recognises that flooding experienced in a town can be largely mitigated upstream. It uses the natural geology and topography to deal with excess water long before it reaches the town. Most of the work uses large woody debris to form "leaky dams" and also to form structures to divert flood flows into temporary attenuation areas or into other areas that allow infiltration, such as areas of forest floor. Thus, natural flood management structures in the landscape maximise water dispersion upstream and slow the flow of water. Land management practices have been designed and implemented in partnership with landowners and farmers at low cost.

the future, zoning development away from sensitive areas and instituting or strengthening building codes in hazard-prone areas (DCCAE, 2018a, p. 25). Soft adaptation for urban resilience building involves a multitude of interrelated dimensions, including political, institutional, social, economic and individual dimensions. Soft measures facilitate, finance and use "hard" adaptation measures, making soft socio-political infrastructure as necessary as physical infrastructure (Aguilar-Barajas *et al*., 2019, p. 39). Desmond (2018) found that the key components for building climate resilience in Ireland were in place, but that effective coordination of institutions and process is required. Many countries are working out how to get adaptation working "on the ground" at the local level. Desmond observed that Ireland should be looking to the activities of other advanced countries to learn from their experiences. She states that "It will take imagination, innovation (social and technological), and political and societal will to bring all stakeholders on board to share in driving the agenda for a low-carbon, climate-resilient Ireland" (p. viii). In this context, adaptive capacity requires flexibility and diversity of approach. Flexible, diverse approaches to adaptation pose a problem for institutions, professions and individuals, as they imply the possibility of transformation and thus involve a degree of uncertainty and pose a threat to institutional, professional and individual interests.

The role of the individual citizen living in the built environment is also critical in the context of soft adaptation. Research has found that individuals can be presented with mitigation and adaptation choices that they may choose to ignore, even if engaging with those choices would involve reduced cost for the individual. For example, researching social housing tenants in Belfast, Hayles and Dean (2015) call for a greater, more realistic understanding of how individuals operate in their homes, drawing parallels with a Danish study that found that identical houses had radically different levels of energy use, up to a factor of three times (Gram-Hanssen, 2010). Brown and Gorgolewski (2015) state that "it is commonly accepted that good design and the latest new technologies on their own are not sufficient to create efficient and healthy buildings. Building inhabitants play an important role in affecting building performance" (p. 210). They note that there is a level of "buy-in" necessary to make design strategies successful and that a building's inhabitants "can negate the expectations predicted (and certified) during design" (p. 211).

## 2.6 Costs of Action and Inaction

It is difficult to translate the usual cost–benefit analyses to decisions made about resilience-building adaptions/ mitigations in the built environment. Such analyses generally do not include many of the following: potential costs of non-construction, potential pre-construction costs in cases of delay, operating and maintaining current non-adapted systems and the cost of repair following a disruption after a disturbance/ shock (Cerè *et al*., 2017). Neither do they generally consider the costs that appear to inevitably rise above budget during construction processes nor the cost of "building back better" (United Nations Office for Disaster Risk Reduction, 2015), when it is wise to build better now. It is widely accepted that such global-level, aggregated estimates have tended to understate the economic costs of climate change, in part due to important omitted impacts, such as the costs associated with more extreme weather events or the indirect economic effects of social or political disruptions due to climate change (DCCAE, 2018a, p. 20). It is accepted that there are uncertainties about the progression of the effects of climate change. There is agreement about the projections of climate variables and trends, and their impacts (changes in precipitation patterns, overall temperature increase, sea level rise) on the continental worldwide scale; however, at local and regional levels there are uncertainties, and these uncertainties will remain. Desmond *et al*. (2017) note that these uncertainties can be "treated as a motivation towards a precautionary approach" and not be considered a barrier to action (p. 7). The NAF (DCCAE, 2018a) recognises that the uncertainties surrounding the future impacts of climate change in combination with "embedded short-term investment horizons" create a major challenge for all levels of policy and decision-making; however, these uncertainties "should not be read as an excuse for inertia in addressing climate change" (p. 19).

Lord Stern's seminal report (2006) focuses on four issues central to the economics of climate change: discounting, modelling unmanaged climate change

risks, climate policy targets and the estimates of mitigation costs. Stern (2006) notes:

> We thus have a process that is long-term, full of uncertainty, with consequences potentially way outside human experience and where the effect depends on the sum total of human emissions. These features make the public understanding of the problem itself, and policies to tackle it, extremely difficult. The science 'conspires' to render the making of policy very troublesome. (p. 2)

Stern stresses the severe dangers involved in delaying actions to address climate change, noting that $CO_2$ levels are already at very high levels, and that this problem is "compounded by the fact that much high-carbon infrastructure and capital equipment can be very long-lived" (p. 3). Stern stresses that there is no alternative to a thorough analysis of the ethics and uncertainties that underpin standard economic "fixes" on discount rates, which "are generally mistakes in this context" (p. 3). He further states that "learning and deciding at the same time are particularly severe when delay is dangerous" (Stern, 2006, p. 4). Learning and deciding at the same time is precisely what is involved in resilience thinking and adaptive capacity. Stern notes that "Policy for mitigation can be seen as 'avoiding the unmanageable', and policy for adaptation 'managing the unavoidable'" (2006, p. 5). He describes the perception of the need to choose between economic growth and climate responsibilities as "misleading and somewhat of an artificial horse-race" (p. 6). Stern estimated that the costs of not addressing the impacts of climate change exceeded the costs of taking measure to address them. This is also recognised at the national level, with the NAF stating that:

> From a purely cost–benefit perspective, the present value of avoided or reduced climate impacts in the future represents the "benefit" of any proposed investments in adaptation. Global estimates suggest mean costs of climate impacts in the region of 1–2% of global GDP [gross domestic product] for warming of 2.5°C, rising to about 3% of global GDP for 3°C of warming, with the worst off regions losing 10–20% of GDP per year... Stern (2006) estimated the cost of unabated climate change at between 5% and 20% of global GDP annually. (2018, p. 19)

There is a growing body of literature examining mitigation costs at an urban scale (e.g. Gouldson *et al*., 2015); however, the literature in relation to adaptation costs or the costs of inaction is much less extensive. Indeed, Hunt and Watkiss (2011) highlight the paucity of studies on the quantification and valuation of climate risks at a city scale. In a review of international practice, the authors suggest that only a small number of cities have attempted to

**Box 2.3. Estimating the costs of climate impacts on the built environment**

- A range of studies estimate the costs associated with future climate disruption based on damage costs associated with recent or historical environmental disasters, e.g. loss of property or insurance costs relating to a flooding event or wildfire (e.g. EEA, 2017; McAneney *et al*., 2019).
- Estimates of loss of property are provided based on predicted future vulnerabilities, e.g. to sea level rise, and mapped to property locations and prices (e.g. Hallegatte *et al*., 2013; Kulp and Strauss, 2019).
- Estimates of insurance risks often account for the transfer of risk through additional insurance costs to individual households (Walker *et al*., 2016).
- Existing compensation schemes resulting from managed retreat programmes (primarily in the USA) are evaluated to estimate the costs of future climate displacement (e.g. Mach *et al*., 2019).
- Limited studies attempt to estimate the co-benefits arising from adaptation measures, e.g. in relation to urban green spaces to combat flood risk, which may also lead to health benefits, e.g. increased physical activity or reduced local air pollution (for a study related to UHI effects, see Estrada *et al*., 2017).

provide quantitative estimates of the costs of climate risk (under alternative scenarios), primarily focusing on estimating the costs arising from sea level rise. In relation to this emerging literature, common approaches are outlined in Box 2.3. As highlighted by the Climate Change Advisory Council (2020), it is essential that the investment cost of adaptation is identified; however, "adequate cost–benefit analyses require accurately capturing the costs of inaction, including those from disruptions and losses from extreme weather events now and into the future" (CCAC, 2020, p. 144).

## 2.7 Conclusion

Over the last decade, resilience has emerged as a key policy concept applied across a range of arenas, such as disaster management, economics, public health and urban planning, to deal with growing uncertainties and systemic risk. Resilience refers to the ability of a system to bounce back following a shock or disturbance (e.g. flooding), and it also addresses the ability of a system to transform and evolve to reduce future risk or vulnerability of a system, emphasising adaptive capacity and social learning. This is critical in relation to climate change, in that the built environment should have the ability to bounce back following a shock; it also addresses the slow-burn processes associated with climate change and the need to adapt to and reduce, rather than simply respond to, risk. Grey, green and soft adaptation provide a useful and holistic framework for advancing climate adaptation relating to the built environment, which will be further discussed in Chapters 3 and 4. This chapter has briefly examined the literature on the costs of adaptation action and inaction. There is a dearth of literature in this area, with most studies focusing on climate change costs in the built environment associated with mitigation, and there is scope for further studies on adaptation costs in relation to the Irish built environment to demonstrate the potential long-term efficiencies of mainstreaming adaptation measures.

# 3 International, National and Local Adaptation Frameworks

## 3.1 Introduction

A substantial multilevel policy framework has emerged at international, EU and national levels to address climate change adaptation, identifying pathways towards creating more resilient societies. In this chapter, we examine how adaptation to climate change is conceived in policy at these different spatial scales. It begins at the international level with a brief review of the growing profile of adaptation on the climate action agenda, including within the Paris Agreement, the United Nations (UN) Sustainable Development Goals (SDGs) and the 2021 EU Strategy on Adaptation to Climate Change. The chapter then moves on to discuss the NAF (DCCAE, 2018a) and the Climate Action Plan (CAP) (DCCAE, 2019), examining the elements most relevant to the built environment. In relation to the NAF, we examine the intention to mainstream the plan in sectoral and local adaptation plans; therefore, we provide a brief review of sectoral plans most relevant to the built environment before reviewing a sample of local adaptation plans.

## 3.2 International Policy Context

At the global level, Article 8 of the UNFCC's Paris Agreement (2016) establishes adaptation to climate change as a global goal by enhancing adaptive capacity, strengthening resilience and reducing vulnerabilities, with global through to local dimensions. The Paris Agreement was adopted in December 2015 and came into force in November 2016, at which point Ireland ratified it and became legally bound by its provisions. Article 7.1 of the Agreement provides that:

> Parties hereby establish the global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2. (p. 9)

This is a significant advance towards developing a more comprehensive resilience framework in relation to climate change through strengthening the adaptation pillar of global climate policy. By widening the normative framing around adaptation, calling for stronger adaptation commitments from states, being explicit about the multilevel nature of adaptation governance and outlining stronger transparency mechanisms for assessing adaptation progress, the Paris Agreement is a milestone in ongoing efforts to make adaptation a priority equal to mitigation (Lesnikowski *et al*., 2017). Shine (2018) notes that adaptation and mitigation are placed "on an equal footing for the first time in an international agreement". She observes that a link is established between mitigation and sustainable development, moving away from the previously dominant sectoral approach to adaptation, mitigation and sustainable development. Significant work remains to be done, however, to clarify how the long-term goal for adaptation set out in Article 7 will be meaningfully realised (Lesnikowski *et al*., 2017), including credible commitments, adaptation planning methods/toolkits and clear implementation pathways.

Adaptation is also increasing in importance in the deliberations of the IPCC. For example, the IPCC's *Special Report: Global Warming of 1.5°C – Summary for Policymakers* (2018b) refers to "enhancing the resilience and the adaptive capacities of societies" (p. 19) and "specific climate resilience-enhancing investments" (p. 21), and describes climate-resilient development pathways as follows:

> Trajectories that strengthen sustainable development at multiple scales and efforts to eradicate poverty through equitable societal and systems transitions and transformations while reducing the threat of climate change through ambitious mitigation, adaptation and climate resilience. (p. 24)

Adaptation is frequently mentioned in this document in conjunction with mitigation. Adaptation options are noted as having "synergies with sustainable development, if well managed", and adaptation is also conversely noted as potentially resulting in "trade-offs or maladaptations with sustainable development" (p. 19). The main report, *Special Report: Global Warming of 1.5°C* (IPCC, 2018a), notes that "Cities and municipalities are at the frontline of adaptation", and describes climate change adaptation as follows (p. 70):

- Climate change adaptation refers to the actions taken to manage the impacts of climate change (IPCC, 2014).
- The aim is to reduce vulnerability and exposure to the harmful effects of climate change (e.g. sea level rise, more intense extreme weather events or food insecurity).
- Different adaptation pathways can be undertaken. Adaptation can be incremental or transformational, meaning fundamental attributes of the system are changed.

The report notes that there can be limits to adaptive capacity in both people and ecosystems, to the point where the avoidance of "an intolerable risk" is not possible (IPCC, 2018a, p. 70). An "adaptation pathway" is "understood as a series of adaptation choices involving trade-offs between short-term and long-term goals and values" (p. 64), and the report notes that "It is through governance that justice, ethics and equity within the adaptation–mitigation–sustainable development nexus can be addressed" (p. 71). The UN SDGs also provide a global framework for promoting resilience and adaptation. For example, SDG 11 aims to make cities and human settlements resilient and adaptive to climate change, while SDG 13 outlines the need to take urgent action to combat the impacts of climate change. Ireland has committed to achieving the UN SDGs by 2030. These SDGs consolidate the UN's *Sendai Framework for Disaster Risk Reduction 2015–2030*, which aims to build resilience and adaptive capacity in the context of environmental hazards and risks.

At the EU level, the European Commission's Communication *Forging a Climate-resilient Europe – The New EU Strategy on Adaptation to Climate Change* (CEC, 2021) sets out the ambitions of the EU's response to climate adaptation. The strategy notes that adaptation has received more limited attention from policymakers than mitigation, leading to a lack of preparedness with regard to anticipated impacts. It emphasises the importance of "no regret" adaptation solutions to secure societal and political buy-in, i.e. interventions worth pursuing regardless of the ultimate climate path because they have multiple co-benefits, such as nature-based solutions and wider biodiversity enhancements and economic benefits, such as reducing risk or promoting innovation, and they avoid human, natural and material losses. The long-term vision outlined in the strategy is that in 2050 "the EU will be a climate-resilient society, fully adapted to the unavoidable impacts of climate change" (CEC, 2021, p. 3). This includes enhancing adaptive capacity and minimising vulnerability to climate impacts, in line with the Paris Agreement and the proposed European Climate Law (aligned with the global goal on adaptation in Article 7 of the Paris Agreement and SDG 13). Of relevance to the built environment, the strategy emphasises the importance of improved data to inform decision-making, nature-based solutions as a cost-effective adaptation approach and climate-proofing of major new infrastructure; it also specifically addresses preparing Europe's building stock to withstand the impacts of climate change. In this context, the strategy notes that extreme weather and long-lasting climatic changes can damage buildings and their mitigation potential (e.g. solar panels or thermal insulation after hailstorms). However, the strategy highlights the potential of the built environment to contribute to large-scale adaptation, for example through local water retention that reduces the UHI effect with green roofs and walls. The Commission will explore options to "better predict climate-induced stress on buildings and to integrate climate resilience considerations into the construction and renovation of buildings through Green Public Procurement criteria for public buildings, the Digital Building Logbook, and as part of the process to revise the Energy Performance of Buildings Directive and the Construction Products Regulation" (p. 15).

## 3.3 National Context for Adaptation Policy

### *3.3.1 The National Adaptation Framework*

The NAF was developed in accordance with the provisions of section 5 of the Climate

Action and Low Carbon Development Act 2015, and specifies:

> … the national strategy for the application of adaptation measures in different sectors and by local authorities in their administrative areas in order to reduce the vulnerability of the State to the negative effects of climate change and to avail of any positive effects that may occur. (DCCAE, 2018a, p. 9)

Adaptation under the NAF should (p. 9):

- seek to minimise costs and maximise opportunities from the impacts of climate change;
- be risk based;
- be considerate of impacts on other sectors and levels of governance.

The NAF recognises that uncertainty in future climate scenarios should "strengthen the case for early investment in climate protection and resilience that could help avoid locking in future exposure to climate risks" (DCCAE, 2018a, p. 18). The NAF is very clear in this respect, stating that "Rather than a barrier to action, uncertainty may be treated as a motivation to take a precautionary approach to climate change" (DCCAE, 2018a, p. 19). Critical to understanding the NAF process is the relationship between the adaptation framework and sectoral and local adaptation policies (see Figure 3.1). In summary, adaptation measures should be mainstreamed across sectors and public policy, requiring an all-of-government approach.

National adaptation goals should inform local adaptation strategies, which in turn should inform local authority statutory development plans.

The NAF provides guiding principles for adaptation (DCCAE, 2018a, pp. 63 and 64). These principles are stated to inform adaptation planning at regional, local and individual levels, and also at the sectoral level (see Box 3.1).

Drawing on the conceptualisation of adaptation by the EEA (2013), the NAF notes that adaptations are typically categorised as soft, green and grey, thus providing a critical framework for understanding or developing future actions (DCCAE, 2018a, p. 25):

- **Soft adaptation** involves alterations in behaviour, regulation or system of management, examples include extending timeframes of plans further into the future; zoning development away from sensitive areas; and instituting or strengthening building codes in hazard prone areas.
- **Green adaptation** measures seek to utilise ecological properties to enhance the resilience of human and natural systems to climate change impacts. For example, the re-instalment of dune systems to act as buffers against coastal storm damage.
- **Grey adaptation** measures involve technical or engineering solutions to climate

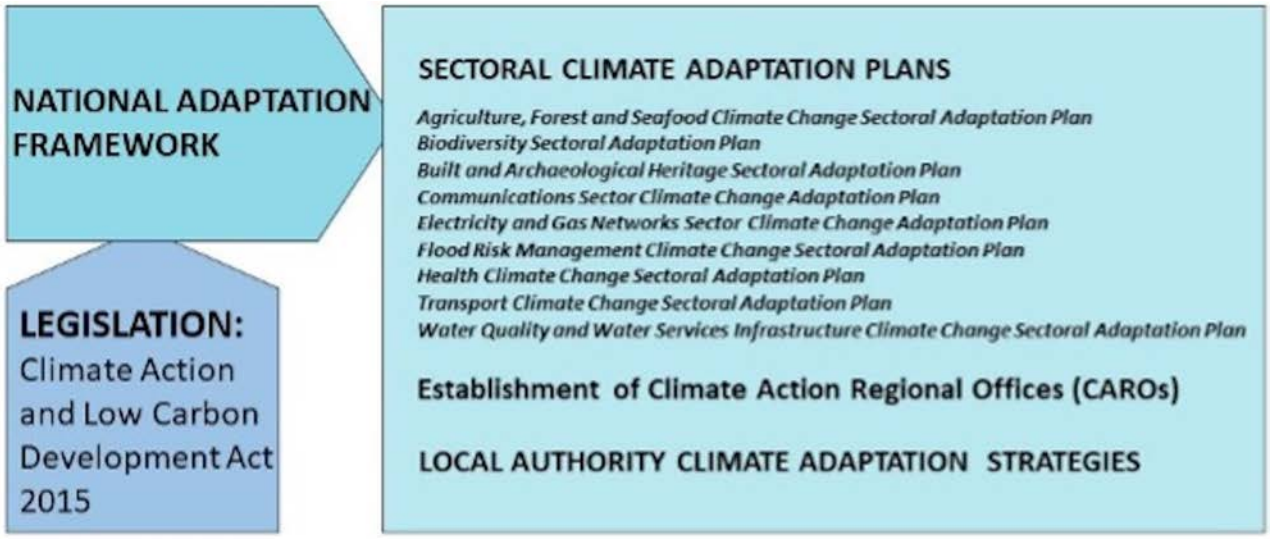


**Figure 3.1. National, sectoral and local climate adaptation policy and actions.**

**Box 3.1. The NAF's guiding principles on adaptation**

**Ownership.** There must be a clear commitment at senior levels within relevant organisations to pursuing adaptation from the outset. In the longer term, sufficient personnel and financial resources for adaptation must be made available.

**Vulnerability-based assessment.** Each sector and region will begin its adaptation planning with a clear understanding of sensitivities and vulnerabilities to current and future climate change.

**Openness and knowledge transfer.** Sharing best practices in adaptation, improving the collection of adaptation-relevant information and the communication of this information are all essential for adaptation processes.

**Foster cooperation.** A working partnership with relevant and affected stakeholders throughout the entire adaptation process is an important prerequisite for successful adaptation. The objectives and the areas of responsibility of the participants must be clearly determined and communicated.

**Account for uncertainty.** Uncertainties are an inherent part of all projections of climate change and its impacts. They will never be fully eliminated, but adaptation measures will be required nonetheless. A precautionary approach to adaptation should be adopted. Appropriately accounting for uncertainty can improve adaptation decisions by making them more robust in the face of uncertainties.

**Climate scenarios.** When prioritising climate change impacts at regional and local levels, both past weather events and scenarios of possible future climatic and socio-economic changes should be analysed. In order to understand the uncertainty in the potential impacts of climate change, a range of scenarios should always be drawn upon for the estimation of climate trends.

**Identify a wide range of adaptation options.** A comprehensive range of adaptation options should be considered at the outset (green, grey and soft). The available options should be described in as much detail as is reasonably possible in terms of their objectives and direct and indirect effects.

