Comhairle Cathrach
Bhaile Átha Cliath
Dublin City Council

codema
Dublin's Energy Agency

DUBLIN CITY COUNCIL

DRAFT CLIMATE CHANGE ACTION PLAN

2019-2024

This Draft Climate Change Action Plan has been prepared by the Dublin energy agency Codema, in partnership with the Environment Strategic Policy Committee and the Elected Members of Dublin City Council.

The Draft Action Plan was also prepared having regard to *A Strategy towards Climate Change Action Plans for the Dublin Local Authorities*, published in 2017.

Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA)
The Draft Climate Change Action Plan has been prepared in accordance with the requirements of the Planning and Development (Strategic Environmental Assessment) Regulations 2004 and Article 6 of the Habitats Directive 92/43/EEC. The SEA and AA process, carried out in tandem with the preparation of the Draft Climate Change Action Plan, have ensured full integration and consideration of environmental issues throughout the action plan preparation process. Through these assessment processes, a number of the actions have been recommended for mitigation, and will be incorporated into the final plan. Please see Chapter 8 of the SEA environmental report for information on these measures.

The SEA Environmental Report and Screening Statement in support of the AA and Natura Impact Report are available as separate documents, to be read in conjunction with this Climate Change Action Plan.

CONTENTS

FOREWORD

MESSAGE FROM LORD MAYOR NIAL RING

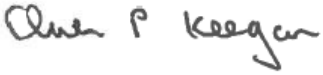
I welcome the publication of the Draft Climate Change Action Plan and the associated public consultation programme inviting submissions from all stakeholders, in advance of the finalisation of this Plan by Dublin City Council. The Draft Action Plan represents a concerted effort to diverge from a 'business as usual' scenario, will assist in meeting binding EU 2020 targets and mitigate against fines that could be imposed, if Ireland does not meet these challenging targets. Dublin is thriving as a premier European City - and its citizens are its best asset. The impacts of climate change are increasingly being felt at the local level, including recent heat wave and storm flooding events. Having regard to the sustainable development of Dublin into the future, policy and decision makers need to be committed to embedding climate change into spatial planning, infrastructure development and local authority functions and operations. A range of other measures are required to support this agenda, including ring-fencing appropriate funds for climate change in future national budgets. To explore these issues, I invite all citizens, businesses and other stakeholders to engage with this public consultation process and make submissions on the Draft Climate Change Action Plan. Dublin City Council is a signatory to the EU Covenant of Mayors for Climate & Energy. The preparation of this Climate Change Action Plan facilitates capacity building and shared knowledge between cities across Europe, in addressing both climate change mitigation and adaptation, at the local level. I wish to thank the Climate Change Sub-Committee of the Environment SPC, Chief Executive, Council staff and Codema, who worked in partnership on the preparation of this Action Plan and look forward to working with my colleagues on its finalisation and implementation.

MESSAGE FROM THE CHIEF EXECUTIVE OWEN KEEGAN

It is the mission of the *Corporate Plan 2015-2019* to make Dublin the 'best place in which to be, to live, to work, to do business and to enjoy'. As the City continues to experience growth and facilitates ongoing development across the housing, economic, social, cultural and other sectors, the Council is committed to safeguarding the environment and increasing the City's capacity to reduce greenhouse gas emissions and adapt to the impacts of climate change. This is a key consideration if the City is to continue to increase economic competitiveness and attract inward investment. Enhancing urban resilience to climate change is at the heart of the Draft Climate Change Action Plan, which has been prepared by Codema (Dublin's Energy Agency) in partnership with staff across all Council Departments.

The actions presented in this plan will guide the City as we prepare for, respond to, and adapt to the impacts of climate change and facilitate a reduction in greenhouse gas emissions. The delivery of these actions in the short, medium and long term will enable the Council to respond to energy targets to 2030 and beyond.

I welcome the establishment of the Dublin Metropolitan Climate Action Regional Office, which will work closely with Dublin City Council, Codema and the other Dublin Local Authorities in the implementation, monitoring and updating of the Climate Change Action Plan, into the future.