**Prioritise adaptation actions.** It will not be practicable to undertake all adaptation options identified. Implementation of adaptation actions must be prioritised in accordance with relevant criteria such as efficiency, cost-effectiveness, risk and urgency and ensuring a just transition. The local authority and sectoral adaptation guidelines discuss both how to prioritise climate risks at the appropriate scales and, following this, how the adaptation options identified should be prioritised for implementation.

**Monitoring progress.** It will be necessary to establish appropriate monitoring mechanisms and indicators to ensure the effectiveness of sector-specific adaptation responses. Such mechanisms will also ensure the efficient use of resources while allowing flexibility in how plans are implemented.

impacts – examples include the construction of sea walls and tidal barrages.

**Barriers** to the effective implementation of adaptation planning processes identified in the NAF include (DCCAE, 2018a, p. 50):

- There is a requirement for buy-in at all levels of governance and among the general public.
- There needs to be better coordination between national structures and the local government sector.
- Adaptation requires political will, viable institutions and effective policy frameworks to ensure coordination among individual actions. There is a need to identify and promote adaptation leadership.
- Planning for adaptation is a complex task and requires appropriate capacity-building within local authorities and across all levels of governance.
- Synergies *between* individual local authorities should be exploited.

*National Adaptation Framework: built environment*

The NAF considers that the most appropriate way of increasing built environment resilience is through the "deepening of adaptation considerations in the planning and building standards processes" (DCCAE, 2018a, p. 67), including:

- the avoidance of inappropriate forms of development in vulnerable places through integration of climate considerations into decision-making;
- consideration of UHI effects;
- consideration of the spatial implications of water stress;
- consideration of acquisition of flood-prone land for suitable uses;
- continued promotion of GI as appropriate and consideration of the capacity for adaptation for biodiversity;
- the location, layout and design of development should accommodate predicted climate impacts, avoiding future costly and inefficient future redesign and redevelopment.

On this last point, the NAF states that this approach will require the facilitation of innovative building design, new materials and standards, and that planning authorities should understand what adaptation to the adverse impacts of climate change requires. It notes that this principle is equally applicable to the climate-proofing of older buildings. The NAF states that consideration must be given to how national building standards "can support or impede climate adaptation measures" (DCCAE, 2018a, p. 68). Noting that all structures (including historic structures) must be kept "in a good state of repair to resist damage from a variety of threats" as extreme weather events increase, the NAF further states that managing climate change impacts on the historic built environment, "… in particular the archaeological and architectural heritage, is also essential" (DCCAE, 2018a, p. 68). This is further advanced in sectoral guidance for built heritage. However, there is no requirement for a sectoral adaptation plan that covers the non-historic elements.

### *3.3.2 Climate Action Plan 2019*

The CAP, published in 2019, is primarily focused on mitigation and the transition to a zero-carbon society, with adaptation measures limited to one of the plan's 16 chapters. Regarding adaptation, the CAP (DCCAE, 2019) states that, in addition to reducing GHG emissions:

> … we must also adapt to certain climate change impacts that are already locked in and will continue and evolve for the foreseeable future. Many of the observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, and sea levels have risen. (p. 142)

It describes the need for adaptation as "both urgent and essential to successfully transition to a climate resilient economy and society by 2050" (DCCAE, 2019, p. 142). The CAP notes that early adaptation makes economic sense, that adaptation minimises risks and costs and that adaptation protects lives and property through resilience-building in existing systems (DCCAE, 2019, p. 143). The CAP states that there is justification for the government to "take a proactive role to tackle clear market failures", to lead and coordinate adaptation through the provision of an enabling environment for "independent adaptation actions by private actors" and that all government ministers, not just those associated with the 12 sectors identified as having to prepare an adaptation plan, must respond to the need for climate adaptation. This echoes the NAF's call for the mainstreaming of adaptation goals and an all-of-government response. The CAP states that it is essential that adaptation is integrated/mainstreamed into decision-making "within all relevant national policy and legislation, and department and agency" (DCCAE, 2019, p. 145). The CAP gives examples of such mainstreaming and notes that it should be ensured that spatial plans take account of current and future climate risks and that building standards evolve in line with projected climate impacts.

The CAP includes a chapter specifically on the built environment, which focuses on mitigation measures to be put in place, primarily related to energy efficiency, building performance standards and retrofitting. The CAP states that new approaches, which go beyond existing approaches, will be required to mobilise the acceleration of work to make buildings climate resilient. One such approach is to ensure that "every significant new build or refurbishment takes

the opportunity to maximise the adoption of climate resilient measures", with the CAP noting that this and other measures will require significant innovation in the approach of the Department of the Environment, Climate and Communications (DCCAE) and its agencies, and furthermore noting that collaboration will be required between the government, local authorities, enterprises, financial institutions and communities (DCCAE, 2019, p. 78). However, while the focus of the built environment chapter is mitigation, some recommendations are transferable to future development of built environment adaptation actions, including the need to improve the fabric of buildings and the setting of new building standards, the potential for the upskilling of contractors and other "industry players", the need to avoid "lock-in" within the urban and built environment system, and the role of government in setting incentives to shift market behaviour. These measures have equal applicability to adaptation actions, and there is potential for developing more detailed built environment responses at the national level. In relation to local-level measures for the built environment, the CAP recommends the development of a climate action toolkit and audit framework for local authority development planning to drive the adoption of stronger climate action policies in relation to the patterns and forms of future development. This should also be extended to assessing adaptation needs within forward planning and development management at the local authority level. Climate action plans will be published annually, with *Interim Climate Actions 2021* (Government of Ireland, 2021) published in 2021.

### *3.3.3 Sectoral Planning Guidelines for Climate Change Adaptation*

The NAF does not directly propose any adaptation measures or projects, but rather identifies sectors for which sectoral adaptation plans are to be made. The *Sectoral Planning Guidelines for Climate Change Adaptation* (DCCAE, 2018b), produced by the DCCAE, provide guidance and a framework for those sectors that are required to produce statutory adaptation plans under the NAF. The guidelines "aim to ensure that a coherent and consistent approach to adaptation planning is adopted by the key sectors in Ireland" (DCCAE, 2018b, p. ii). This approach is structured around a six-step cycle as follows: (1) preparing the ground, (2) climate impact screening, (3) prioritisation, (4) policy impact assessment, (5) develop your plan and (6) implement, evaluate and review. It is notable that there is no requirement for a sectoral plan directly relating to the housing/commercial property sector, particularly given its exposure to extreme risk from the projected effects of climate change. Although all sectors have interreliances and overlaps, the sectors most relevant to the built environment are flood risk management, built and archaeological heritage, water quality and water services infrastructure, transport, electricity and gas networks, communications networks, health and biodiversity. The first four of these sectoral plans are examined in brief below, noting their content of relevance to the built environment. The Flood Risk Management Climate Change Sectoral Adaptation Plan (FRMP) (OPW, 2019), which is largely related to the built environment, is examined first and in the greatest detail. This is the second published plan (and the first statutory), indicating that this sector is in a more advanced position than others that have issued guidance documents. It is an example of a sectoral plan that clearly followed the six key steps for the process of making the plan set out in the *Sectoral Planning Guidelines for Climate Change Adaptation* (DCCAE, 2018b).

#### *Sectoral plan: flood risk management*

Prepared by the Office of Public Works (OPW), the FRMP states that "Ireland must prepare to adapt" to the effects of climate change, while addressing the causes of climate change (OPW, 2019, p. 1). It acknowledges the likelihood of increased rainfall; more intense storms; increased frequency of heavy rain days, with such intense precipitation events increasing by possibly 20%; and rising sea levels, which have risen *c*.20 cm in the past century and continue to rise by *c*.3.5 cm every decade, with the mean global sea level potentially rising by *c*.1 m by 2100. It notes that in recent decades Ireland has suffered severe flooding events, which affected many thousands of properties. The stated purpose of the plan is to:

- outline the potential impacts of climate change on flooding and flood risk management in Ireland;
- identify the objectives for an effective and sustainable approach to adaptation as part of flood risk management for the future;
- promote a coordinated approach to adaptation within the flood risk management sector and sustainable flood risk management measures in

other sectors, and across the policies and actions of other sectors, including local authorities; and
- recommend any further actions required to meet the objectives for adaptation (p. 12).

In recent years, the OPW conducted a preliminary flood risk assessment, which addressed flood risk at the national level and identified areas at significant risk of flooding. The OPW's Catchment Flood Risk Assessment and Management (CFRAM) programme assessed flood risks for 300 Irish communities, in which approximately two-thirds of the national population live and 80% of the properties are designated as potentially at risk of flooding. These risks were assessed both under current climatic conditions and in the context of possible future climate change impacts. FRMPs made in 2018 outline measures identified by CFRAM (alongside measures previously in the process of design/construction or completed) and which are stated to potentially provide flood protection to 95% of those properties identified as being at risk of flooding within the 300 assessed communities. CFRAM assessments indicate "potentially very significant increases in the flood impact and the number of properties that could become at risk of flooding" (p. 2). The EU Floods Directive requires a national review of flood risk every 6 years, and this is acknowledged in the FRMP. By the end of 2018, the OPW had completed 43 major flood relief schemes, and at the time of the FRMP's publication there were a further 35 in progress, all at different stages of planning, design or construction. It is stated that the completed schemes cost €350 million, protecting more than 9000 properties "with an overall benefit of approximately €1.7 billion" (p. 19). A further 118 flood relief schemes were identified in the FRMP. The FRMP states that the government's priority of addressing flood risk is demonstrated by the annual allocation for flood defence actions, reaching €100 million by 2021 (p. 19). The FRMPs were further reviewed in 2021. However, the conclusions of the Review were that no new, additional measures have been, or need to be, introduced at this time, reflecting the comprehensive nature of the first cycle.

*Sectoral plan: built and archaeological heritage*

The Built and Archaeological Heritage Climate Change Sectoral Adaptation Plan (BAHP) (DCHG, 2019) was prepared by the Department of Culture, Heritage and the Gaeltacht. This sectoral adaptation plan is concerned only with those elements of the built environment that constitute "heritage", stating that:

> Heritage in Ireland ranges from the many modest sites of local and regional importance to those of national and global significance. It includes private homes, commercial and public buildings, national monuments, underwater and buried archaeology and the physical and cultural settings of all of these. This plan considers not only those structures and sites that have been statutorily listed, but all man-made assets that have historical, aesthetic and cultural value, even though they may not be officially protected. (DCHG, 2019, p. 7)

This historic fabric thus refers to "all buildings, structures and urban settlements, both vernacular and architect designed, that are of historic, aesthetic, social or technical interest" (DCHG, 2019, p. 13). The BAHP acknowledges the likely risk to heritage from catastrophic weather events as well as "slow-onset environmental-deterioration mechanisms" (DCHG, 2019, p. 7). The five adaptation goals are (DCHG, 2019, p. 8):

1. improvement of understanding of heritage resources and their vulnerability to climate change;
2. development and mainstreaming of sustainable policies and plans for adaptation of heritage;
3. conservation of Irish heritage for the benefit of future generations;
4. communication and knowledge transfer;
5. exploitation of opportunities to demonstrate the value of heritage and to secure heritage resources.

The BAHP provides 11 comprehensive case studies that illustrate damage already sustained by built and archaeological heritage through climate change impacts, along with sectoral consequences and possible actions for preparation and adaptation for future, more severe, impacts. It is clear that all possible flood events affect "non-heritage" buildings and infrastructure as well as heritage buildings and infrastructure. The BAHP describes the potential damage to heritage buildings and infrastructure

from the impacts of climate change; all of these descriptions also apply to "non-heritage" buildings and infrastructure. The plan's priority impacts list includes fluvial, pluvial and groundwater flooding; coastal flooding; storm damage; coastal erosion; and maladaptation. It places "buildings" as being "heritage affected" in these contexts; these impacts will also affect "non-heritage" buildings.

The BAHP considers the cross-sectoral implications for built and archaeological heritage, identifying areas of intersection between the plan and the "parallel sectoral areas", which are grouped according to government department. It notes that the Department of Housing, Planning and Local Government (DHLPG) "has responsibility for several areas where there are potential synergies", including housing and planning. The BAHP notes that the adaptation plan required from DHPLG "is to consider water quality and water-services infrastructure only" (DCHG, 2019, p. 72). Accordingly, given the framework for sectoral plans set out in *Sectoral Planning Guidelines for Climate Change Adaptation* (DCCAE, 2018b), the BAHP does not address cross-sectoral implications with the housing and planning sectors, only with water quality and water services infrastructure.

*Sectoral plan: water quality and water services infrastructure*

The Climate Change Sectoral Adaptation Plan for the Water Quality and Water Services Infrastructure Sectors (WQWSP) (DHPLG, 2019) was prepared by the DHPLG. Of relevance to built environment adaptation, the WQWSP acknowledges and recognises the following (p. 1):

- the major challenge of protecting and improving water services infrastructure and that the scale of this challenge will be increased by threats related to climate change impacts;
- that there will be mobilisation of pollutants resulting from increased rainfall and flooding, and reduced dilution of contaminants because of low flow, leading to increased contaminant concentrations in water bodies;
- increased surface and sewer flooding;
- resource issues relating to water availability, including those resulting from increased demand in increasingly hot weather.

The WQWSP states that it is a "national-scale plan and focuses on independent impacts on the sectors rather than the broad range [of] coincident and downstream impacts" (DHPLG, 2019, p. 6). The housing and commercial property sector is one of those clearly affected by the water quality and water services sectors. On interdependencies between sectors, the WQWSP observes that the "water service sectors must be considered in the context of other sectors – and vice versa. Thus, the implementation phase of this plan must involve consultation with the other sector departments and agencies in Ireland", mentioning the importance of limiting "climate-induced cascade impacts upon other sectors like agriculture, forestry, energy and health" (DHPLG, 2019, p. 42). It notes that many organisations will have involvement in plan implementation, including the Environmental Protection Agency (EPA), the Electricity Supply Board (ESB) and Irish Water. There is no mention of the housing/commercial property sector (DHPLG, 2019, p. 42).

Adaptive measures defined in the WQWSP include grey measures (including "hard engineering solutions", such as flood defences, mechanical aeration/circulation of a water body, new-builds/upgrades of raw water and waste water treatment infrastructure, and improvements to raw water and sewerage networks). Soft adaptation methods included are communication "consisting of outreach to citizens, customers (household and industrial), and owners and operators of private schemes and private operators" (DHPLG, 2019, p. 44); research, the focus of which is "to enhance the adaptive capacity of the sector and reduce uncertainty to inform decisions of key stakeholders" (DHPLG, 2019, p. 45); and publicity campaigns to encourage water conservation. Green adaptation measures included are the restoration of degraded ecosystems to improve the quality of freshwater and catchment hydrology, and integrated catchment management (ICM) measures, which involve both the reduction of pollution inputs to natural water systems, and surface water flood and drought management, such as SUDSs.

*Sectoral plan: transport*

The Transport: Climate Change Sectoral Adaptation Plan (Transport Plan) (DTTS, 2019) was prepared by the Department of Transport, Tourism and Sport. This plan states that "Planning legislation can offer

resilience" (DTTS, 2019). It mentions "building back better" principles as an approach to post-disaster rebuilding, stating that this approach "reduces vulnerability to future disasters and builds community resilience" (DTTS, 2019, p. 13). The Transport Plan notes that a whole-of-government approach is required by build back better principles and for land use to be transport appropriate:

> … building and planning regulations are employed to reduce the possibility of building infrastructure in high-risk areas (e.g. denying permission to construct on floodplains) and to enforce increased resilience of physical assets at the point of (re)construction. (pp. 13–14)

Transport is a sector that is part of our critical infrastructure. The Transport Plan states that "Critical infrastructure supports and underpins the effective functioning and overall resilience of all other sectors of the economy. Extreme weather events rarely affect one sector in isolation", mentioning in particular the effects of transport infrastructural failure on electricity and gas networks and vice versa (DTTS, 2019). The Transport Plan extends its attention to sectors outside those listed in the NAF, considering the tourism and sport sectors. The plan notes the challenges of the impacts of climate change faced by these sectors and recommends pre-emptive adaptive measures for "future-proofing outdoor sport infrastructure, for example by the development of indoor or covered sports facilities to accommodate players and spectators in adverse weather conditions" (DTTS, 2019, p. 35).

Noting the high costs typically associated with infrastructure assets, adaptation measures that take the worst-case scenario climate projections are likely to be prohibitively costly. Considering the long-term uncertainty of the future climate, the Transport Plan notes that an appropriate response is to establish indicative adaptation pathways, and that long-term risks and their associated costs will be more clearly identified in the future through future sectoral adaptation planning (DTTS, 2019, p. 64). The Transport Plan mentions soft, green and grey types of adaptation action. Taking a moderate-priority climate impact on rising temperatures of 1–1.6°C, the Transport Plan notes that the area subject to the highest projected degree of change is in the east, with expected rises in daytime and night-time temperatures. It states that there will be changing needs for heating and cooling, as energy demands rise for depots and fixed infrastructure (such as ports and airports), i.e. buildings (DTTS, 2019, p. 75). Housing/commercial property will be similarly affected. The largest proportion of housing and commercial property is situated in the east of the country.

## 3.4 Local Adaptation

The NAF provides context for local adaptation strategies, and notes that local understanding is critical for adaptation, stating that:

> … adaptation is an important consideration for local authorities, businesses and the general public in terms of developing the capability to mainstream climate change adaptation within all areas of existing local authority activity. (DCCAE, 2018a, p. 11)

Local government has a "critical role to play in managing climate risks and vulnerabilities and identifying adaptation options" (DCCAE, 2018a, p. 74). The NAF identifies housing and planning as among key services that local government delivers to the public. Local authorities are identified as key stakeholders, holding responsibility for the implementation of adaptation measures in their respective areas. Every local authority must make and adopt an adaptation strategy, developing it in accordance with the requirements set out in the Local Authority Adaptation Strategy Development Guidelines (DCCAE, 2018c), the NAF and the provisions of the Climate Action and Low Carbon Development Act 2015. The NAF notes that many neighbouring local authorities face similar challenges from the impacts of climate change and that local authorities are proposing the adoption of a joint/regional approach to adaptation planning. This provides opportunities for knowledge, experience and resource sharing, and facilitates the use of economies of scale. Climate action regional offices (CAROs) were established to guide local authorities in their development of local adaptation strategies. The NAF states the importance of support for regional and local approaches to the delivery of climate resilience. Such a regional approach does not,

however, remove from a local authority the obligation to "advance the adaptation strategy process" (DCCAE, 2018a, p. 75).

The deadline provided in the NAF for each local authority to make and adopt local adaptation strategies was 30 September 2019. The Local Authority Adaptation Strategy Development Guidelines were produced in December 2018, in order to assist local authorities with making local adaptation strategies. The guidelines recognise the pivotal role played by local government in planning for emergency situations and for emergency response. They note that local authorities have a close relationship with the community and local knowledge of the environment, which places them in a position to manage the risks and vulnerabilities in their area and to identify adaptation actions. It is stated that, ideally, "adaptation should take place in a pro-active and anticipatory manner, thereby preventing the worst of the risks to society that accompanies climate change" (DCCAE, 2018c, pp. 2–3). The guidelines state that the essential mainstreaming of climate change adaptation within every area of local authority activity, both existing and planned, requires capacity-building and training for all people involved with adaptation planning. The four CAROs established facilitate coordinated engagement between local authorities (Table 3.1). CAROs are operated by a lead local authority. Counties are grouped into CAROs according to shared risks from the impact of climate change. CAROs are coordinated by the National Local Authority Climate Action Steering Group and serve to ensure that a consistent approach to adaptation strategy development is taken across their region and that adaptation strategies are developed in accordance with the guidelines. Local authorities are expected to work with their regional CARO when developing their adaptation strategies.

Local strategies must be fully aligned with the sectoral plans, and CAROs facilitate coordination between sectoral and local adaptation efforts, ensuring that relevant sectoral input is obtained (DCCAE, 2018c, p. 20). Stakeholder engagement and communication is mandatory under the NAF during the adaptation strategy development process. A "structured and substantive programme" for stakeholders must be included; those stakeholders include elected members of the authority, the public, non-governmental organisations and state bodies. The guidelines provide suggested content for the strategy, outlined in Table 3.2.

### *3.4.1 Local authority climate change adaptation strategies*

An overview of one local authority adaptation strategy from each CARO region is provided here, paying particular attention to the provisions within the strategy that pertain to the built environment. These local authorities are chosen to provide a variety in terms of urban/rural mix and population size, illustrated in Table 3.3.

#### *Dublin City Climate Change Action Plan*

The Dublin City Climate Change Action Plan (DCCCAP) was prepared by the Dublin energy agency Codema, in partnership with the Environment Strategic Policy Committee, and Codema incorporated the requirement for a Dublin City adaptation strategy into a broad climate action plan that addresses both mitigation and adaptation, noting the overlap of issues and solutions (see Figure 3.2). This integration across mitigation and adaptation contrasts with other local authority adaptation-specific strategies; however, this combined approach will be required in future through the Climate Action and Low Carbon Development (Amendment) Bill. Dublin City Council's area is entirely urban and consists entirely of built environment. Accordingly, its whole plan is effectively built environment oriented. It outlines opportunities for making Dublin a low-carbon and climate-resilient city.