EXECUTIVE SUMMARY

For the first time, Dublin's four local authorities have joined together to develop Climate Change Action Plans as a collaborative response to the impact that climate change is having, and will continue to have, on the Dublin Region and its citizens. While each plan is unique to its functional area, they are unified in their approach to climate change adaptation and mitigation, and their commitment to lead by example in tackling this global issue.

This Climate Change Action Plan features a range of actions across five key areas - Energy and Buildings, Transport, Flood Resilience, Nature-Based Solutions and Resource Management - that collectively address the four targets of this plan:

- A 33% improvement in the Council's energy efficiency by 2020
- A 40% reduction in the Council's greenhouse gas emissions by 2030
- To make Dublin a climate resilient region, by reducing the impacts of future climate change-related events
- To actively engage and inform citizens on climate change

In order for Dublin City Council to achieve these targets, this Climate Change Action Plan sets out the current climate change impacts and greenhouse gas emission levels in the City, through the development of adaptation and mitigation baselines. It also examines the future impacts that climate change may have on the region and then sets out a first iteration of actions that will be used to reduce the source and effects of these impacts.

The adaptation baseline has identified that the effects of climate change are already impacting Dublin City at a significant rate and are very likely to increase in their frequency and intensity. Dublin Bay's average sea level appears to be rising faster than initially forecasted and has risen by twice the global average in the last 20 years. The number of days with heavy rainfall has also increased, and the amount of extreme flooding events in the capital has risen in the last 10 years. Dublin City has also experienced extreme temperatures, as witnessed recently in 2018, with Met Éireann issuing its first ever Status Red warning for snow in February, followed by one of the hottest summers on record during June and July. All these extreme weather events clearly highlight the need to reduce the impacts that climate change is having on the environment, the economy and the citizens of Dublin.

The mitigation baseline calculates the greenhouse gas emissions for the Council's own activities and also for the entire City (including a breakdown of the residential, transport and commercial sectors). It found that Dublin City Council produced just under 40,370 tonnes of CO_2 in 2017 and has reduced its emissions by 24% in the last 10 years. In addition, the Council has improved its energy efficiency by 29.8% and is currently on track to meet its 33% energy efficiency target by 2020.

The actions in this plan have been gathered to close the gap between the current baselines and the stated targets, and will be regularly updated and added to on the Dublin Climate Change platform (www.dublinclimatechange.ie). These actions have many co-benefits, such as improved health through cleaner air and active travel, a better environment through habitat protection, and a stronger economy from new markets and job opportunities.

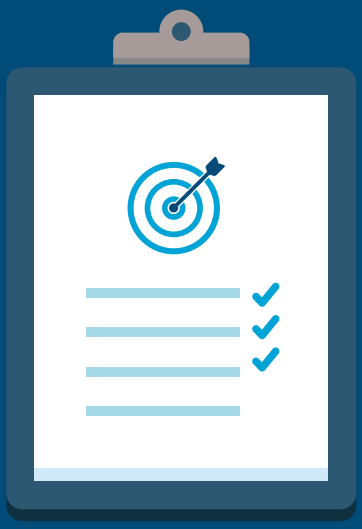
However, given that the Council's buildings, operations and social housing account for less than 5% of the total emissions in Dublin City, it highlights the need to tackle the remaining 95% of emissions produced city-wide. In recognising this challenge, Dublin City Council will work with key stakeholders to influence and support carbon reduction initiatives across the City's transport, commercial and residential sectors.

In addition, as public awareness is key to tackling both climate adaptation and mitigation, Dublin City Council commits through this plan to address the current knowledge-gap and will encourage citizens to act on climate change through a range of awareness and behavioural change actions.

This Climate Change Action Plan has been developed by the Dublin energy agency Codema on behalf of Dublin City Council, following an extensive process of research, policy analysis, one-to-one meetings and workshops with staff and regional working groups. It follows on from the publication of *A Strategy towards Climate Change Action Plans for the Dublin Local Authorities*, which was published in January 2017.