**Table 3.1. CAROs**

| CARO | Lead authority | Local authorities within CARO area |
|---|---|---|
| Atlantic Seaboard North | Mayo County Council | Donegal, Galway City, Galway County, Mayo, Sligo |
| Atlantic Seaboard South | Cork County Council | Clare, Cork City, Cork County, Kerry, Limerick |
| Dublin Metropolitan Region | Dublin City Council | Dublin City, Dún Laoghaire-Rathdown, Fingal, South Dublin |
| Eastern and Midlands Region | Kildare County Council | Carlow, Cavan, Kildare, Kilkenny, Laois, Leitrim, Longford, Louth, Meath, Monaghan, Offaly, Roscommon, Tipperary, Waterford, Westmeath, Wexford, Wicklow |

**Table 3.2. Suggested content of a local authority adaptation strategy**

| Section | Suggested contents |
|---|---|
| 1. Introduction | Contextual overview of climate change, policy and adaptation, including:<br>• evidence of climate change and adaptation/mitigation action<br>• adaptation policy<br>• strategy methodology<br>• acknowledgement of all contributors to the strategy |
| 2. Regional and local context | Overview of regional CARO and local authority, including:<br>• overview of CARO region<br>• full description of relevant local authority area |
| 3. Adaptation baseline assessment | Overview of local authority area climate hazards, including:<br>• timeline of past climate hazard events<br>• overview of impacts of hazard events |
| 4. Climate risk identification | Overview of projected impacts<br>Presentation of risk register and priority risks |
| 5. Adaptation goals, objectives and actions | Outline of adaptation goals and objectives<br>Overview of adaptation action plans<br>Overview of implementation management |
| 6. Implementation, monitoring and evaluation | Description of climate trends and impact monitoring mechanisms<br>Schedule of strategy evaluation |

**Summarised from Table 6.1 in the Local Authority Strategy Development Guidelines (p. 49).**

**Table 3.3. Example local authority adaptation strategies**

| Local authority adaptation strategy | CARO | Number of pages |
|---|---|---|
| Dublin City Climate Change Action Plan | Dublin Metropolitan Region | 123 |
| Longford Climate Change Adaptation Strategy | Eastern and Midlands Region | 50 |
| Sligo (Draft) Climate Change Adaptation Strategy | Atlantic Seaboard North | 108 |
| Limerick City and County Climate Change Adaptation Strategy | Atlantic Seaboard South | 44 |

Emphasis is placed on adapting to climate change now, ensuring all future plans are climate-proofed and associated opportunities maximised. These "opportunities" involve green, soft and grey adaptation measures, consistent with the NAF. The DCCCAP notes Dublin city's unique situation in Ireland, covering 117 $km^2$ and having 52 km of coastline, with three main rivers and many smaller rivers running through its area. In 2016, it had a population of 550,554 individuals, occupying 240,553 households, and both figures are expected to rise. The DCCCAP notes that Dublin city is exposed to a different set and scale of risks than rural regions, sparsely populated regions and those with no coastline. Flooding is deemed to present the biggest risk for the Dublin city area, which is particularly vulnerable to flooding of all kinds: fluvial, pluvial and that arising from sea level rise, storm surges and tidal surges. Urban flooding can place extreme pressure on water services and overwhelm the urban drainage network, resulting in network flooding. Dublin City Council developed a pluvial flood risk management strategy that served to inform the DCCCAP, which recognises three categories of measures for the reduction of pluvial flood risk in the

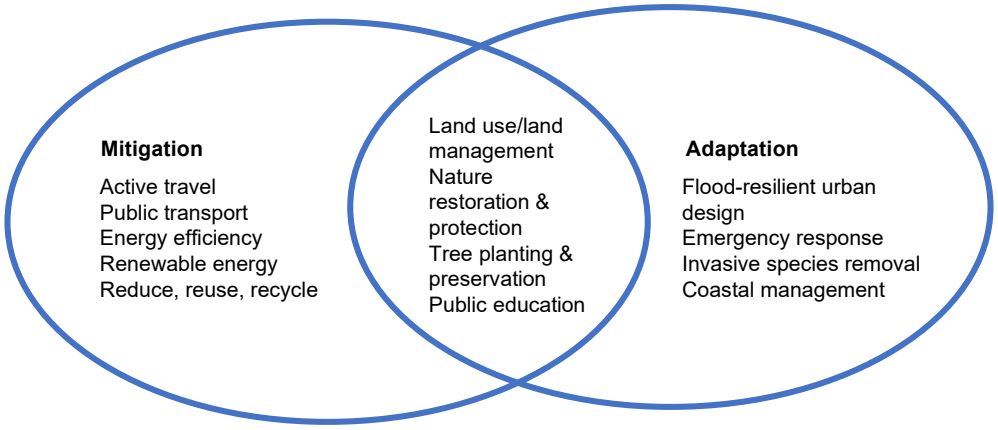


**Figure 3.2. Examples of mitigation and adaptation crossovers. Adapted from DCCCAP (Dublin City Council, 2019, p. 12).**

city (Dublin City Council, 2019, p. 84); this is outlined in Table 3.4.

The DCCCAP acknowledges that, despite Dublin City Council's preference for nature-based flood alleviation measures, there are parts of the city where these are not an option and where engineered, grey measures are the only option. It states that the Council "is actively researching alternatives to physical flood defences, such as zoning policies to restrict further development in at-risk areas" (Dublin City Council, 2019, p. 86). The DCCCAP describes the main action types to employ nature-based solutions to the impacts of climate change, which include green roofs on civic buildings; further development of the area's GI; the protection, planting and maintenance of trees; and the construction of wetland habitats. It includes targets of continuous green space along rivers; the reduction of soil sealing (i.e. increasing ground permeability to water); and the protection of native species, parks and tree cover, estimating that the area has approximately 10% of tree canopy cover (Dublin City Council, 2019, p. 91). Examples of urban nature-based solutions include green roofs and tree pits, which form part of SUDSs, and the plan acknowledges that the tree canopy cover provides shade and regulates urban heat. The plan notes that nature-based solutions are "a smart, 'engineered' way to provide sustainable, cost-effective, and adaptable measures that support climate resilience" (Dublin City Council, 2019, p. 92).

### *Longford Climate Change Adaptation Strategy*

Longford is a small, landlocked, low-lying county, with a population of 40,873 in 2016. The Longford Climate Change Adaptation Strategy 2019 (LCCAS) (Longford County Council, 2019) describes its

**Table 3.4. Categories of measures for the reduction of pluvial flood risk in Dublin**

| Category of measures | Adaptation and mitigation measures | Category of adaptive action |
|---|---|---|
| Community and business resilience | Awareness-raising and education | Soft |
| | Rainwater harvesting | Grey/green |
| | Domestic rain gardens | Green |
| Site-specific measures | SUDS storage and infiltration | Green |
| | GI/bioswales | Green |
| | Surface conveyance | Grey |
| Overall measures | Flood warnings | Soft |
| | Land use management | Soft |
| | Vegetation management | Green |

**Adapted from case study "Flood Resilient City Outcomes" (Dublin City Council, 2019, p. 84).**

settlement pattern as dispersed, "characterised by a relatively weak urban and village structure". The largest town, Longford, contains just 25% of the total population of the county, with no other town in Longford exceeding a population of 1500 individuals. The LCCAS acknowledges that the settlement pattern in the county "has potential implications for the provision of services in extreme weather events in terms of resources and capacity" (Longford County Council, 2019, p. 19). The LCCAS states that there are "… positive interactions between adaptation and mitigation measures. Employing both adaptation and mitigation measures represents a robust climate action response in addressing the challenges associated with climate change at local level" (Longford County Council, 2019, p. 14). The LCCAS risk analysis for projected increased temperatures includes the potential consequences of an increased risk of heat-related health conditions and deaths, increased energy consumption for cooling and "subsidence and heat-related damage or disruption to buildings, energy and transport networks". Risk analysis for increased winter precipitation includes damage to buildings and infrastructure, "drainage capacity unable to cope during periods of intense rainfall" and the risk to water quality should slurry stores overflow. Risk analysis for increased storm intensity includes disruption to council services and to the local economy, and disruption to services caused by events such as flooding and those affecting water quality (p. 36).

The following are key policies relating to the built environment (Longford County Council, 2019):

- Action 2.1.1. in the LCCAS is to "Align climate actions with projects and dedicated funding streams through housing, regeneration and other development initiatives across Longford County Council activities" (p. 39), including a vulnerability assessment of infrastructure, buildings and properties owned by Longford County Council (p. 40).
- Objective 6 of the LCCAS, to "promote a combined climate action response to infrastructure provision", has associated actions, which include engagement with critical infrastructure providers to establish the potential for combined responses and resilience enhancement of existing infrastructure (p. 41).
- Objective 5 of the LCCAS is "to maintain the integrity of public infrastructure against negative climate change impacts and increase the design resilience of planned developments into the future" (p. 40). Actions include the incorporation of GI into the design of the public realm to mitigate flooding and to "evaluate the broader applications of green infrastructure in achieving environmental and societal goals" (p. 40).
- Objective 7 of the LCCAS, "to integrate climate action considerations into land use planning policy and influence positive behaviour", is potentially actioned by the integration and promotion of "climate-smart building and urban design performance outcomes in development standards through the development management process" (p. 42). It is notable that there is no action under this objective relating to the prevention of building on areas prone to flooding, given the stress placed on the importance of this by the relevant sectoral adaptation plans, in combination with Longford's propensity for pluvial/fluvial flooding. The county suffered from severe flooding events in 2009, 2011 and 2015 (p. 33). Objective 8, "to manage the risk of flooding through a variety of responses and to mitigate the risk and impact of flooding", also neglects to address the prevention of building on flood-prone land.

### *Sligo Climate Change Adaptation Strategy*

The Sligo (Draft) Climate Change Adaptation Strategy 2019 (SCCAS) (SCC, 2019) follows the five-step process set out in the Local Authority Adaptation Strategy Guidelines. In forming the Sligo Adaptation Baseline, the local authority used case studies to illustrate how climate events affected the county, with three relating to damage following extreme intense precipitation/high tides/storminess; one to a gorse fire following warm, dry weather; and one to road damage from extended cold weather. The strategy acknowledges the risks to critical infrastructure and buildings, stating that significant losses in terms of property damage and infrastructure can be attributed to flooding. County Sligo has 110 km of coastline (including five estuaries) and the SCCAS notes that Sligo has a significant amount of coastal property and infrastructure subject to coastal flooding and erosion. Storminess is recognised as a disruptor, with winds threatening buildings adjacent to potential hazards (e.g. trees) and also critical infrastructure, particularly the electricity supply. It is noted that increased summer

temperatures may cause heat-related damage, which leads to disruption of energy and transport networks, as well as affecting conditions in buildings. It is also noted that "there may be further opportunities for innovative, sustainable building services, materials, and urban planning" (SCC, 2019, p. 48).

Regarding risks to the coastal environment, the SCCAS suggests that "traditional local interventions of 'hard' and/or 'soft' engineering solutions to reduce vulnerability and preserve the present-day shoreline are unlikely to represent an optimum long-term management strategy for the coastal zone" (SCC, 2019, p. 50). It is suggested that "set back" lines may be instituted in buffer zones, indicating that no development may take place seaward of these lines. It is acknowledged that this approach of "shoreline realignment" or "managed retreat" may be economically and culturally contentious; however, it may represent the most economic strategy. The strategy observes that, because of predicted increases in precipitation and rising sea levels, flooding poses the greatest long-term risk associated with the impacts of climate change to infrastructure, communities and businesses. SCCAS outlines three high-level goals: to engage, to plan and to adapt. The SCCAS develops specific actions under each of the goals and objectives in the strategy (Table 3.5). For each action, indications are provided as to who is responsible for the action, whether or not there is currently a budget available for the action, the time frame of the action, other bodies/ organisations that should be involved in the action and the theme in the NAF with which the action is concerned (SCCAS, 2019, p. 68).

### *Limerick City and County Climate Change Adaptation Strategy*

Limerick City and County Council serves a population of *c.*195,000, just under half of whom live in Limerick city and its suburbs. Eighty other settlements, towns and villages are identified in the Limerick County Development Plan. Limerick City and County Council manages *c.*5200 social housing units (Limerick City and County Council, 2019). The northern boundary of Limerick is formed by the Shannon river and its estuary, which is almost 100 km in length. The most damaging severe weather events in Limerick have resulted in flooding (fluvial, pluvial and coastal), with

**Table 3.5. Sample of objectives and corresponding actions in the SCCAS**

| Objective | Action |
|---|---|
| Identify areas/communities that may be affected by future climate-related events and consider possible pre-emptive actions | Ensure that the prominence of climate change is maintained within the County Development Plan and ensure all climate change-related actions in the Plan are followed through and achieved |
| Use climate adaptation planning to promote health and well-being | Identify local authority-owned properties that may be suitable for "greening" activities, e.g. community gardens or allotments, tree planting, that would support climate awareness |
| Increase awareness of house owners and tenants on potential impacts on housing from climate change events and how best to look after their home to avoid or reduce impacts | Update the tenants' handbook and the online communication and social media plan to provide the necessary climate change resilience information |
| Improve resilience of existing housing stock against future climate-related events | Where possible, work with Sligo Sustainable Energy Community to identify funding opportunities for retrofit programmes for local authority housing<br>Complete the existing pilot project concerning new building methods, ensuring compliance with modern energy standards |
| Protect water and waste water infrastructure and services against future climate-related events | Work with and support Irish Water in identifying vulnerable public drinking water supplies or waste water treatment infrastructure and develop contingency plans |
| Reduce the potential future impact of flooding throughout the county | Ensure that the flood risk management policies outlined in the CDP, as well as the strategic flood risk assessment, are implemented |

**Summarised from pp. 70 and 71 of the SCCAS.**

fluvial the most frequent. Increases in the severity of extreme precipitation events will increase river flows and, in combination with tidal effects (particularly in the Shannon estuary), will increase the risk of flooding. The Limerick City and County Climate Change Adaptation Strategy (LCCCCAS) (Limerick City and County Council, 2019) provides actions under the objectives in the strategy (Table 3.6). For each action, indications are provided as to who is responsible for the action, whether or not there is currently a budget available for the action, the time frame of the action, the lead directorate for the adaptation action and the associated directorate for the adaptation action (Limerick City and County Council, 2019, p. 25).

## 3.5 Conclusion

At the international level, adaptation has increasingly been promoted as a second and equal pillar within climate action alongside more established mitigation practices. This recognises that climate change is locked in and that uncertainties should not undermine the case for taking adaptive action. This recognises the importance of the precautionary approach, whereby uncertainty is accepted and embraced through adaptive management.

At the national level, the adoption of the NAF in 2018 represents a significant step change in Irish policy, advancing an all-of-government and all-of-society approach to adaptation and the mainstreaming of adaptation through sectoral and local adaptation plans. The NAF recognises the importance of enhancing the resilience of Ireland's built environment, stating that "adaptation considerations in the planning and building processes" should be "deepened" to increase resilience in the built environment, including avoiding inappropriate development in vulnerable places and that the location, the layout and the design should "accommodate predicted climate impacts, avoiding future costly and inefficient future redesign and redevelopment" (DCCAE, 2018a, p. 67). While the importance of the built environment is recognised, there is currently no specific sectoral guidance for built environment adaptation; instead, sectoral adaptation plans have been prepared for overlapping and interreliant sectors (flood risk management, built and archaeological heritage, water quality and water services infrastructure, transport, electricity

**Table 3.6. Sample of objectives and corresponding actions in the LCCCCAS**

| Objective | Adaptation action |
|---|---|
| Ensure the most efficient response to climate risk and climate events by Limerick City and County Council | Review the flood response plan to ensure that lessons learned are incorporated for future responses. Review and collate information on existing early warning systems (e.g. flood early warning systems, coastal surge system, tides and up-to-date weather forecast) to better predict future events |
| Ensure that the risk and impact of flooding is adequately integrated into planning policy | Review flood risk management policies to ensure that they are effective in preventing inappropriate development in areas that are or may be at risk of flooding. Prepare flood risk assessment for the metropolitan area and vulnerable zoned settlements in the county to inform development plan policy |
| Ensure the integration of climate adaptation and mitigation into land use and planning policy | Integrate climate change adaptation planning into all plans, strategies and policies prepared by the Council. Provide training and guidance on sustainable urban drainage techniques |
| Incorporate climate-proofing of infrastructure into planning policy | Encourage cooperation between utility and service providers to ensure that their networks are resilient to the impacts of climate change |
| Increase the climate resilience of Limerick City and County Council building and housing stock where appropriate | Prepare an inventory of council housing. Assess climate resilience of current housing stock<br>Ensure that new builds are designed with climate change in mind. Consider a programme of retrofitting housing stock. Ensure that retrofits are carbon neutral where possible |
| Encourage the adoption of green solutions to climate change | Encourage the implementation of ecosystem- and catchment-based approaches to protect against the impacts of climate change. Prepare GI content for the development plan |

**Summarised from pp. 25–37 of the LCCCCAS (Limerick City and County Council, 2019).**

and gas networks, communications networks, health, biodiversity). This represents an opportunity to promote an integrated framework that recognises the built environment sector as a "key entry point" for climate adaptation, underpinned by the rigorous six-step process outlined in *Sectoral Planning Guidelines for Climate Change Adaptation* (DCCAE, 2018b). This potentially would provide a clearer framework for local authorities in addressing significant built environment adaptation challenges at the local level.

In relation to local adaptation strategies, the built environment inevitably comes into greater focus, with local strategies focused on place-based preparedness. The four local authority adaptation strategies examined in this chapter (including the DCCCAP) are notably different in format, length, level of detail and width of scope. Despite Sligo, Longford and Limerick all using the five-step process prescribed in the Local Authority Adaptation Strategy Guidelines, there is a perceptible difference in the specificity/generality of the adaptation actions provided in the strategies, with some being broad statements of intent and others referring to specific measures. Local authority adaptation strategies are also variable in the application of grey, green and soft adaptation measures, nature-based solutions or GI, with opportunities to improve practice, adopt better practices and identify areas for future development.

# 4 The Built Environment: Spatial Planning, Building Regulation and Building Control

## 4.1 Introduction

This chapter examines policy and regulation for the built environment relating to the spatial planning system, building regulation and building control to identify how climate change adaptation is addressed in current frameworks. After briefly introducing the Irish planning policy framework, we identify the role of the National Planning Framework (NPF) (DHPLG, 2018) in advancing climate change adaptation. To examine planning at the regional scale, we focus on a case study from the *Regional Spatial and Economic Strategy for the Southern Region* (RSES Southern Region; Southern Regional Assembly, 2020). At the local level, we selectively focus on the following three current local authority development plans to illustrate the content of local planning frameworks, which reflect contrasting development and spatial contexts, in addressing climate change adaptation: *Cork City Development Plan 2015–2021* (Cork City Council, 2015); *County Donegal Development Plan 2018–2024* (Donegal City Council, 2018); and *Laois County Development Plan 2017–2023* (Laois County Council, 2017). Finally, we examine the nature of the building regulation and building control system in Ireland.

## 4.2 Overview of the Irish Spatial Planning System

The original planning system was introduced in 1963, establishing at a local authority level land use regulatory instruments based on the formulation of land use development plans and discretionary development control. The current system has been largely shaped by the Local Government Planning and Development Act 2000 (as amended), which modernised the original system of planning in the face of rapid economic and physical development during the so-called Celtic Tiger era. The 2000 Act put in place a system that was based on the ethos of sustainable development (broadly conceived) and was more strategic in scope, covering national, regional and local levels (Grist, 2013). While the Act did not create a statutory national plan, it put in place a regional tier of planning that provided the implementation mechanism for the National Spatial Strategy, published in 2002 (DOELG, 2002). This national level of planning has now been replaced with the NPF (DHPLG, 2018). Critically, the new Office of the Planning Regulator, established in 2019, was mandated with ensuring the compliance of local and regional planning authorities with national planning policies, including the achievement of binding climate obligations. This oversight role comprises independent assessment of all local authority and regional assembly forward planning, including the zoning decisions of local authority members in local area and development plans. The key components of the three-tiered system now in operation in Ireland are summarised in Table 4.1, which shows the various levels and the key planning instruments therein. In the following sections, we review how planning policy at national, regional and local levels is addressing climate adaptation. We examine the relevant content of the NPF, using the RSES Southern Region as an example of regional-level spatial guidance, and select three local authority development plans to illustrate local planning policy.

### *4.2.1 Project Ireland 2040 – National Planning Framework*

The NPF (2018) is the state's second national framework for spatial planning, replacing the National Spatial Strategy (2002). Section 1.3 of the NPF outlines 10 national strategic outcomes, which if delivered will create "shared benefits" (DHPLG, 2018, p. 14) across the country. These include compact growth; enhanced regional accessibility; strengthened regional economies and communities; sustainable mobility; a strong economy supported by enterprise, innovation and skills; high-quality international connectivity; enhanced amenity and heritage; transition to a low-carbon and climate-resilient society; sustainable management of water, waste and other environmental resources; and access to high-quality childcare, education and health services. Among the stated intentions for making the vision a reality

**Table 4.1. The Irish planning system**

| Level | Organisation | Planning instruments |
|---|---|---|
| National | Minister for Housing, Local Government and Heritage (Department of Housing, Local Government and Heritage) | NPF: Project Ireland 2040 |
| | | National Spatial Strategy 2002–2020 |
| | | Ministerial planning guidelines (over 30 sets of guidelines) |
| | An Bord Pleanála – Planning Appeals Board | Planning appeals |
| | | Strategic infrastructure and strategic housing |
| | Office of the Planning Regulator | Independent assessment of all local authority and regional assembly forward planning, including the zoning decisions of local authority members in local area and development plans |
| Regional | Three Regional Assemblies (established on 1 January 2015; replaced the previous eight Regional Authorities and two Regional Assemblies) | Regional Spatial and Economic Strategies (adopted in 2019) |
| | | Metropolitan Area Strategic Plans (for five cities) |
| | | Regional planning guidelines |
| Local | Planning authorities (31 city or county councils) | City or county development plans |
| | | Local area plans |
| | | Development management |

are "developing a new region-focused strategy"; "using state lands for certain strategic purposes"; and "supporting this with strengthened, more environmentally focused planning at local level" (p. 11). This local focus will:

> … tackle Ireland's higher than average carbon-intensity per capita and enable a national transition to a competitive low carbon, climate resilient and environmentally sustainable economy by 2050, through harnessing our country's prodigious renewable energy potential. (p. 12)

Key environmental goals, including climate action, are outlined in Section 9 of the NPF. Key goals relate to resource efficiency and a transition to a low-carbon economy; protecting, conserving and enhancing natural capital; and creating a clean environment for a healthy society. On balance, there is greater focus on mitigation than adaptation in this section, with particular emphasis being given to the low-carbon economy and renewable energy transitions in an effort to drive carbon neutrality. While the section on climate action and planning (p. 119) of the NPF states its intention to align with the National Mitigation Plan (DCCAE, 2017) and NAF (DCCAE, 2018a), adaptation measures and examples are given limited attention; however, "grey" and "green" adaptation are very briefly described (DHPLG, 2018, p. 120) as follows:

- Grey adaptation typically involves technical or engineering-oriented responses to climatic impacts, such as the construction of sea walls in response to a sea level rise.
- Green adaptation seeks to use ecological properties to enhance the resilience of human and natural systems in the face of climate change, such as the creation of green spaces and parks to enable better management of urban microclimates.

However, adaptation measures can be identified under various other headings in the NPF. For example, core objectives relating to flood risk management include avoiding inappropriate development in areas at risk of flooding; avoiding new developments that increase flood risk elsewhere, including those that arise from surface run-off; ensuring effective management of residual risks for development permitted on floodplains; avoiding unnecessary restrictions on national, regional or local economic and social growth; and improving the understanding of flood risk and ensuring flood risk management in accordance with best practice. Moreover, Section 7 of the NPF, on "realising our island and marine potential", also recognises the importance of adaptation interventions. The NPF notes that, resulting from climate impacts,

"sea levels and patterns of accretion and erosion are key issues for planning and flood risk assessment, especially in managing the ongoing development of our cities and towns", and that adaptation responses considered might include barrages or other "technologies" to protect low-lying city centres (DHPLG, 2018, p. 103). The NPF also advances policies relating to "green infrastructure planning", which are aimed at "protecting and valuing our important and vulnerable habitats, landscapes, natural heritage and green spaces (DHPLG, 2018, p. 117). The NPF states that "nature and green infrastructure provide a range of uses, goods and services and make the best use of land, help manage competing demands and can complement other sectors" (DHPLG, 2018, p. 125). Green belts and green spaces in urban environments are acknowledged as useful for recreation, amenity and biodiversity, and contribute to quality of life and to sustainability. Green space as potential climate adaptive space is not explicitly mentioned; however, the GI approach advanced in the NPF presents a significant opportunity for mainstreaming green adaptation policies within the local authority planning process.

## 4.3 Regional Spatial and Economic Strategies: Case Study of the Southern Region

The NPF states that the Regional Assemblies will prepare strategies in accordance with the NPF's framework (p. 12), taking the high-level principles of the framework and applying them in more detail at the regional level (p. 134). These strategies form the regional tier in the hierarchy of Ireland's spatial planning and economic plans/strategies. The RSES Southern Region (Southern Regional Assembly, 2020) is briefly examined, with attention given to matters relating to adaptation and resilience-building in the built environment. The Southern Region holds one-third of the Irish population (1.6 million) and has three of Ireland's five cities, 15 towns with populations ranging from 5000 to 10,000 and 45 settlements with populations ranging from 1500 to 5000. The RSES describes the region as having a "strong urban structure" (p. 12). It includes Metropolitan Area Strategic Plans (MASPs) for Cork, Limerick–Shannon and Waterford.

While broad environmental issues are addressed explicitly in Chapter 5 of the RSES, the strategy highlights the importance of building a strong, resilient and sustainable region across its policies. For example, the RSES notes that there will be a requirement for up to 86,000 new homes in the region by 2026 and 125,000 new homes by 2031, and that there will be a requirement for upgrading and replacing older and poor-quality social housing stock (p. 32). Within this context, the strategy emphasises the need to increase housing supply through future-proofed means, such as avoiding development on land with flooding potential or incorporating GI elements and the need to future-proof and retrofit the existing built environment. Chapter 5, on the environment, sets out the strategy's key goals in relation to climate resilience. The RSES notes the widespread adverse observed and potential impacts of climate change, including coastal erosion, sea level rise, flooding and threats to biodiversity, critical infrastructure, water management, and human health and well-being (p. 131). Regional Planning Objective (RPO) 88 outlines the strategy's commitment to the implementation of the National Mitigation Plan (DCCAE, 2017) and the NAF (DCCAE, 2018a). Noting that it supports the measures outlined in the CAP, the RSES states that "supporting actions will focus on renewable energy, energy efficiency, sustainable transport, agriculture and forestry and climate resilience through flood defences" (p. 132). RPO 89, "building resilience to climate change" is broad in scope, aiming to support measures to build resilience to climate change throughout the region to address impact reduction, adaptive capacity, awareness-raising, providing for nature-based solutions and emergency planning. It is stated that development of the built environment will involve "changes to building regulations, smart metering and buildings, and new initiatives to support low carbon heating" (p. 133).

The RSES promotes an ecosystems services approach, recommending it for use by local authorities in the preparation of their development plans. This is applied across a range of environmental objectives, such as enhancing biodiversity or water quality, and it also provides a key framework for adapting to climate change risks (i.e. green adaptation), particularly in relation to flood risk management. An example is provided of how draining floodplains for

urban development or for intensive agriculture can have an impact on the natural buffering effect of the floodplain, leading to an increase in flood risk (p. 140). Inappropriate development in flood risk areas must be avoided in accordance with the *Planning System and Flood Risk Management Guidelines 2009* (OPW, 2009), and water management systems such as SUDSs and green roofs should be integrated (p. 141). Natural flood risk management can be employed in planning, relying upon one or a combination of the following (p. 142):

- water storage in wetlands and other man-made structures;
- reduction of surface run-off through increasing soil infiltration;
- slowing the passage of water through increased resistance to flow, e.g. planting on floodplains/ riverbanks.

RPO 124, "green infrastructure", includes the requirement that all development plans and local area plans should protect, enhance, provide and manage GI in an integrated and coherent manner, addressing the themes of biodiversity protection, water management and climate action (p. 147).

## 4.4 County and City Development Plans

The development plan is the principal policy document of a local authority, containing statutory objectives that will guide development during the period of the plan (Grist, 2019). City and county development plans must be consistent with the NPF and the appropriate RSES, with the recently established Office of the Planning Regulator mandated to monitor compliance. Three development plans have been selected for a brief overview of their inclusion of built environment adaptation for climate resilience: County Donegal Development Plan 2018–2024, County Laois Development Plan 2017–2023 and Cork City Development Plan 2015–2021. Sections of the plans examined are the core strategy/strategic objectives and policies relating to water services, flood prevention and housing.

### *4.4.1 County Donegal Development Plan 2018–2024*

The 10 key strategic objectives of the County Development Plan in the County Donegal Development Plan (DDP) do not make any reference to climate change, its impacts or mitigation or adaptation to impacts (Donegal County Council, 2018, pp. 8 and 9). In the section on core strategy, the National Mitigation Plan (DCCAE, 2017) is briefly mentioned. The word "adaptation", used in the context of climate impacts, occurs twice in the DDP. The key core strategy objective relating to climate action is outlined in Box 4.1; however, specific adaptation approaches are not elaborated on.

Regarding flooding, the DDP notes that flood risk is increased through building in places at risk of flooding, the reduction in the storage capacity of floodplains and the overuse of hard surfaces, which causes an increase in surface run-off. Predictions of increased frequency and severity of flood events as a result of climate change impacts are noted. The DDP states that:

> the planning process can play a significant positive role in managing flood risk by such actions as ensuring that: (1) vulnerable developments are not built in identified flood-prone locations; (2) developments do not reduce the natural storage capacity provided by floodplains, and (3) developments do not increase surface water run-off over and above natural rates. (p. 96)

Flooding objective 2 is to "adopt a sequential approach to flood risk management when assessing the

**Box 4.1. Core strategy objective 17 of the DDP**

It is an objective of the Council to promote sustainable development and transport strategies in urban and rural areas, including the promotion of measures to:

1. reduce energy demand in response to the likelihood of increases in energy and other costs as a result of long-term decline in non-renewable resources;
2. reduce anthropogenic GHG emissions; and
3. address the necessity of adaptation to climate change.

Source: Donegal County Council (2018), p. 27.

location for new development based on avoidance, substitution, justification, and mitigation of flood risk" (p. 99).

Marine resource coastal management objective 3 (p. 167) includes:

- avoiding new development in areas at risk from coastal flooding in line with the flooding policies of this plan;
- managing coastal change in a manner that accepts that coastal erosion/sea level rise is a natural and/or inevitable process and does not permit/provide coastal protection works in areas subject to significant long-term coastal erosion/change or sea level rise unless there is an overriding reason of public interest to do so (e.g. built-up urban areas), where it would damage the visual, scenic or environmental amenities of the area or where it would have a significant impact on natural coastal geomorphological processes and systems.

The "urban housing" section of the DDP does not make any reference to climate change, its impacts or mitigation of or adaptation to those impacts. There is one reference to "green infrastructure" in the chapter "Community culture and the Gaeltacht"; this reference is not in the context of adaptation/mitigation of climate change impacts.

#### *4.4.2 County Laois Development Plan 2017–2023*

A stated "mandatory requirement of the County Development Plan" is the "promotion of sustainable settlement and transportation strategies in urban and rural areas including the promotion of measures", which includes addressing "the necessity of adaptation to climate change … In particular, having regard to location, layout and design of new development" (Laois County Council, 2017, pp. 12 and 13). For example, strategic aim 13 in the County Laois Development Plan (LDP) is to:

> Ensure that development is promoted, supported or facilitated by the *Laois County Development Plan*, provides for climate change including for the increased risk of flooding and the promotion of renewable energy where possible. (Laois County Council, 2017, p. 22)

The section on water supply and waste water services in the LDP does not make any reference to climate change, its impacts or mitigation of or adaptation to those impacts. It acknowledges that surface and storm water run-off is a "major by-product of development in both urban and rural areas" and states that "The Council will require the application of SuDS in development proposals, for example through reducing the extent of hard surfacing, and using permeable pavements" (p. 122). A strategic flood risk assessment was prepared by the Council, dividing County Laois into flood zones, which will be reviewed and amended as necessary when CFRAM studies are available. The LDP states that, in making its zoning decisions and planning application decisions, the Council will rely on the best available flood risk data and will be mindful of the unpredictable nature of climate change (p. 123). Based on flood risk assessment, the LDP takes the "sequential approach" outlined in *Flood Risk Management: Guidelines for Planning Authorities* (DEHLG, 2009) to "ensure that new development is directed towards land that is at a low risk of flooding" (p. 124).

The LDP identifies that significant changes are required to address the necessity of adaptation to climate change and recognises that the Council is a key agent for change and raising awareness at the local level. The LDP has stated its policies as follows:

- CC1: support and facilitate the national objectives for climate adaptation and work with the EPA, the Eastern and Midland Regional Assembly and adjoining planning authorities in implementing future guidance for climate change-proofing of land use plan provisions as is flagged in the National Climate Change Adaptation Framework (DECLG, 2012);
- CC2: prepare a climate change adaptation plan following the adoption of the county development plan, in line with relevant government guidelines;
- CC3: integrate, as appropriate, the National Climate Change Adaptation Framework 2012 and any related guidelines that may arise during its implementation in the service areas of Laois County Council.

The LDP has a section on GI, which recognises the multifunctional benefits of a GI approach; however, no explicit goals are identified in relation to climate adaptation and GI. Nevertheless, an effective GI strategy is likely to deliver climate-related co-benefits.

Neither the section on housing policy nor the section on urban design in the LDP makes any reference to climate change, its impacts or mitigation of or adaptation to those impacts.

### 4.4.3 *Cork City Development Plan 2015–2021*

The *Cork City Development Plan* (CCDP) (Cork City Council, 2015) has seven "interconnected strategic goals". Goal 6 is to "Tackle climate change through reducing energy usage, reducing emissions, adapt[ing] to climate change and mitigate[ing] against flood risk". A key aim of the CCDP is to reduce emissions that lead to global warming through sustainable energy usage in transport and buildings. It also aims to mitigate the effects and adapt to the challenges of climate change, such as the increased risk of flooding, through the design, layout and location of appropriate land uses (Cork City Council, 2015, p. 15). Goal 7 of the CCDP is to "Protect and expand the green infrastructure of the city". The focus here is on recreation, quality of life and biodiversity; indeed, the CCDP rarely uses the word "adaptation" in the context of climate impacts. However, many of its policies are clearly adaptive and resilience-building.

The CCDP notes that most development in the city uses "traditional" methods to manage rainwater using drainage systems, and the plan promotes the alternative approach of SUDSs (p. 169). The CCDP acknowledges that rising sea levels and increased frequency and severity of rainfall events will result from climate change, and that these impacts will significantly increase flood risk and coastal erosion. It notes that CFRAM "is central to the medium to long term strategy for the reduction and management of flood risk in Ireland" (p. 175).

The 2011 CFRAM Study for the River Lee (OPW, 2011), undertaken by the OPW, was the first pilot study for the CFRAM programme. Cork city was designated as an area requiring further assessment for reduction and management of flood risk by the OPW in 2013, and the Lower Lee Flood Relief Scheme is ongoing. Objective 12.14, flood risk management in development proposals, states that "Cork City Council will implement *The Planning System and Flood Risk Management: Guidelines for Planning Authorities 2009* in the preparation of land use plans and determining planning applications" (p. 177), adopting a precautionary approach through avoidance where possible of development in areas prone to flooding. Key policies are outlined in Table 4.2.

## 4.5 Building Control Regulation, Building Regulations and Standards

The Building Control Regulations 1997 (Government of Ireland, 1997a; Law Reform Commission, 2020; a collective citation, consolidated by the Law Reform Commission, including multiple amendments made between 2000 and 2020) apply to the construction of new buildings and to material alterations of and extensions to existing buildings. The Building Control Regulations provide for matters of administration and procedure that intend to secure compliance with the regulations. Responsibility for compliance with the Building Control Regulations lies with the property owner, the contractors and the designers of the building(s). It is the responsibility of the developer or property owner to appoint a builder who is competent to build in accordance with plans certified by a designer as compliant with the minimum standards in the regulations and who is competent to certify

**Table 4.2. Key policies from the CCDP**

| Objective | Policy |
|---|---|
| Objective 12.15: restrictions on development in flood risk areas | To restrict development in identified flood risk areas, floodplains in particular, except where the applicant satisfies the justification test as outlined in *The Planning System and Flood Risk Management: Guidelines for Planning Authorities 2009* (OPW, 2009) |
| Objective 12.16: floodplains | To protect, enhance and manage the city's floodplains, wetlands and coastal habitat areas that are subject to flooding as vital "green infrastructure" that provides space for storage and conveyance of floodwater, enabling flood risk to be more effectively managed and reducing the need to provide flood defence infrastructures |
| Objective 12.17: flood impact assessment | All significant developments impacting flood risk areas will be required to provide a flood impact assessment to accompany the planning application to identify potential loss of floodplain storage and proposals for the storage or attenuation (e.g. SUDSs) of run-off discharges (including foul drains) to ensure that development does not increase the flood risk in the relevant catchment |

that they have undertaken the works in accordance with those plans. The developer or property owner is also responsible for the appointment of a registered professional (a registered architect, building surveyor or chartered engineer) to act as assigned certifier on completion of the building works. A statutory code published by the DHLPG, *Code of Practice for Inspecting and Certifying Buildings and Works 2016* (DHPLG, 2016), provides guidance on the inspection and certification of building works to ensure compliance with the building regulations. In this code, S.1(2), provides that:

> Where works or a building to which the Building Control Regulations apply are inspected and certified in accordance with the guidance contained in this Code of Practice, this shall, *prima facie*, indicate compliance with the relevant requirements of the Building Control Regulations.

The Energy Performance of Buildings Directive (EPBD) (Directive 2002/91/EC) requires EU Member States to perform two actions: firstly, to set a minimum energy standard for construction of new-builds and, secondly, to form a methodology that will assess and document the performance of buildings in the context of energy use (EU, 2002). The EPBD was updated ("recast") in 2010 (Directive 2010/31/EU), providing a requirement that all new-builds achieve "nearly zero energy building" (NZEB) status by 2020, with public buildings required to meet this status by 2018 (EU, 2010). The 2002 EPBD was transposed into Irish legislation through an amendment to the Building Control Act 1990, and its provisions were incorporated into the Building Control Act 2007 (which amended the 1990 Act) and into the 2002 and 2010 EPBDs through the European Communities (Energy Performance of Buildings) Regulations 2006 (Statutory Instrument, S.I., No. 666/2006) (Government of Ireland, 2006) and the UK Energy Performance of Buildings (England and Wales) Regulations 2012 (S.I. No. 243/2012) (UK Government, 2012).

The Building Regulations 1997 (Government of Ireland, 1997b) (as amended) (as distinct from the Building Control Regulations 1997; Government of Ireland, 1997a) set out minimum standards for construction. The regulations are performance based, and they set out the statutory minimum building standards and performance requirements that must be achieved. The Building Control Regulations provide that all works or buildings to which the regulations apply must be designed and constructed in a manner compliant with the requirements detailed in the Second Schedule of the Regulations, which sets out the minimum performance requirements that a building must achieve. These are technical guidance documents, and consist of Parts A to M. All parts of the Building Control Regulations are relevant to adaptation (structure, fire, site preparation and resistance to moisture, access, waste water and drainage). Part L on conservation of fuel and energy is more relevant to mitigation. The most significant adaptation risks are structure, resistance to moisture and overheating. Therefore, the regulations should be considered as a holistic framework for addressing adaptation, including Part A (structure), Part B (fire), Part C (site preparation and resistance to moisture), Part D (materials and workmanship), Part F (ventilation) and Part H (drainage and waste water disposal structure). The Dwelling Energy Assessment Procedure (DEAP) is incorporated into Part L of the technical guidance document, and provides the methodology required by the EPBD to assess building performance.

The technical guidance documents of the Building Control Regulations reference approximately 800 standards by the National Standards Authority of Ireland (NSAI) or European (EN) Standards. Another regulatory aspect for consideration is that represented by the Structural Eurocodes. As outlined by Smyth (2012), the Structural Eurocodes are a suite of 10 harmonised mandated standards divided into 58 parts. They are voluntary codes, designed to provide a common framework for the structural design of buildings and civil engineering works and a means of demonstrating compliance with national regulations. They are also intended to eliminate technical obstacles to internal trade within the EU. Localised conditions are acknowledged in the form of nationally determined parameters (NDPs). NDPs are left open as a matter of national choice and are contained in national annexes, in which supplementary information may also be given (Smyth, 2012).

The Building Control Regulations are performance based using NSAI Standards and European Standards. Designs and constructed buildings should achieve the performance requirements using the design and construction approaches set out in these standards. The certification of completed

buildings to these standards is set out by the Building Control Regulations procedures. Irish building regulation standards are the minimum standards set for performance requirements, not necessarily for optimum performance. They are theoretical standards, representing an evaluation of presumed/standardised/ optimum occupation and use (Brophy and Hegarty, 2016). In the context of climate change, buildings constructed under the current Building Control Regulations may not have the required resilience for future climate regimes (Smyth, 2012). For example, Part D of the Building Control Regulations requires that materials are "proper materials", meaning materials that are fit for the use for which they are intended and for the conditions in which they are to be used. However, it may be useful to integrate future weather predictions into the application of these regulations. It is also critical that the building standards used for the design of structures and components capture changes in conditions of use as a result of climate change. This includes a review of the weather data and adaptation considerations that are contained in design standards, including NSAI, European and Structural Eurocode Standards. The aim should be to genuinely future-proof design standards.