The actions in this plan will be continually monitored and updated by a dedicated climate action team working across all Council Departments. They will be assisted by the newly established Dublin Metropolitan Climate Action Regional Office, which will ensure that the overall plan is fully updated every five years to reflect latest policy, technology and climate-related impacts. The new office will work with Codema, as technical support and research partner, to ensure that the plans continue to be informed by international best practice and regional research institutions.

ABOUT THE PLAN



Dublin City Council's Climate Change Action Plan sets out how the Council will improve energy efficiency and reduce greenhouse gas emissions in its own buildings and operations, while making Dublin a more climate-resilient City with engaged and informed citizens. This will be achieved by a range of ongoing and planned actions in five key areas, which will be continuously monitored, evaluated and updated to 2030 and beyond.

KEY TARGETS

33%
improvement in the Council's **energy efficiency** by 2020

Make Dublin a **climate-resilient region** by reducing the impacts of future climate change-related events

40%
reduction in the Council's **greenhouse gas emissions** by 2030

GHG

Actively engage and **inform our citizens** on climate change

OVERVIEW OF DUBLIN CITY

MAIN RISK AREAS:

SEA LEVEL RISE

FLOODING

EXTREME WEATHER EVENTS such as storms, cold spells, heat waves

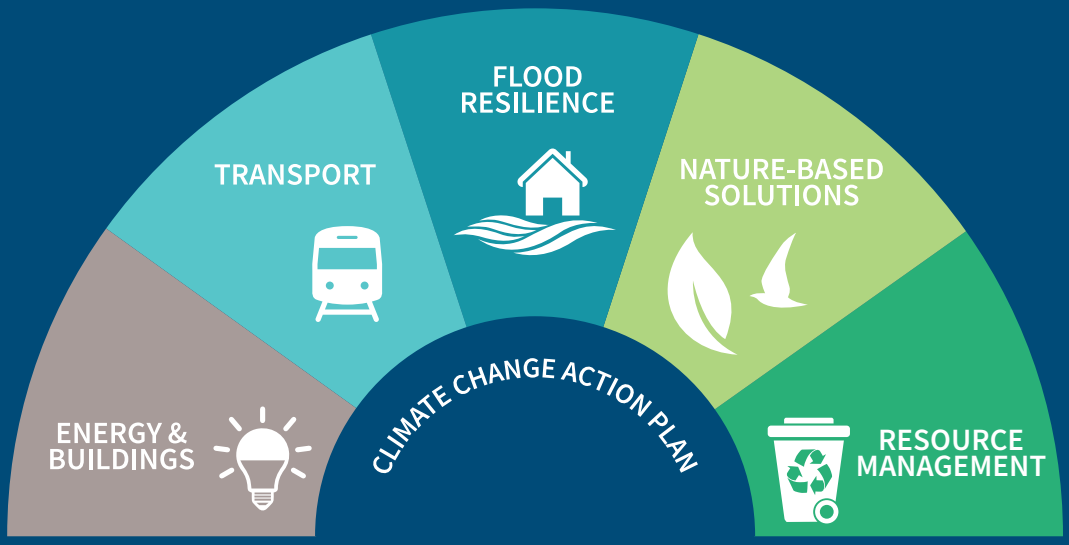
POPULATION
554,554

240,553