### *4.5.1 Certification of compliance with building regulations*

Under the terms of the Building Control Regulations 1997 (Government of Ireland, 1997a) (as amended), registered professionals (e.g. professional architects, surveyors or engineers) are required to certify both the design of a proposed building and its status as compliant with the regulations on completion. These registered professionals are appointed by developers or individual property owners and are working for and answerable to them. They are not working on behalf of the building control authority within whose jurisdiction the construction occurs. These are independent registered professionals and thus are not employees of the developers. There are details of complaints and sanctions set out in the Building Control Act 2007 that can result in the removal of these professionals from the registers if they do not carry out their functions correctly. There is also traceability for these professionals, as they sign "statutory declarations" that completed buildings are in compliance with the Building Control Regulations.

Meijer and Visscher (2017) observe that quality control in the context of building construction is becoming more privatised in many European countries, and they state that "emphasis is put on the safety aspects of complex constructions. Far fewer demands are made on the quality of the builders" (p. 143). They note that some European countries make direct demands on the quality of builders. Ireland does not, despite the fact that builders are permitted to certify that a building is compliant with the Building Control Regulations. There is a registration system for Irish builders, namely the Construction Industry Register Ireland (CIRI). CIRI's website notes the Building Control Regulations' requirement for a property owner to appoint a competent builder "who will construct in accordance with the plans, specifications and Building Regulations, and who will sign the Certificate of Compliance on Completion", and it further states that "Builders included on CIRI are regarded as competent for projects consistent with their registration profile" (CIRI, n.d.). However, at this time, the register appears to function on a voluntary basis and there is no requirement that a builder must be assessed and registered as fit to perform the necessary statutory requirements of constructing in compliance with the plans and regulations and certifying this compliance. An individual owner who is constructing a single building or an extension to an existing dwelling is permitted to apply to "opt out" of certification, releasing them from the financial and administrative burden of the statutory process. Considered alongside England and Wales, France, Germany, the Netherlands, Norway and Sweden, Ireland is the only country that permits an application for a complete opt-out (Meijer and Visscher, 2017, p. 146). Proposed new CIRI legislation is currently at Bill stage (see Government of Ireland, 2022). The main objective of the proposed legislation is to develop and promote a culture of competence, good practice and compliance with the Building Control Regulations within the builder community of the construction sector.

### *4.5.2 Construction industry context*

Meijer and Visscher (2017) state:

> The current [building] quality control framework of a country is the result of (and embedded in) decades of traditions,

> developments in governmental structures, regulations and the enforcement practices of a specific country. It is a unique system which makes it impossible to transfer a (apparently effective) system from one country to another. Insight is needed into the specifics and maturity of a regulatory system of a country to be able to understand and learn from the best practices, policy approaches and instruments of that country. (p. 155)

In this context, Brophy and Hegarty (2016) note that the delivery of high-performance buildings relies on performance levels in the construction industry being high, and that building procurement is a complex procedure that may not be conducive to the development of collaborative relationships between professions. A significant proportion of Ireland's construction industry consists of small and medium-sized enterprises (SMEs), micro-enterprises and individual tradespeople who function as subcontractors – 95% of companies working within the construction industry in 2010 employed fewer than 10 employees (Brophy and Hegarty, 2016).

Disputes are regular occurrences within the construction sector, and plenty of evidence of this can be found in the literature, including lack of communication and cost/time overruns (Treacy and Spillane, 2016). Construction is an intricate process that happens within the contexts of multiple teams of workers, contractual arrangements that are frequently complex and elements of work that overlap temporally and spatially (Brophy and Hegarty, 2016). These occur within the context of pressures exerted by tight, interdependent time and budgetary constraints. Relationships between sectors of construction workers can as a result be adversarial rather than collegiate and collaborative. Treacy and Spillane (2016) found that in Ireland, during the last recession, "main contractor defects" signified the highest mean score of all factors that contributed to disputes within the construction industry examined in their quantitative study, with "sub-contractor defects" also scoring highly (p. 35). Changes in the construction sector, including increased subcontracting, casualisation of labour (e.g. reduction in the number of apprenticeships) and outsourcing of operations, also have the effect of blurring the chains of responsibility.

#### *4.5.3 Quality control and enforcement*

The Building Control Act 1990 designates each local authority as a building control authority, and as such the authority is authorised to ensure compliance with building regulations and to enforce building standards as necessary. Under the terms of the Building Control Regulations 1997 (Government of Ireland, 1997a) (as amended), the building control authority may inspect any building and/or all associated documentation/ certificates. Non-compliance with the regulations may lead to criminal prosecution, penalties, fines or imprisonment if found guilty.

Property is the primary capital asset of most households and of many businesses, and unless there exists a socially embedded culture of compliance with such laws then there will be times when such laws are disregarded, circumvented or "flexed"; as Calor and Alterman (2017) note, "Noncompliance with planning and building laws occurs in most countries" (p. 208). This is why statutory enforcement procedures are necessary; however, having provisions in place for enforcement procedures serves little benefit if such procedures are rarely or never used. Shapiro observes that "Enforcement is the obvious and significant but unspoken problem when it comes to realizing the benefits of up to date codes" (2016, p. 498).

Brophy and Hegarty (2016) state that building control authorities are under-resourced and that there is a general perception of inadequate levels of staffing (p. 14). The powers to enforce and prosecute those who do not build in accordance with the provisions in the Building Control Regulations are available in the Building Control Act 1990 (as amended). In 2016, there had been no reported incidents of a building control authority instigating a legal action against a party for non-compliance with energy efficiency standards under the terms of the Building Control Regulations (Brophy and Hegarty, 2016). Section 16 of the Building Control Act (as amended) provides that "Any person who contravenes (by act or omission) any requirement of this Act or of any order, regulation or notice under this Act shall be guilty of an offence." In 2018, no reported judgments were found that indicated that any person had been found liable under this provision (Ní Fhloinn, 2018).

Subject to terms in the Sale of Goods and Supply of Services Act 1980 (Government of Ireland, 1980), the

quality of the materials used and the workmanship employed in the construction of a dwelling are assured to the buyer of a building in a contract. Contract law is private law. In Ireland, homeowners who find that their dwelling is defective frequently cannot access a remedy in contract. Defects, as mentioned previously, often take time to become evident and any limitation period may have passed, and the contract itself may limit the builder's liability. Furthermore, if the homeowner is not the original purchaser of the house, then remedy in contract is not possible, as the homeowner is not party to the original contract. This leaves the only available remedy for the homeowner in tort law a claim of negligence (Ní Fhloinn, 2017), which is also private law. Such claims are stressful, time-consuming and costly. The Building Control Regulations are public law, and full compliance with them greatly reduces the incidence of defects in buildings. Incorporating resilience features into buildings is performed most cost-effectively when the building is being built, underscoring the importance of incorporating resilience features into building codes (Shapiro, 2016). The relevant legal tools are in place to improve and update building regulation, and enforcement tools are already in place to ensure compliance.

Evaluation and monitoring of buildings post construction to assess their performance is necessary to ensure that the building regulations result in the production of high-performance buildings, and also that buildings are being occupied in a manner that maximises their performance levels. Small-scale Irish research has revealed that there is limited correlation between the in-use energy performance of buildings and the fulfilment of energy regulation requirements (e.g. Brophy and Hegarty, 2016; Kinnane *et al*., 2017). Brophy and Hegarty (2016) note that a recent UK study indicated that over 60% of dwelling occupants kept their trickle vents permanently closed, 25% kept them open and only 1% used them actively on a daily basis to provide ventilation as needed (the remainder changing vents infrequently). Shapiro (2016) states that, despite buildings being designed and built for energy efficiency, there may be a "rebound effect", with occupants increasing their energy use and not making optimal use of the ventilation system in place. She also states that "changing building practices is by no means a panacea for eliminating or even reducing the climate impacts of the built environment – addressing the interrelationship between human behaviour and policy is also critical to success" (p. 492). This relates to soft adaptation measures. It is not sufficient for a building to have the potential to perform highly; high performance must be evident in its manner of use.

#### *4.5.4 Training and oversight*

Appropriate, adequate training and effective, transparent oversight are necessary for the provision of high-performance buildings: "the availability of appropriate information is critical to delivery. Providing guidance and technical construction information can result in greater levels of compliance, greater efficiencies and earlier adoption of new standards" (Brophy and Hegarty, 2016, p. 15). Shapiro (2016) suggests that "climate-related code training should be mandated for code officials, and expanded to architects, engineers, contractors and other construction professionals", noting that "contractor training is particularly neglected" (p. 504). She observes that, similar to Ireland, in many states in the USA there is no requirement for contractors to be licensed/registered, nor are there requirements for continual professional training for contractors. Shapiro (2016) further notes that "this training should include education in the energy codes and the resiliency aspects of building codes" (p. 504), and suggests that mandatory licensing/registration and continual professional training for all construction professionals would incentivise them to upskill.

## 4.6 Conclusion

The NAF states that "adaptation considerations in the planning and building processes" should be "deepened" to increase resilience in the built environment, including avoiding inappropriate development in vulnerable places, and that the location, the layout and the design should "accommodate predicted climate impacts, avoiding future costly and inefficient future redesign and redevelopment" (DCCAE, 2018a, p. 67). From the review of spatial planning policy from national to local levels, adaptation measures can be identified across the various plans. On balance, mitigation measures have greater emphasis in plans at national, regional and local levels, perhaps reflecting the scale of the challenge of transitioning to a zero-carbon society along with binding commitments to reduce carbon emissions. Moreover, planning practice, research

and education has a more established track record of engaging with debates around reduced energy use, particularly the relationship between urban form and car dependency. In this regard, adaptation is the Cinderella of planning for climate action. Adaptation measures tend to be dispersed throughout the plans assessed, with some policies included under headings on coastal management, flood risk management or GI.

There is perhaps potential here for spatial plans at various scales to contain a more coherent framework or set of policies for adaptation, adopting the NAF's grey, green and soft adaptation narrative. A more explicit set of policies would have the benefit of strengthening the adaptation pillar of climate actions within the planning policy framework, giving adaptation an equal priority with mitigation. An illustrative example relates to GI, which has increasingly been adopted by planning authorities in Ireland. While GI has clear co-benefits for climate adaptation, these are often implicit rather than clearly stated objectives of GI policies, which has potential to undermine the incorporation of climate adaptation-specific design interventions. For example, a new urban green space could be designed to provide recreation or to increase biodiversity gain, missing opportunities for the space to be designed to address providing shade in the summer by landscaping appropriately or as a means to capture surface run-off following a heavy precipitation event.

The primary focus of adaptation measures within spatial plans relates to flood risk management, particularly fluvial flooding, with a growing emphasis in planning policy on avoiding development in flood-prone areas. This approach should also be extended by assessing not only flooding vulnerability but also wider land use policies that influence potential upstream flood mitigation, such as the influence of rural land use patterns. Furthermore, given predictions of rising heavy precipitation events, there is considerable scope for enhancing planning policy to address the risk of localised flooding from surface run-off in urban areas. This also needs to be addressed in conjunction with wider planning goals related to compact residential development, which have the potential to lead to more intensive use of urban plots and a reduction in urban green space.

While flood risk mitigation represents an immediate and high-profile issue to address in planning policy, a wider range of adaptation measures should be given higher profile in spatial plans and development management (particularly in influencing design outcomes). For example, single-aspect apartments have less scope for cross-ventilation, and west- and south-facing single-aspect apartments are more at risk of overheating from solar gain, which could be mitigated by enhanced apartment design guidance to ensure dual-aspect apartment design. Another example relates to the design of public and private open or green spaces, which should incorporate measures to increase shade and measures to address the needs of vulnerable groups in warmer summers, such as more seating in public spaces for older citizens to rest in shaded areas or shaded areas (through natural landscaping) in play parks. In this context, the Urban Design Manual (DHLGH, 2009) should be updated to include good practice design guidance in relation to a wide range of climate adaptation design interventions and mainstreaming adaptation within environmental assessment methodologies.

In relation to building design, a study by Smyth (2012) concluded that the Building Control Regulations are fit for purpose to facilitate adaptation and that they require little modification; however, the Building Control Regulations, technical guidance documents and codes and standards require review. There is scope to explore how the precautionary approach adopted in the NAF is incorporated into standards. For example, the NAF states that consideration must be given to how national building standards "can support or impede climate adaptation measures" (DCCAE, 2018a, p. 68). Buildings are designed to NSAI and industry standards (e.g. Eurocodes and CIBSE). It is important that these standards are based on weather sets that take account of future changes in weather such as wind loading, rain intensity, freeze–thaw cycles, solar gains and snow loading. The standards set out in the Building Control Regulations are "minimum" standards. Are these current minimum standards sufficient for forward-thinking climate adaptation? What would "optimum" standards look like? Are the current regulations sufficient to ensure that climate adaptation and mitigation are built in during construction to a degree that accounts for predicted climate change impacts? A second issue relates to how any new measures would be monitored to ensure correct implementation during construction, which relates to capacity, training and upskilling in relation to adaptation design.

# 5 Barriers, Opportunities and Pathways

## 5.1 Introduction

The findings presented and discussed in this chapter are from two sources. Firstly, customised online surveys were undertaken targeting the following stakeholders: elected members of local authorities, public sector planners, and architects and engineers from both the public and private sectors. The survey design was informed by initial discussions with planners, engineers and architects from both the public and private sectors, including those from professional organisations, and feedback on the pilot surveys prior to their launch. Surveys were circulated with the assistance of professional institutes and the climate change spokespeople for all major political parties. Requests to participate in surveys were also sent via email directly to independent county councillors and local authority planners, architects and engineers. The number of completed surveys is outlined in Table 5.1. The survey of local authority elected members represents a country-wide sample and a broad spectrum of political affiliations.

Secondly, the chapter draws on insights gained through semi-structured qualitative interviews with 27 key informants, conducted during April and May 2021. The potential participants were selected to represent the following professions working in local authorities: planning, architecture, engineering (civil and building services), environmental/ecological scientists and landscape architecture. Participants also included those working in the areas of heritage and conservation. Participants from local authorities were mainly working at a senior level. Participants with past or present links to a CARO and/or with known association with or knowledge of the production of a local authority's climate adaptation strategy were also selected, as they overlapped with the categories of professions listed above. Three professionals working in private practice (a planner, a landscape architect and an engineer) were selected on account of their involvement with climate action. Seven county councillors were selected, of whom four overlapped with one of the professions listed above. Interviews were conducted using Zoom between April and June 2021. The interviews ranged in length from 42 minutes to 2 hours and 15 minutes and are fully anonymised.

**Table 5.1. Returned completed surveys**

| Survey participants | Completed |
|---|---|
| Local authority elected members | 92 |
| Planners | 40 |
| Architects | 51 |
| Engineers | 45 |
| **Total** | **228** |

## 5.2 Prioritising Adaptation

County councillors were asked to "click all statements that you agree with, even if they seem contradictory". The elected members of local authorities surveyed agreed that human activity is the cause of climate change, to the greatest degree of certainty possible (62%) and/or that it is very likely (37%). In addition, 58% selected "climate change impacts are a threat to human life and/or well-being, but there are other threats which are equally/more serious"; 52% selected "climate change impacts are currently the most serious global threat to human life and/or well-being"; and 55.5% selected "the threats to human health and well-being from climate change impacts are not being taken seriously enough". In this context, 67.8% of councillors stated that we need transformational action, right now, to address climate change and its impacts, and 77% stated that we need to take action, but cannot disregard the livelihoods and well-being of people in the process. Notably, in the context of adaptation, 23% of councillors stated that they were worried that the progression of climate change is already locked in to an upward trajectory (see Figure 5.1).

Planners, engineers and architects surveyed generally indicated that they, as individuals, believe that they are more conscious/considerate of climate adaptation than the organisations they work for. For example, public sector planners were asked "In your opinion, what level of priority should be given to climate change adaptation in planning decision-making?" and "In your opinion, what level of priority do you think climate change adaptation is given relative to other planning

| Value | Percent |
|---|---|
| We need to take action, but we can't disregard the livelihoods and well-being of people in the process | 77.0% |
| We need transformational action, right now, to address climate change and its impacts | 67.8% |
| We need to take action, but we can't disregard the costs of action | 35.6% |
| I'm worried that the progression of climate change is already locked in on an upward trajectory, that it has already gone too far to reverse its effects | 23.0% |
| We can't sacrifice our ways of life in the name of climate change action | 6.9% |
| We can't take actions that will threaten our quality of life when we don't have sufficient evidence to prove without doubt that the actions will work | 5.7% |
| No opinion | 2.3% |

**Figure 5.1. County councillors' perceptions about taking climate change action.**

concerns in decision-making in your organisation?" County councillors were asked a similar question. As indicated in Figure 5.2, planners (85% of respondents were local authority planners and 15% were regional-/national-level planners) and county councillors surveyed indicated that generally their organisation attributes a lower priority to climate change adaptation in planning decision-making than they personally consider appropriate (Figure 5.3). Only 28% of planners surveyed agreed that adapting to climate

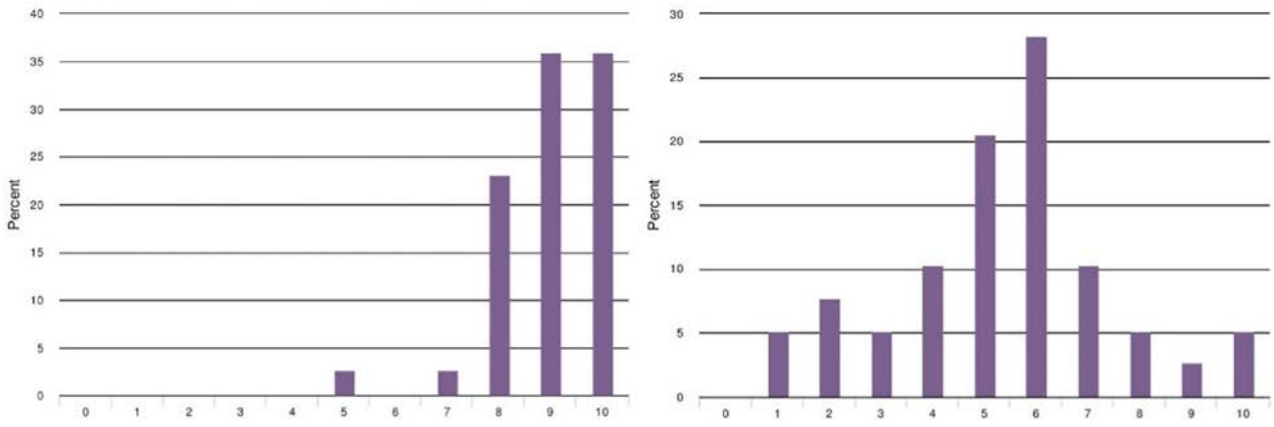


**Figure 5.2. Planners. Left: "In your opinion (on a scale of 1–10, with 1 representing lowest priority and 10 representing highest priority), what level of priority should be given to climate change adaptation in planning decision-making?" Right: "In your opinion, what level of priority do you think climate change adaptation is given relative to other planning concerns in decision-making in your organisation?"**

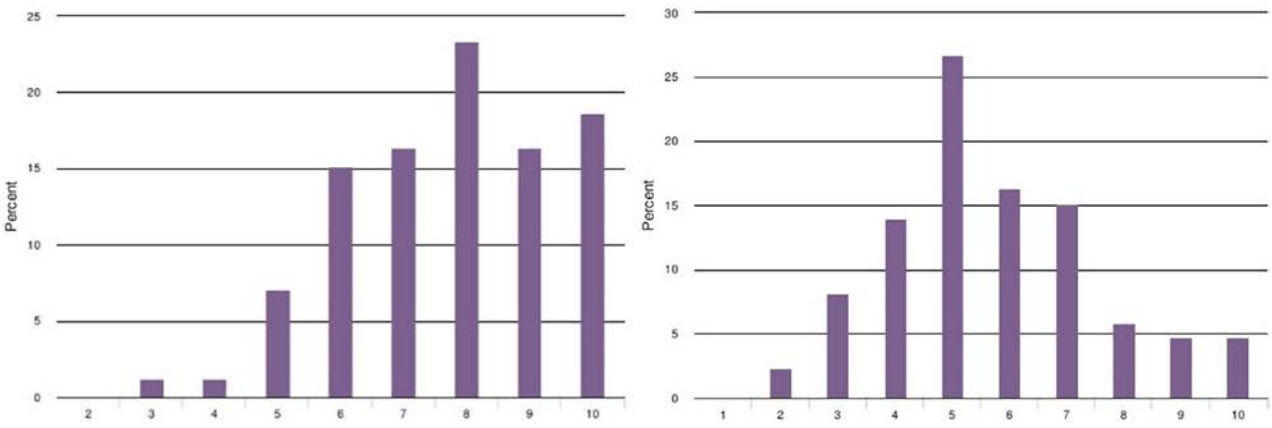


**Figure 5.3. County councillors. Left: "In your opinion (on a scale of 1–10, with 1 representing lowest priority and 10 representing highest priority), when planning decisions are made in your local authority, what level of priority should be given to adaptation to climate change impacts relative to other concerns?" Right: "When planning decisions are being made in your local authority, what level of priority do you think adaptation to climate change impacts is given relative to other concerns?"**

impacts was a high-priority consideration for their organisation. The engineers and architects surveyed generally indicated that they, as individuals, believe that they are more conscious/considerate of climate adaptation than the organisations they work for.