HOUSEHOLDS

52 km
COASTLINE

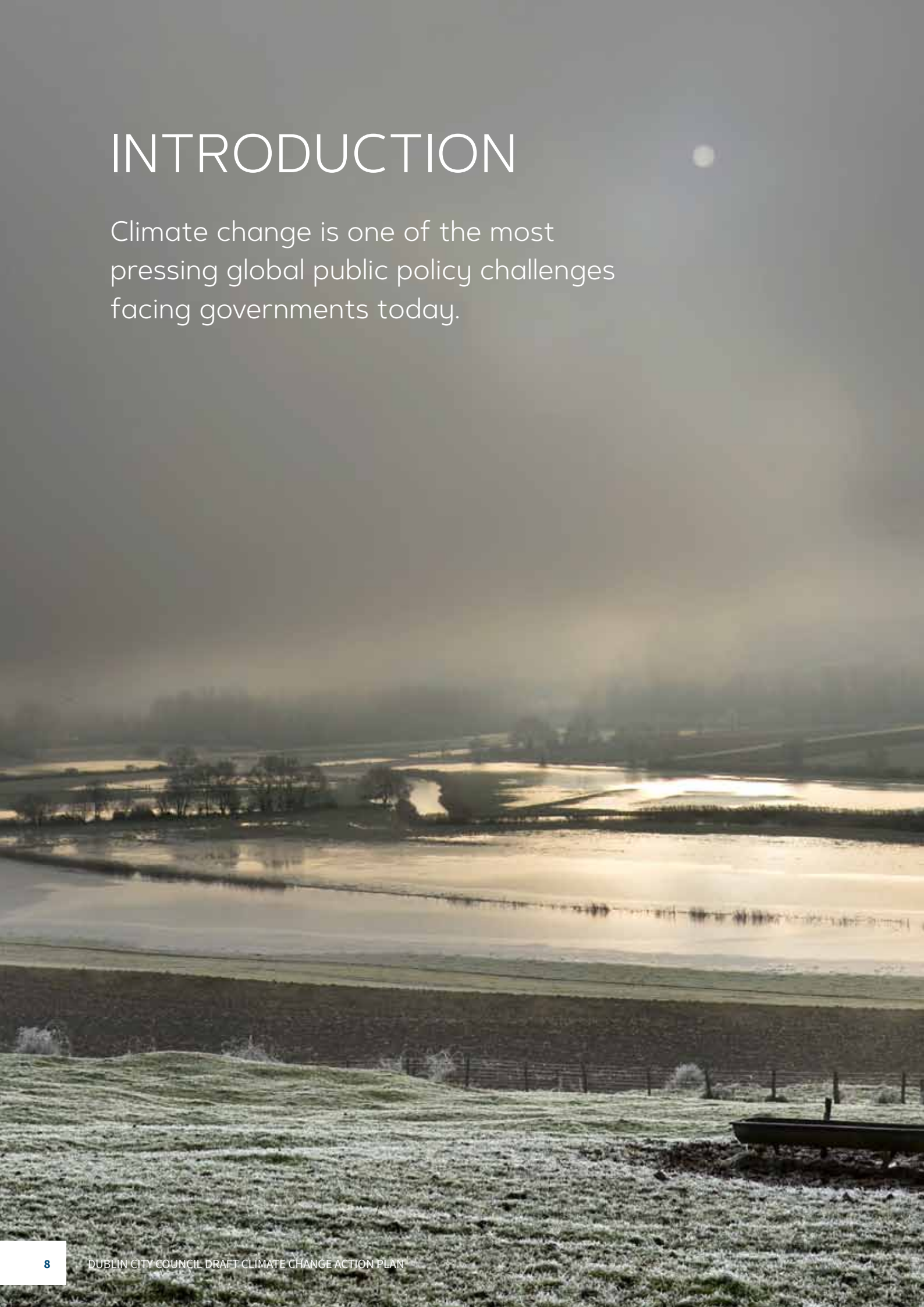
ACTION AREAS

The actions in this plan have been organised under the action areas shown below, reflecting Dublin City Council's remit.



INTRODUCTION

Climate change is one of the most pressing global public policy challenges facing governments today.



THE FOUR MAIN TARGETS OF THIS PLAN ARE:

Climate change is one of the most pressing global public policy challenges facing governments today. Its impacts are already having far-reaching economic, social and environmental consequences. International agreements, most recently the Conference of the Parties (COP) 21 Agreement in Paris, have been developed to unify national governments in a commitment to reduce the human causes of climate change.

The Irish Government has published the *Climate Action and Low Carbon Development Act 2015*[1], the *National Mitigation Plan*[2], the *National Adaptation Framework*[3], *Project Ireland 2040* (the *National Planning Framework*[4] and the *National Development Plan*). These set out how Ireland will achieve its international and European commitments, and transition Ireland to a low-carbon society. To provide local authorities with support in developing their Climate Change Action Plans (CCAPs), the Department of Communications, Climate Action and Environment (DCCAE)has developed the *Local Authority Adaptation Strategy Development Guidelines 2018*[5]. In addition, the government has established four Climate Action Regional Offices (CAROs), each led by a local authority.