There was a widely held view among participants that adaptation and mitigation should be addressed together. Many participants have an apparently holistic view of climate action, which includes adaptation, mitigation, resilience, sustainability, biodiversity and energy efficiency. Some participants had an understanding of the terms "adaptation" and "resilience"; however, the term "adaptation" was taken by many participants to mean "climate action" in a general sense. Others stated that there is often confusion surrounding the meanings of mitigation and adaptation. This is illustrated in the following interview extracts:

> I personally would believe from looking at our adaptation and mitigation plans, I believe they kind of are one and the same … I suppose the adaptation is how do we live, how do we move forward with this new climate change, with temperatures rising and water levels falling and with whatever else is happening. I do not think you can look at them as two individual projects. I think if you are looking at one, I think you need to take a look at the other one at the same time because I think they are hand in glove, you do not have one without the other. (Participant 18)

> I think adaptation and mitigation are just different sides of the same coin. If you look at what needs to be done we need to do both and we need to do both in parallel, and I think maybe in recent months and years there seems to be much more of a focus on the mitigation side in terms of the shiny new tech solutions to climate action, like electric vehicles or solar panels or retrofitting, but I think we are at risk [of] perhaps underestimating what is needed in terms of the resilience piece and the adaptation piece in terms of how it is linked into planning and county and city development plans. (Participant 17)

> … possibly some people think adaptation is mitigation because these are very specific terms which maybe some people are not quite aware of. They have very particular definitions which I learnt when we were putting together the adaptation plans. Adaptation is more responding and mitigation is tackling the roots of the causes. Whereas maybe for some people adaptation might mean mitigation as well, in a very loose sense. So there is lots

> of this confusion going on. Like I said it's so complex, there is that confusion, there is an inability to see the big picture, there is omissions in thinking, there are all of these things going on. (Participant 23)

## 5.3 Findings Relating to Grey Adaptation

This section addresses incorporating grey adaptation measures into the design of the built environment. Both engineers and architects were asked in the online surveys to indicate the extent to which clients have requested the incorporation of grey adaptation measures within the design of a building or building system over the last 5 years. Notably, a clear majority of the engineers and architects surveyed had been requested to include on-site water retention measures in design briefs in the past 5 years (Figure 5.4); however, other adaptive measures were less common in briefs (see Figure 5.5 for architect respondents). More than 50% of architects surveyed had rarely or never been requested to include built shading in design briefs in the past 5 years.

Both engineers and architects surveyed were asked whether buildings that are certified as constructed in compliance with the regulations will perform excellently regarding ventilation and energy, with 4% of engineers and 3% of architects answering "yes". If the respondents did not answer "yes" to the above question, they were asked why this was the case; the responses are outlined in Figures 5.6 and 5.7. Key issues raised included how occupants use a building, placement of buildings relevant to other structures, uncertainty in the certification process and the need for higher standards.

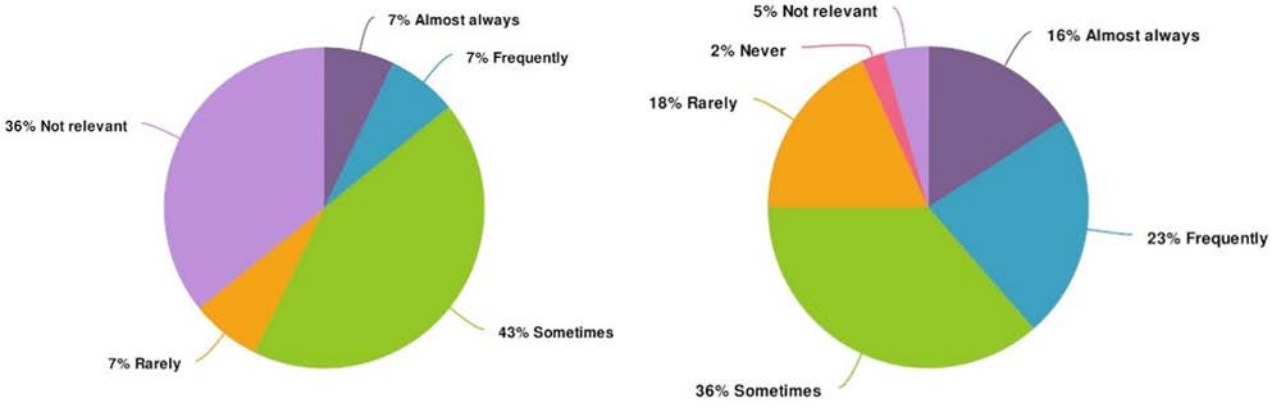


**Figure 5.4. "During the past 5 years, how often have the following requests been included in a design brief? On-site water retention measures (e.g. water recycling, swales)". Left: engineers. Right: architects.**

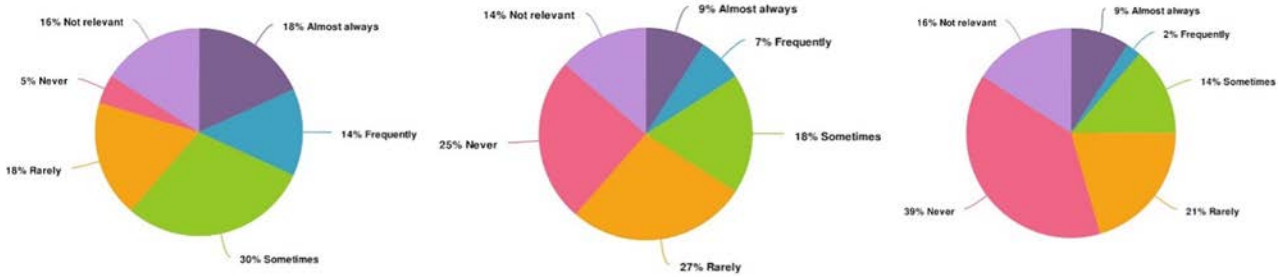


**Figure 5.5. Architects. "During the past 5 years, how often have the following requests been included in a design brief?" Left: "Flood avoidance measures (e.g. site/construction layout to avoid flooding)". Centre: "Flood resistance measures (e.g. design to prevent flood water entering a building and damaging fabric, such as flood resistant doors)". Right: "Flood resilience measures (e.g. so building fabric is not damaged or easily repairable if water enters a building, e.g. higher electrical outlets)".**

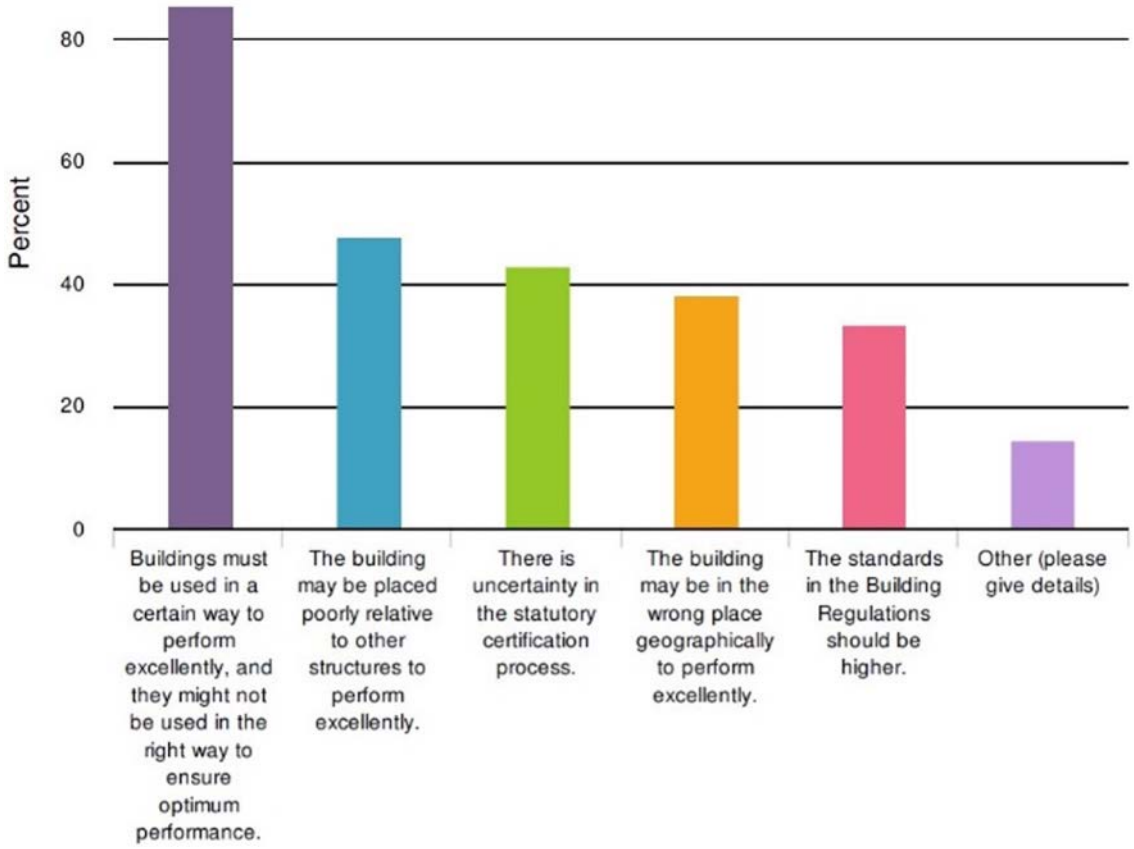


**Figure 5.6. Engineers. "Why do you think that if buildings are certified as having been constructed in full compliance with the Regulations, they will not necessarily perform excellently? (Tick all that apply)".**

## 5.4 Findings Relating to Green Adaptation

As discussed in Chapter 4, GI has emerged as a key planning approach to incorporate green adaptation into the built environment. While progress has been considerable, the findings below suggest that green adaptation is less widely adopted in terms of individual building design. For example, of the engineers surveyed, 29% had sometimes and 50% had rarely or never been requested to include a green roof. All (100%) reported that they had rarely or never been requested to include a green wall in a design brief in the past 5 years. Among the architects surveyed, 32.2% had frequently or almost always been requested to include a green roof while 19.3% had been asked to do so sometimes and 49.4% had rarely or never been asked to include a green roof (see Figure 5.8). The corresponding proportions of respondents who had been asked to include a green wall in a design brief in the past 5 years were 30%, 18% and 46%, respectively.

This low level of client adoption of GI at the building design scale was also raised within stakeholder interviews, as outlined below. These interview extracts indicate missed opportunities to incorporate GI features and also to promote the potential ancillary benefits of GI design. GI interventions were often seen as complementary to grey infrastructure, more cost-effective than, for example, investment in "hard" flood defences and with potential to reduce vulnerability in areas where grey adaptation was not financially feasible.

> But there seems to be a disconnect here in Ireland. The built environment profession remains largely ignorant of advanced, progressive policies and innovative practices in UGI [urban GI]. Take the specific area of green roofs and living roofs. Ireland is a laggard, we have been very slow in using them. They could be used to adapt existing buildings to climate change, and incorporated in the design of new buildings. (Participant 7)

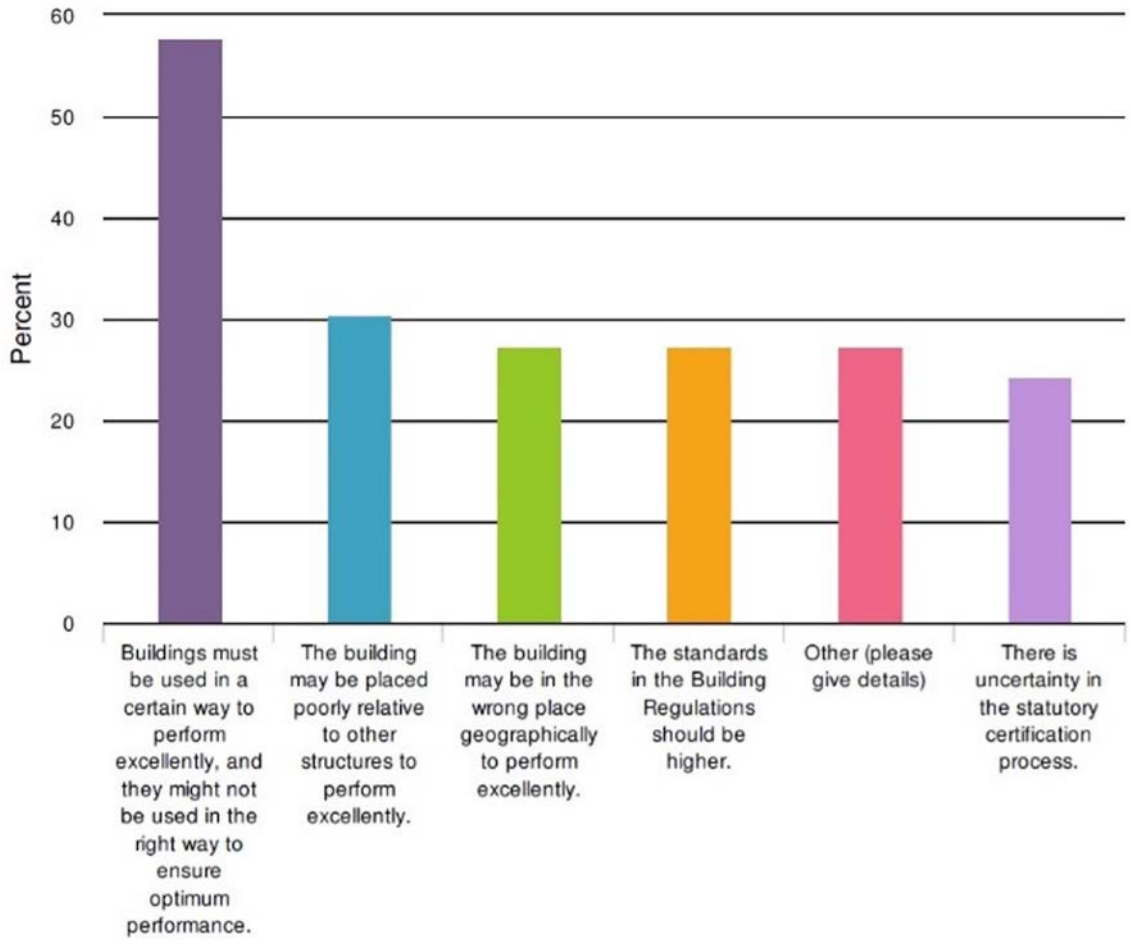


**Figure 5.7. Architects. "Why do you think that if buildings are certified as having been constructed in full compliance with the Regulations, they won't necessarily perform excellently? (Tick all that apply)".**

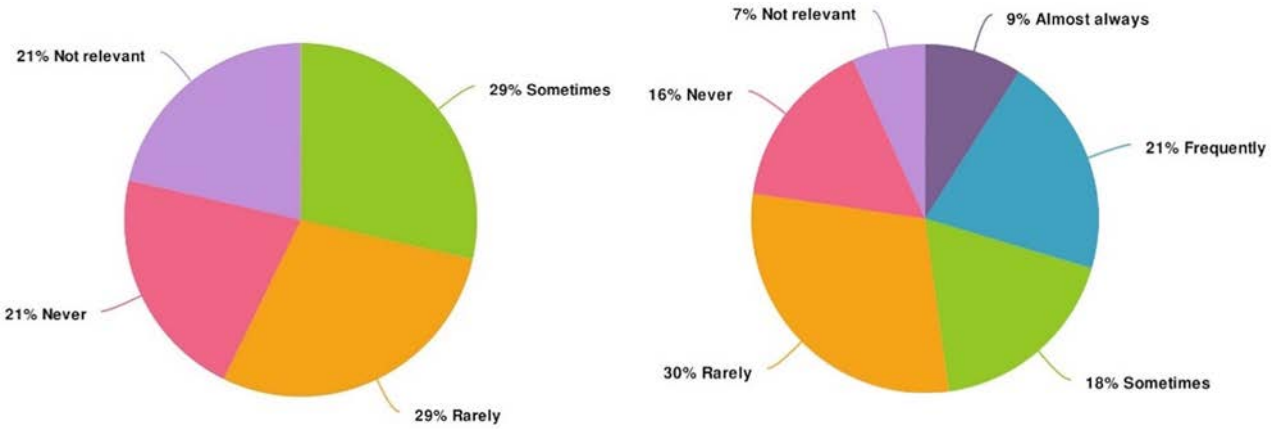


**Figure 5.8. "During the past 5 years, how often have the following requests been included in a design brief? Green roofs". Left: engineers. Right: architects.**

> Like the measures needed to make housing developments more resilient, adaptation to climate change is more than just the building construction itself. It's things like rain gardens, green roofs, green walls, sustainable urban drainage to capture that rainfall in housing estates and roads and make sure it does not flood the houses and the drainage network. (Participant 17)

> … because the other thing we are looking at in terms of adaptation … somebody was going over nature-based solutions and SUDSs, but the SUDSs also serve a purpose; those green corridors are for biodiversity so, whether its foxes, hedgehogs, frogs, or newts, they are able to move from different habitats so that they can genetically mix, and people do not know that. (Participant 16)

## 5.5 Findings Relating to Soft Adaptation

Two key issues were raised by survey respondents and interviewees in relation to soft adaptation issues: (1) the interaction between building design and occupant behaviour and (2) potential gaps between design and actual performance. As highlighted above, when asked why they thought that if buildings are certified as having been constructed in full compliance with the regulations they might not necessarily perform excellently, surveyed engineers and architects selected the option that buildings must be used in a certain way to perform excellently and that they might not be used in the right way to ensure maximum performance (engineers, 86%; architects, 58%). This is related to individual human behaviour. Interviewees discussed failures of grey adaptive measures for "soft" reasons, which can result in grey adaptation being maladaptive.

> I think this is also where Part F and ventilation is critical because if people may shut the vents in the walls because they perceive there is a draft coming in and then that just means it does not work any more, or if you have more sophisticated say mechanical systems or something like that, people perceive that that is an energy drain and they want to turn it off or turn it down and then that creates an unhealthy environment inside. (Participant 5)

> … if you make a building more fuel efficient it does not mean that the building owner is going to use less fuel. They might just like the idea of all the extra warmth. So buildings have to be used a certain way. If I retrofit a building and say I have improved its thermal efficiency but then I find that the tenant is using the exact same amount of fuel, it might be just that he likes hotter rooms. He has the heating on for a longer period every day than he would have. Because his budget for heating is x amount and he is going to spend x amount no matter. (Participant 11)

Entries in the "other" field relevant to soft adaptation reinforce the potential for maladaptation:

- "Part L and F are guides, not mandatory instruments. They are rarely installed correctly and even fewer are ever operated correctly." (engineer)
- "The compliant building may not be suitable for the real behaviour patterns of the occupants." (architect)
- "Gap between design and actual performance." (engineer)
- "Certification does not always find defects and regulations are the lowest bar to reach." (architect)
- "Design and workmanship of key details is often poor, leading to a performance gap between anticipated efficiency and the finished product." (architect)
- "The compliant building may not be suitable for the real behaviour patterns of the occupants." (architect)

The engineers and architects surveyed were asked whether they agreed that, if buildings are designed according to the minimum standards set in building regulations (technical guidance documents), then they are designed for climate adaptation. They were also asked whether buildings that are certified as constructed in compliance with the regulations will perform excellently with regard to ventilation and energy. Discounting the "don't know" and "not relevant" options, all of the engineers surveyed and 90% of the architects surveyed disagreed with the statement (Figure 5.9). In relation to Parts F and L of the Building Control Regulations, 38% of architect respondents suggested that these regulations represented minimum standards as opposed to optimum or forward-thinking standards.

The engineers and architects surveyed were asked whether they agree with the statement "There are adequate checks performed by local authority building control officers to ensure compliance with building regulations" (see Figure 5.10), with 57% of engineers

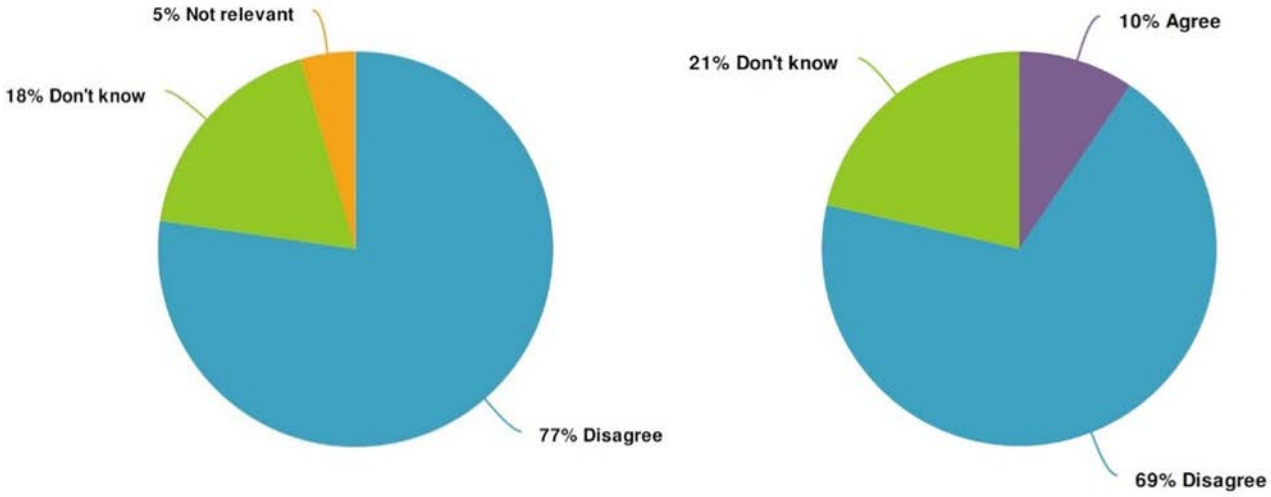


**Figure 5.9. "Please indicate whether you agree or disagree with the following statements, or indicate that they are not relevant for your area of work". Left: engineers – "If I design buildings according the minimum standards set in the regulations, then I am designing for climate adaptation." Right: architects – "If buildings are designed according to the minimum standards set in the regulations, then they are designed for climate adaptation."**

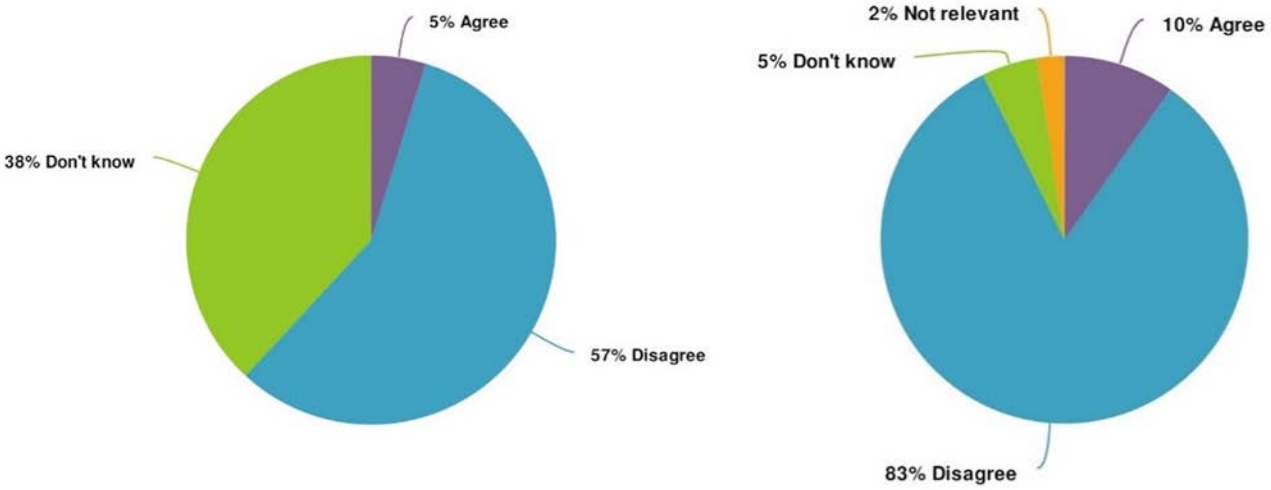


**Figure 5.10. "There are adequate checks performed by local authority building control officers to ensure compliance with building regulations." Left: engineers. Right: architects.**

and 83% of architects surveyed disagreeing with this statement. Moreover, 67% of planners and 77% of county councillors surveyed considered that there were insufficient staff in their local authority/ organisation to adequately attend to building control and enforcement, highlighting the absence of adequate resources.

## 5.6 Findings Relating to Barriers

All four surveys asked "What do you see as significant barriers to the practical implementation of built environment climate adaptation measures in Ireland?" Responses are summarised in Table 5.2.

Cost-related factors were viewed as key barriers to resilience-building in the built environment, related to the potential for (or perception of) higher costs of construction associated with higher standards for climate resilience, leading to a perceived reluctance among developers to implement higher standards. However, this perception was challenged in the interviews with key informants. For example, the following interviewee highlighted that higher design

**Table 5.2. Responses to the question "What do you see as significant barriers to the practical implementation of built environment climate adaptation measures in Ireland?"**

| Response | Planners (%) | Architects (%) | Engineers (%) | County councillors (%) |
|---|---|---|---|---|
| Higher expense of building to more resilient/climate-ready standards | 61.1 | 54.3 | 50.0 | 63.8 |
| Lack of client support/interest | Not applicable | 50.0 | 57.9 | Not applicable |
| Reluctance among developers to implement more climate-resilient standards | 66.7 | 47.8 | 50.0 | 57.5 |
| Lack of political support (national and/or local) | 83.3 | 45.7 | 52.6 | 36.3 |
| Lack of public support | 61.1 | Not applicable | Not applicable | 40.0 |
| Lack of oversight and enforcement of building regulations | Not answered | 43.5 | 50.0 | Not answered |
| Current certification process is inadequate to ensure certainty that building standards are being met | 36.1 | 30.4 | 34.2 | Not answered |
| Pressure to build in areas where flooding is possible | 36.1 | 26.1 | 26.3 | 31.3 |
| Lack of desire to densify existing urban areas | 55.6 | 28.3 | Not answered | 47.5 |
| Lack of knowledge among architects on how to design with increased focus on climate resilience | 44.4 | 54.3 | Not answered | Not answered |
| Insufficient resources for monitoring and review | 77.8 | Not answered | Not answered | Not answered |
| People in the Council prefer things to be done in the same way they have been done for years | Not answered | Not answered | Not answered | 31.3 |
| The public prefer things to be done in the same way they have been done for years | Not answered | Not answered | Not answered | 41.3 |

standards were not necessarily more expensive if incorporated early in the design process:

> I suppose if you think that you are going to build something that is better, [you might think] that it will cost more. Whereas in some cases those things can just be integrated into the design. So it shouldn't necessarily lead to extra costs. It may require more consultants at the design stage or input from different specialities. So there might be extras from that point of view. (Participant 5)

Furthermore, a range of interviewees highlighted that adaptive measures are more expensive, and can be prohibitively costly, when implemented retrospectively, while the costs of inaction are rarely addressed:

> We are not hearing much about the cost of not doing anything of course. The cost of clean ups after severe storms. The cost of dealing with flooding. The cost of fines if we do not meet our targets. We are hearing a lot less about that. (Participant 15)

A lack of political support, often related to interest group positions, was also given as a potential barrier to more ambitious adaptation measures, an issue particularly highlighted by planner respondents and in the key informant interviews:

> We all know how the political process works. It might make sense in terms of what needs to be done but you have got different parties with different agendas and you have got vested interests. You have got lobby groups, quite strong ones, in various sectors that can delay implementation of certain policies in the climate action area. (Participant 17)

The perception of a lack of political will was manifest in different ways; at times, interviewees expressed frustration with central government guidance, but on other occasions there appeared to be a generational divide *within* organisations in relation to how climate actions were prioritised, highlighted by both officers and elected representatives. Human capital, in this context, is critical in breaking down traditional ways of working (and a traditional engineering focus with local government), entrenched institutional silos and inertia, thus creating more sustainable paths.

However, perhaps a clearer manifestation of a lack of political support was in relation to resources for

implementing actions and monitoring/reviewing, as is evident from these interviews:

> There's an awful lot to be done and it needs to be resourced across the board. Local authorities have a role to play but local authorities need to be resourced. The CARO offices need to be resourced. It's hard to see where it's all going to come from. (Participant 12)

> Even where we have our current climate action plan, … I said you have to put an awful lot of actions in here, where is the chapter on human resources to activate them and do them, and that was not considered. If you look at our climate action plan there is nothing there, and I mean nothing. There is not a chapter or section on, where is the team, how is this going to be resourced? (Participant 7)

An absence of adequate resourcing within local authorities was a recurring theme in the interviews, specifically leading to an absence of leadership for climate adaptation at the local level. This is also against the backdrop of the continued impacts of sustained austerity in the local government sector since the financial crisis over a decade ago. Those local authority officers, particularly outside the larger city authorities, who were tasked with working on local adaptation actions were often taking on this role in addition to existing responsibilities. This is illustrated in the following interview extracts:

> It's unfair to the job I believe because it's not being given the respect it deserves and the attention it deserves by being diluted and handed out, but if we waited for funding for everything to be done, we would be very slow at getting results and getting things done. So I suppose it's something that you don't want to fall behind and you don't want to see your county fall behind other counties in getting the adaptation strategy up and getting the work done for the lack of somebody putting their hand up and saying "I will take this on for a while and see how it goes". (Participant 18)

> People have very busy workloads as it is and it's another thing to take on and it's not that people are resistant towards it but it's the typical "where are the resources to help me with this?" If there is an added task or an added plan to be delivered on. If there is added resource to be put to the housing stock, where is the funding for that going to come from? And what part of my work programme do I have to delay or drop in order to deliver this? (Participant 21)

Moreover, resourcing issues also affected the breadth of expertise available in the preparation of local adaptation strategies in relation to the built environment, with interviewees highlighting the need for specialist knowledge of, inter alia, building systems, impacts on cultural heritage, and ecosystem services through GI. For example:

> There is a need for nature-based solutions and green infrastructure expertise. So yes, local authorities have biodiversity officers and some of them have heritage officers but they may not have the expertise in terms of green rooms, green walls, sustainable urban drainage systems in urban areas, and there needs to be an expertise at local authority level that can look at those on a broader scale in terms of their benefits for biodiversity, for flooding, for air quality, for numerous natural and scientific as well as engineering benefits. (Participant 17)

> I would know that some local authorities do not have an architect, they have an engineer and they do the housing. (Participant 6)

In this context, there is potential for sharing resources or expertise across local authorities with the support of the CAROs.

A further issue raised in the interviews with key informants related to a concern about an implementation gap in relation to local authority adaptation plans. Developing a local adaptation strategy is a significant achievement and milestone; however, effective adaptation also requires the

translation of policy into action, requiring monitoring, the allocation of responsibilities and resources, and human resource capacity. This is critical in improving transparency and accountability within local adaptation.

> … I think sometimes there is a tendency in Ireland to confuse policy with strategy. Strategy is how you implement policy … Unless you, in your strategy, have key measurable actions, how that is going to be time-lined and accountable. I think it's just, there is a real danger that it's just wishful thinking and self-deception, insofar as the rhetoric is not met by realistic or authentic commitment to delivery. So, a "chasm" is created between rhetoric and reality. (Participant 7)

> … the devil is always in the detail and the proof is in the implementation. We have lots of examples of strategies and policies that are out there at a national level that have not been implemented. (Participant 17)

## 5.7 Findings Relating to Opportunities

In this section, we explore potential opportunities for enhancing the practice of adaptation. Four key issues were identified within the online surveys and key informant interviews: (1) knowledge, (2) communication, (3) building multidisciplinary problem-solving and (4) upskilling and training. Firstly, enhancing knowledge and the evidence base for decision-making was identified as a key priority by planners and local councillors (Table 5.3). For example, when asked "What could your organisation provide to better incorporate the impacts of climate change into planning policy or decisions?", key deficits identified related to knowledge on how to incorporate climate projections into planning decisions and granular information regarding expected climate change at local and regional scales. This echoes the discussion in Chapter 4 in relation to the need for granular weather and climate data in relation to building standards and design decision-making.

Secondly, the need for effective communication was also identified within survey responses. This related to demonstrating the value and importance of adaptation to the public and also informing the public of how best to adapt to climate change. In this context, better practice case studies to demonstrate adaptation approaches were identified as important in communicating with the public and key stakeholders, alongside providing more publicly accessible adaptation documents written for a wider public audience. In this context, using examples of poor planning decisions that increased vulnerability to climate change in the past is also of value. Communicating targets, milestones and achievements to the public is also critical to enhancing accountability and transparency. While technical guidance is critical, communicating effectively is essential to ensure public buy-in, with novel public engagement also offering potential to build public support:

> … number one I think we need the data and the research so that we know in our country what is most efficient. So there is a job of

**Table 5.3. Responses from planners and county councillors to the question "What could your organisation provide to better incorporate the impacts of climate change into planning policy or decisions? (Tick all that apply.)"**

| Response | Planners (%) | County councillors (%) |
|---|---|---|
| Knowledge of how to incorporate climate projections into planning decisions | 73.7 | 70.2 |
| Information about expected impacts of climate change at local/regional scales | 63.2 | 72.6 |
| Resources to conduct analysis/review of planning applications | 39.5 | N/A |
| More political willingness to take difficult decisions if/when required | 73.7 | 66.7 |
| More public engagement to foster support for difficult decisions | 63.2 | 70.2 |
| We do not need anything provided; enough is being done | N/A | 1.2 |
| We do not need anything provided; there is already too much being done | N/A | 1.2 |
| Do not know | N/A | 2.4 |

> work there to do, the research, the building guidelines should reflect our ambitions here, and it's a communications issue … there should be a communications plan to try and bring people along on this journey, which at the minute is too complicated. (Participant 26)

> People want more meaningful engagement. We have seen some of the moves in terms of virtual reality type engagement or virtual consultation rooms that has been forced to happen during Covid. I think there is something in those. I think the ability to visualise a development or a coastal flooding infrastructure 50 years into the future as to what [it] is going to look like in terms of what your village currently looks like. (Participant 17)

Thirdly, while resourcing and ownership of adaptation actions was raised as a potential barrier, the potential of multidisciplinary problem-solving and developing new ways of working was highlighted as a potential pathway towards more sustainable practices. This includes the need for collaboration, overcoming institutional silos and bringing different perspectives to bear in developing new adaptation pathways. This applies to local authority practices and also to design teams. This is highlighted in the following interview extracts:

> A lot of it is thinking about, is actually how the design team need to collaborate early … it's a very important part of being sustainable because if the design team meets early and thinks about how things should be phased and about the kind of materials [we are] going to use. Landscape [architects] need to understand what they are actually planting so it's good for biodiversity. So you know everybody is working with that same mindset, then it can make a big difference. So even the engineers designing so you don't need to have piling right down. There are so many ways to build that it's not so damaging to the environment. But that early team collaboration is very important. It's not like now the planner gets it, then the engineer gets it, then it's passed on. It cannot be like that. It has to be everyone, the design team meeting early. (Participant 4)

> … there can be a silo mentality … No one profession should have the arrogance to claim to have the monopoly of knowledge. The best solutions, as you know, are co-created … There can be a coming together. I think it requires a generosity of spirit and a degree of humility and to try and understand the other person and where they are coming from. I mean I think these things are not insurmountable. (Participant 7)

> … adaption and mitigation and future planning, it has to happen and identify potential risks 20 or 30 years down the road and taking action now and it's hugely important … And I think it has to be interagency and across the spectrum. So you have to have the likes of your local community groups involved and it has to be a partnership or it doesn't work. (Participant 19)

And, fourthly, the need for upskilling, training and continued professional development was identified across the online surveys and interviews. All surveys asked whether the respondent thought that upskilling/continuing professional development (CPD) (planners, architects and engineers) or gaining knowledge about climate change adaptation policy/actions (county councillors) would assist them in their work, which was overwhelmingly supported across all groups, as indicated in Figure 5.11.

While this suggests potential knowledge gaps, it is positive that the survey results indicate an appetite for acquiring new skills to address adaptation needs. While the CAROs have provided local authority climate action training, this appetite for new or additional skills suggests that professional stakeholders may benefit from training within specific professional networks or institutes, and reflects the significant private sector input into the production of the built environment that may not be covered by local authority-focused training. It may also reflect a more fundamental need for climate adaptation to be mainstreamed throughout the education of built environment professionals. This was echoed in the interviews with key informants,

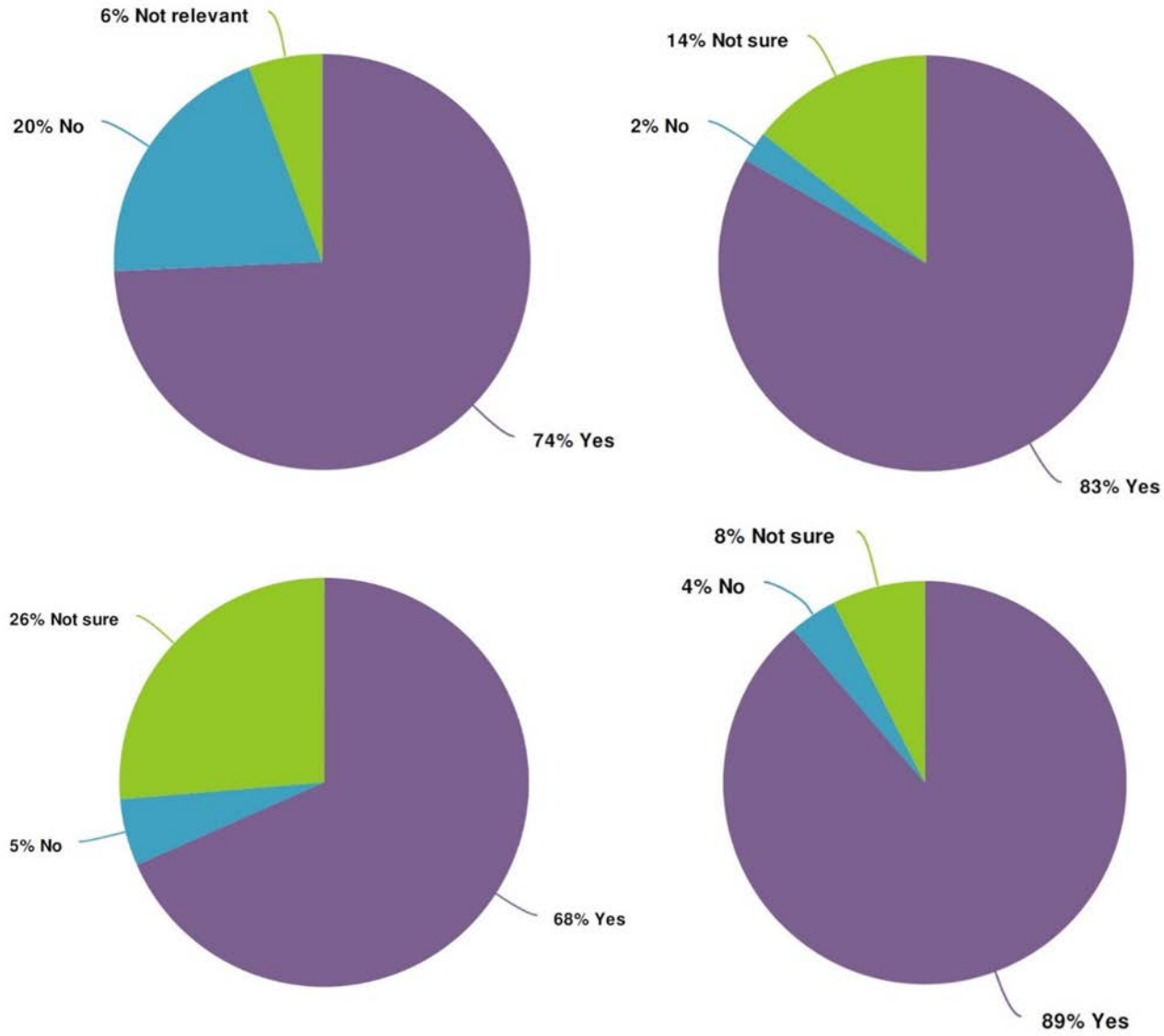


**Figure 5.11. Planners (top left), architects (top right) and engineers (bottom left): "Do you feel that CPD/ upskilling in climate change adaptation measures would assist you to perform your job better?" County councillors (bottom right): "Do you think that increased knowledge about climate change adaptation policy/actions would improve your work as a county councillor?"**

highlighting the importance of training, CPD and the role of the Office of the Planning Regulator in relation to providing training for local elected representatives. For example:

> We did some climate action training there for the climate action team with CARO and they were all talking about leadership and this and that and the other and one of the engineers said to me afterwards "I thought they would tell us what we should do, like how we should progress on Project A or fixing a road or doing whatever, positive ways that we can actually address the climate, and we got none of that." I know exactly where he was coming from but I put that down to the fact that we are just at such an early stage that we haven't really figured out exactly what we need to do; there was a lot of emphasis on this leadership, and when I was looking at who was there from the other counties there weren't too many from senior levels. There was a lot from lower down. (Participant 11)

> The Planning Regulator has been running training courses for County Councillors … I obviously haven't been at them but they seem to be well attended and it's kind of explaining these planning principles, like complex growth and sustainable urban drainage. And actually on the other side for the County Councillors, when we have been presenting things in Council some of them who have attended these courses will specifically [know] about the sustainable urban drainage systems that are being incorporated into the area … so there is kind of a good bit of work there going on the training side and educating them. (Participant 1)

> … if the standards are there they [developers] will build to the standards. I think there is probably the education; they might think they are doing a great job but might not fully appreciate or understand all of the elements. And in relation to the lack of knowledge for architects to build to more climate resilient standards, I guess we are in a rapidly changing world. Technology is developing quite quick. There are new materials. It's probably hard to keep up with the latest so does that mean that we need more CPD and more tailored CPD courses? (Participant 2)

## 5.8 Conclusion

This chapter examined the experiences and perceptions of key stakeholders in built environment adaptation, revealing a mixed picture in relation to progress to date and also identifying potential pathways to enhancing future practice. In relation to building design, there has been limited progress in including GI elements at the building scale and a tendency to design to meet minimum standards, which reflects perceptions of cost implications associated with higher standards. The gap between design and actual building performance was highlighted as a key concern. A key issue for planning, building control and local adaptation more generally is a perception that resources are inadequate to address the issue effectively, with a need for additional human capacity, new ways of working and additional prioritising of adaptation alongside mitigation. Enhanced knowledge, training, CPD and institutional capacity-building offer key paths towards more ambitious adaptation within Ireland's built environment sector.

# 6 Conclusions and Recommendations

## 6.1 Introduction

This final chapter aims to synthesise the key findings of the Built Environment (BE)-Resilient project, an EPA-funded desk study, and to develop a series of recommendations (R1–R28) to advance adaptation of the built environment in the context of climate change. It is not the intention in this chapter to provide a prescriptive set of rules for implementing built environment adaptation but rather to offer a suite of research-based principles to inform policymaking and design, to explore alternative policy instruments and to identify areas for further research. The various recommendations are considered under four headings: (1) mainstreaming adaptation in the built environment, (2) evidence and uncertainty in decision-making, (3) co-designing of adaptation interventions and (4) capacity-building requirements. The key messages summarised from the preceding chapters are outlined in Box 6.1.

## 6.2 Recommendations

### *6.2.1 Mainstreaming adaptation in the built environment*

The spatial planning system, from national to local levels, and including forward planning and development management, and building design (through specifications, standards and regulations) needs to place much greater emphasis on adaptation as an equal pillar of climate action alongside mitigation. Much progress has been made in advancing climate goals within built environment planning and design; however, adaptation action is less advanced and given considerably less attention in policy and practice than mitigation. Adaptation has been incremental and not yet transformative.

*BE-Resilient R1*

Planning is critical in shaping places and the built environment and in securing new development to minimise vulnerability and enhance place-based resilience consistent with reducing GHG emissions. The planning system is relevant for managing risks associated with flooding, heat (indoor and outdoor), air quality and building fabric. Climate adaptation should be mainstreamed within the full scope of planning policy and implementation.

*BE-Resilient R2*

Local adaptation strategies have been adopted by local authorities across Ireland, translating the NAF into local decision-making. As a key local authority statutory instrument, the county/city development plan

**Box 6.1. Key messages**

- Urgent action is needed to mainstream resilience and adaption into the built environment sector. This can be achieved through integrating soft, grey and green adaptive measures into the planning system, building standards and building design specifications at key decision points.
- Anticipatory adaptation measures for enhancing built environment resilience are cost-effective in the medium to long term, potentially opening up new market opportunities.
- Buildings have a long lifetime. Anticipatory adaptation measures avoid costly “lock-ins” within the built environment sector, e.g. building on floodplains, which are more costly to adapt when risks increase in the future.
- Built environment adaptation should emphasise “no regret” solutions, i.e. interventions worth pursuing regardless of the ultimate climate path.
- Climate change built environment adaptive measures generate important co-benefits for building more sustainable and healthier places, e.g. green adaptation interventions have the potential to increase biodiversity or have health and well-being benefits.

must be fully aligned and integrated and be used as a means of implementing local adaptation goals. This function should be monitored and reviewed.

*BE-Resilient R3*

The scope of climate impact evidence to inform regional and county/city development plans should be defined and monitored. Longer term time horizons in relation to mapping vulnerability to climate change should be included in plan-making. This will avoid creating lock-ins in relation to short- to medium-term growth strategies (see also section 6.2.2 below).

*BE-Resilient R4*

Much of the focus of planning policies in relation to climate adaptation relates to flood risk management, with flooding representing a highly visible and present risk to property. However, "slow-burn" processes of change have been given more limited attention within planning policy and practice. Planning policies should be informed by a wide range of potential impacts and provide comprehensive and coherent adaptive actions to address longer term processes of change. These may relate to increasing heat stress and how this relates to managing urban green space or incorporating GI in new developments or managing the risks associated with wind impacts through building orientation or the design of the public realm. New-builds could benefit from more consideration of wind impacts in advance of construction to reduce future risks.

*BE-Resilient R5*

Over the last decade, a GI approach has become increasingly embedded in Irish spatial planning practice, with GI thinking increasingly used by planning authorities to rethink green spaces as key environmental assets that deliver a range of ecosystem services. The benefits of this approach include an emphasis on multifunctionality (i.e. green spaces that deliver a range of benefits), a multiscalar framework (i.e. from micro-GI interventions, e.g. green roofs, to regional and national greenways that connect urban and rural places) and a focus on networks (i.e. from preserving specific sites to developing ecological networks, connected through corridors and linking elements). Green adaptation objectives should be explicit within planning policies for GI to ensure that adaptation opportunities are maximised in implementation. A GI approach offers significant potential for demonstrating the ancillary benefits derived from adaptation.

*BE-Resilient R6*

Reduce risks of surface water flooding through greater use of SUDSs. New residential development should aim for net zero water run-off through increased use of SUDSs and a portfolio of GI interventions (e.g. green roofs, rain gardens).

*BE-Resilient R7*

While the focus of this report has been the built environment, there is a need to develop an integrated approach towards managing the wider land use system to holistically address green adaptation measures that influence built environment outcomes. This includes the influence of upstream sustainable land management on managing fluvial flood risks or coastal wetlands as a measure to protect settlements.

*BE-Resilient R8*

Similar to the planning system, building specifications, control and regulation has been more focused on mitigation efforts, particularly in enhancing energy efficiency and performance. Building regulations strive to achieve a holistic assessment of building performance, including structural integrity, fire safety, ventilation and moisture resistance, informed by standards from the European Committee for Standardization (CEN) (e.g. European Standards and Structural Eurocodes). Building design is relevant for managing risks related to overheating, indoor air quality, damage to building fabric through more intense freeze–thaw cycles, household energy, flooding (property-level flood resilience), subsidence, wind damage and damp. Buildings comply and perform in line with minimum standards; however, given expected rates of construction (particularly house-building) over the next decade, there is a concern that, unless standards and regulations are climate-proofed, we risk locking in homes with risks to health from heat, cold and damp, and property damage due to water penetration, wind impacts and subsidence. Adaptative design will reduce future vulnerability over a building's lifespan.

*BE-Resilient R9*

Improved building regulations and building design should consider overheating among aspects of building safety to reduce risks in new and existing homes (through retrofitting). Decarbonisation strategies for housing would also benefit from being combined with actions to avoid overheating in order to avoid maladaptation. Energy efficiency measures (e.g. insulation) can make buildings more airtight, with consequences for overheating, moisture and indoor air quality. By considering decarbonisation and adaptation together in an integrated approach, there is greater potential to reduce overall emissions (e.g. avoiding maladaptive use of air conditioning), reduce energy costs and improve indoor air quality and comfort. Buildings should be capable of enabling *adaptive comfort* among their occupants, that is, capable of adapting to changing climate conditions over the building's lifespan in line with predicted climate change. The climate data and adaptation considerations used in design standards for buildings should be reviewed through further research along with further assessment of the use and communication of adaptation design standards by designers.

*BE-Resilient R10*

Policymaking and design should integrate mitigation and adaptation actions and foster greater awareness of the interaction between mitigation and adaptation (e.g. potential conflicts or risks of maladaptation). Planning and construction should capture the potential synergies between mitigation and adaptation. For example, a key goal within the NPF is to promote compact urban growth, in part because of the potential of more compact settlements to reduce distances between home and workplace, to integrate land use and public transport more effectively, and to encourage walking and cycling, thus mitigating emissions from private cars. However, while addressing mitigation priorities, the shift to greater urban densities should also be cognisant of adaptation needs, particularly those associated with increased impermeable surfaces (and surface flooding risks), building orientation in relation to indoor solar gain and ventilation to reduce wind impact risks, and the use of GI interventions to address flood risks and overheating. In this context, not all vacant land within urban areas should be viewed as land awaiting development. Examining the potential of land to provide key ecosystem services, such as urban cooling or flood alleviation, and not simply in terms of "development" potential, is essential for effective land use management.

*BE-Resilient R11*

There are also opportunities for integrating adaptation measures into emerging concerns with planning and design in relation to future pandemic resilience, particularly from airborne viruses such as the causative agent of COVID-19. For example, this may relate to a greater emphasis on natural ventilation in buildings, recognition of the co-benefits of urban green spaces for both climate adaptation and health, or the importance of good design of the public realm as people adapt to outdoor hospitality, which includes natural shading (in relation to warmer summers) or shelter from wind (in relation to changing weather patterns).

*BE-Resilient R12*

A series of exemplar design guidelines for adaptation at the urban and building scales should be developed with a target audience of local authority officers, private sector developers, public infrastructure providers and built environment professionals (architects, planners, civil engineers, landscape architects). Previous guidance, such as the government's Best Practice Urban Design Manual (DHLGH, 2009), should be updated to mainstream adaptive design measures.

*BE-Resilient R13*

Built environment policies should focus on the whole of the built environment and not simply on new development. In other words, retrofitting neighbourhoods, central cities and individual buildings, protecting critical infrastructure and ensuring that the cultural built heritage is managed and safeguarded are critical components of the adaptation portfolio.

### *6.2.2 Evidence and uncertainty in decision-making*

Adaptation of the built environment requires a robust and geographically tailored evidence base to inform decisions, build political support and reduce

stakeholder opposition to resilience-building. An appropriate evidence base enables key stakeholders to co-design suitable interventions to mobilise knowledge into local solutions (see also section 6.3.3).

*BE-Resilient R14*

Develop future weather datasets for major cities to provide more granular evidence for decision-making and useable information on climate impacts that provide location-specific estimates of a wide range of potential impacts. For effective building design and control, this includes differences in, inter alia, external temperatures, diurnal range, wind speed and solar radiation, while mapping estimates of potential impacts will enable planners to integrate risks into local growth scenarios. This evidence should help ensure that dwellings are designed to be fit for purpose over a significant proportion of their life and are resilient to the future impacts of climate change.

*BE-Resilient R15*

In line with the NAF, uncertainty in future climate scenarios should strengthen the case for early investment in climate protection and resilience, which could help avoid locking in future exposure to climate risks. Planning and building design should embrace uncertainty and adopt the precautionary principle within adaptive management, and its incorporation into policy and building standards.

*BE-Resilient R16*

Further research is required to estimate the costs of inaction and the costs of adaptation, including the costs of taking action in the future in response to shocks or disruption to the system (post-event adaptation). Any studies of costs should also estimate the ancillary benefits from adaptation measures, such as the benefits of green adaptation on health from recreation or reduced local air pollution. Additional evidence of potential long-term savings will assist in building political and public support for adaptive actions.

*BE-Resilient R17*

Further research is required to assess the awareness, knowledge and responsibilities of key stakeholders in relation to climate adaptation. This includes developers/construction industry clients, built environment professionals, estate management companies, social housing providers and individual property owners, including in the public sector.

*BE-Resilient R18*

Building an appropriate evidence base for climate vulnerability and adaptation should also include social vulnerability alongside the vulnerability of places and built environment assets to emphasise the importance of just resilience. For example, older people are often more vulnerable to heat stress, requiring shaded areas and seating areas within the public realm. Less well-off households may be more vulnerable to rising home insurance costs, while renters may be disadvantaged by having less control over adaptive measures at home to assist property-level resilience.

*BE-Resilient R19*

Further research into building occupant behaviours would benefit adaptation strategies to address the dearth of information on how occupants operate existing buildings effectively or their potential adoption of building-level resilience measures (e.g. motivation, lack of knowledge, prohibitive costs, biases). Further research is recommended to assess the “performance gap” between design and performance in use. This suggests the need for a more holistic approach to understanding building performance beyond a focus solely on regulatory performance requirements.

### *6.2.3 Co-design of adaptation interventions*

While a substantial evidence base exists on risks and vulnerability to climate change impacts, translating knowledge into sustainable practices, behaviours and agreed design interventions represents a significant challenge. Mobilising scientific knowledge and industry knowledge, along with professional stakeholders, elected representatives and the public, has significant potential to develop tailored local solutions through developing innovative community engagement models that are sensitive to the aspirations of local communities.

*BE-Resilient R20*

Adaptation of the built environment should be underpinned by collaborative engagement with all stakeholders affected by climate change, to develop strategic cooperation across the full range of stakeholders, institutions, research and industry.

*BE-Resilient R21*

Various climate scenarios and vulnerability mapping should be included in "issues papers" prepared in advance of public consultation for statutory county/ city development plans. This is to inform public and transparent discussions on various growth options within the context of anticipated climate change risks, and how different growth scenarios may interact with climate impacts to increase risks and vulnerability, or potentially limit growth or development options.

*BE-Resilient R22*

There is scope to develop or test novel stakeholder methods to visualise change scenarios or build consensus around the co-production or co-design of adaptation actions. Given the complexity of climate action communication, innovative methods of engagement are required to break path-dependent trajectories and unlock suboptimal outcomes. For example, "serious games"[1] can be used as a method of cross-disciplinary problem-solving or local citizen assemblies could be deployed to replicate the success of the Irish Citizens' Assembly on Climate Change to address climate adaptation through deliberative arenas.

*BE-Resilient R23*

Local communities should be encouraged to participate in devising and implementing climate adaptation schemes, such as designing and managing GI interventions. For example, community land trusts in Scotland are engaged in owning and managing land-based environmental assets to deliver a range of ecosystem services, such as community-owned woodlands with sustainable land management practices to maximise water retention.

### *6.2.4 Capacity-building requirements*

A key deficit identified within the interviews with key informants related to a lack of resourcing, knowledge or appropriate training for embedding adaptation concerns within local authorities or public agencies responsible for built environment adaptation. These deficits often resulted in an implementation gap, between knowledge of what should be done and deliverable actions. Capacity-building measures include the following recommendations.

*BE-Resilient R24*

Institutional capacity-building is essential to design and implement adaptation solutions. Local authorities have experienced long-term funding constraints and staffing restrictions, while at the same time fulfilling existing and new functions (such as local adaptation). Climate action (both mitigation and adaptation) requires effective local leadership, new ways of working, building bridges across institutional silos, and resources for monitoring and enforcement. While CARO-led training has been impactful, improved knowledge should be aligned with resourcing.

*BE-Resilient R25*

Related to the above issue, local authorities (particularly outside the larger city councils) do not always have the in-house specialist knowledge for adaptation, which include architects, biodiversity/ heritage officers, landscape architects and planners with adaptation knowledge. The CAROs have enabled institutional capacity-building and should be further supported, while sharing specialist knowledge across local authority boundaries should be facilitated (e.g. through secondments, workplace shadowing, sharing of new appointments). Best practice guides or practice exemplars (perhaps prepared by the CAROs) would provide insights into practical pathways for adaptation that would support ongoing capacity-building.

1 See, for example, the EPA reports Scott *et al*. (2016b) on using serious games to co-design green infrastructure and Scott *et al*. (2016c) on "how to" guidance on managing co-design workshops.

*BE-Resilient R26*

A CPD "built environment and adaptation" programme for local authority officers, planners, architects, surveyors, engineers and landscape architects in association with third-level institutes and professional institutes should be developed and piloted. CARO capacity-building has focused on local authority leadership; however, built environment professionals working across the public and private sectors should have additional CPD training opportunities focused on existing professional networks and institutes.

*BE-Resilient R27*

Local elected representatives should also be supported in accessing information and training on adaptation, particularly in relation to one of their key statutory functions of adopting development plans. This could be incorporated into the successful work of the Office of the Planning Regulator in providing training for councillors on the operation and requirements of the planning system. This would potentially enhance knowledge and also build political support.

*BE-Resilient R28*

Irish third-level institutes' professional built environment programmes should develop and incorporate an understanding of climate adaptation as a fundamental area of competence, including understanding the evidence base, regulatory obligations, application and interdisciplinary working and problem-solving. Climate actions should be mainstreamed in built environment education, requiring additional leadership from professional institutes, such as the Engineers Ireland Sustainability Framework (2020–2023).

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# Abbreviations

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| **BAHP** | Built and Archaeological Heritage Climate Change Sectoral Adaptation Plan |
| **CAP** | Climate Action Plan |
| **CARO** | Climate Action Regional Office |
| **CCDP** | Cork City Development Plan |
| **CFRAM** | Catchment Flood Risk Assessment and Management |
| **CIRI** | Construction Industry Register Ireland |
| **CPD** | Continuing professional development |
| **DCCAE** | Department of Communication, Climate Action and Environment |
| **DCCCAP** | Dublin City Climate Change Action Plan |
| **DDP** | County Donegal Development Plan |
| **DHLPG** | Department of Housing, Planning and Local Government |
| **EEA** | European Environment Agency |
| **EN Standard** | European Standard |
| **EPA** | Environmental Protection Agency |
| **EPBD** | Energy Performance of Buildings Directive |
| **FRMP** | Flood Risk Management Climate Change Sectoral Adaptation Plan |
| **GHG** | Greenhouse gas |
| **GI** | Green infrastructure |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **LCCAS** | Longford Climate Change Adaptation Strategy |
| **LCCCCAS** | Limerick City and County Climate Change Adaptation Strategy 2019 |
| **LDP** | County Laois Development Plan |
| **NAF** | National Adaptation Framework |
| **NPF** | National Planning Framework |
| **NSAI** | National Standards Authority of Ireland |
| **OPW** | Office of Public Works |
| **RSES** | Regional Spatial and Economic Strategy |
| **S.I.** | Statutory Instrument |
| **SCCAS** | Sligo (Draft) Climate Change Adaptation Strategy 2019 |
| **SDG** | Sustainable Development Goal |
| **SUDS** | Sustainable urban drainage system |
| **UHI** | Urban heat island |
| **UN** | United Nations |
| **WQWSP** | Climate Change Sectoral Adaptation Plan for the Water Quality and Water Services Infrastructure Sectors |

**AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL**
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

## Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

**Rialú:** *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

**Eolas:** *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

**Tacaíocht:** *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

## Ár bhFreagrachtaí

### Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

### Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil
- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

### Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

### Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol
- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

### Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn
- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

### Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

### Measúnacht Straitéiseach Timpeallachta
- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

### Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

### Treoir, Faisnéis Inrochtana agus Oideachas
- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

### Múscailt Feasachta agus Athrú Iompraíochta
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

### Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil
Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:
- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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# Built Environment Climate Resilience and Adaptation

Authors: Mark Scott, Louise Burns, Mick Lennon and Oliver Kinnane

## Identifying Pressures

Climate change risks present a clear challenge for Ireland's built environment. It has the potential to cause enormous damage to housing, commercial property and critical infrastructure, imposing significant financial costs and posing risks to human health and wellbeing. At the urban scale, vulnerability to flooding (fluvial, pluvial and coastal), coastal erosion and heat stress will increase as a result of this anticipated climate change. At the building scale, building fabric is at increased risk because of increased precipitation (increased water penetration and indoor moisture content), subsidence (more variable water content in soil), more intense freeze–thaw cycles, increased risk of damage from wind and more stormy weather, including structural damage and increased weathering due to driving rain, and impacts on indoor air quality and thermal comfort. These risks are systemic, in that development patterns and decisions can compound and reinforce future risks, such as building on flood plains or increasing impermeable surface cover in cities.

## Informing Policy

Adaptation is the critical second pillar of climate action alongside mitigation. This needs an urgent whole-of-government and whole-of-society approach. In relation to the built environment, greater policy emphasis is currently given to mitigation measures than to adaptation. There is significant scope for increasing policy coherency towards adaptation through the planning system, building control, building regulation performance requirements, industry standards and building design specifications. A broader set of anticipated climate risks could be considered by integrating mitigation and adaptation actions (to avoid maladaptation).

There is good awareness among stakeholders of a portfolio of policy and design approaches to adaptation. However, a gap in policy implementation and barriers to holistic action still exist. In relation to building design, these barriers include a lack of client interest in green adaptation; a tendency to construct to minimum standards; a gap between building design and building performance; the behaviour of building occupants in relation to building performance; and monitoring and review. In relation to planning, barriers include a lack of adequate resourcing; institutional silos and/or inertia; and the absence of specialist knowledge.

## Developing Solutions

Key priorities include:

- *Mainstreaming adaptation in the built environment:* prioritising adaptation as the critical second pillar of climate action; focusing on the full range of climate change risks (not simply flooding); integrating built environment adaptation with the wider land use system; capturing mitigation and adaptation benefits through holistic approaches; and focusing on the whole built environment and not only new builds.
- *Evidence and uncertainty in decision-making:* adaptation of the built environment needs a robust and geographically tailored evidence base; there is a need for granular and useable information on climate impacts; uncertainty strengthens the case for early investment and points to adopting a precautionary approach; and further research is needed on costs, responsibilities of key stakeholders, behaviour of building occupants, and social vulnerability in relation to climate risks.
- *Co-designing of adaptation interventions:* including collaborative stakeholder engagement; inclusion of climate scenarios in statutory public consultations; and testing of novel public engagement methods.
- *Capacity-building requirements:* improving resourcing and institutional capacity; adopting new ways of working to avoid traditional siloed thinking; and continuing professional development.

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