The four Dublin Local Authorities (DLAs) - Dublin City Council, Dún Laoghaire-Rathdown County Council, Fingal County Council and South Dublin County Council - are developing their Climate Change Action Plans collaboratively through Codema, Dublin's Energy Agency. These plans are being developed on the initiative of the Councils' respective Strategic Policy Committees (SPCs).

Dublin City Council (DCC) is on track to meet the public sector target of a 33% improvement in energy efficiency by 2020; this is an average improvement in energy efficiency of approximately 3% per year in the Council's own buildings and operations. The DLAs are all signatories to the EU Covenant of Mayors for Climate and Energy initiative, which is a voluntary commitment by members to develop and implement Sustainable Energy and Climate Action Plans (SECAPs) and reduce their regions' greenhouse gases (GHGs) by 40% by 2030. DCC will apply this target to its own operations but will also influence a reduction in GHGs throughout the City, by leading by example and working with key stakeholders and decision-makers.

DCC will also help to make Dublin a climate-resilient region and protect its critical infrastructure by reducing the impacts of current and future climate change-related events by working in close collaboration with the other DLAs, the Dublin CARO, regional authorities and national bodies.

These commitments to reducing the causes and impacts of climate change need to be integrated into the decision making for planning, policies and operational processes within the local authority. This can be achieved by providing staff with the training and tools required to make informed choices.

Finally, as citizens are crucial for solutions to climate change, DCC will set out to actively inform and engage the public through a range of innovative programmes and partnerships and, where possible, facilitate bottom-up, community-led solutions.

THE FIVE KEY ACTION AREAS OF THIS PLAN

OPPORTUNITIES FOR MAKING DUBLIN A LOW-CARBON, CLIMATE-RESILIENT CITY

ECONOMIC

1. By adapting to climate change now, we can ensure that all future plans are climate-proofed and associated opportunities are maximised
2. By becoming climate leaders, we are attractive to foreign direct investment from companies with a green corporate agenda
3. By using local solutions to mitigate and adapt to climate change, we can upskill our workers and generate employment
4. By implementing innovative solutions, we can avail of climate-related EU grants and reduce future fines
5. By using indigenous, sustainable sources for our energy needs, we can reduce our reliance on foreign fossil fuels

ENVIRONMENTAL

1. By using nature-based solutions to adapt to climate risks, we can increase the green infrastructure of the City
2. By improving our public transport and cycling networks, we reduce congestion and pollution
3. By increasing resilience, we can protect our native flora and fauna
4. By implementing mitigation and adaptation actions now, we lessen the potential impacts on the environment in the future
5. By using nature-based solutions with, or instead of, hard engineering, we can reduce the associated costs of climate action

SOCIAL

1. By improving the energy efficiency of our social housing stock, we can reduce tenants' utility bills and lessen fuel poverty
2. By encouraging cycling and walking, we can improve the health of our citizens
3. By protecting against climate risks, we can reduce impacts on citizens, their properties and our services
4. By informing citizens on the impacts of climate change and possible solutions in their areas, we can create networks of climate-resilient neighbourhoods
5. By increasing nature-based solutions, we can make the City a healthier and more desirable place to live and work

CLIMATE ACTION – ADAPTATION & MITIGATION

This plan concentrates on the two approaches required to tackle climate change. The first, mitigation, consists of actions that will reduce current and future GHG emissions; examples of these include reductions in energy use, switching to renewable energy sources and carbon sinks. The second approach, adaptation, consists of actions that will reduce the impacts that are already happening now from our changing climate and those that are projected to happen in the future.

These include flood protection, reduced impact of rising sea levels, increased resilience of infrastructure, and emergency response planning. The approaches are interconnected and should be planned together.

Mitigation and adaptation actions in this plan are based on both the current situation as defined in the baselines, the future risk projections and the remit of the Dublin Local Authorities.

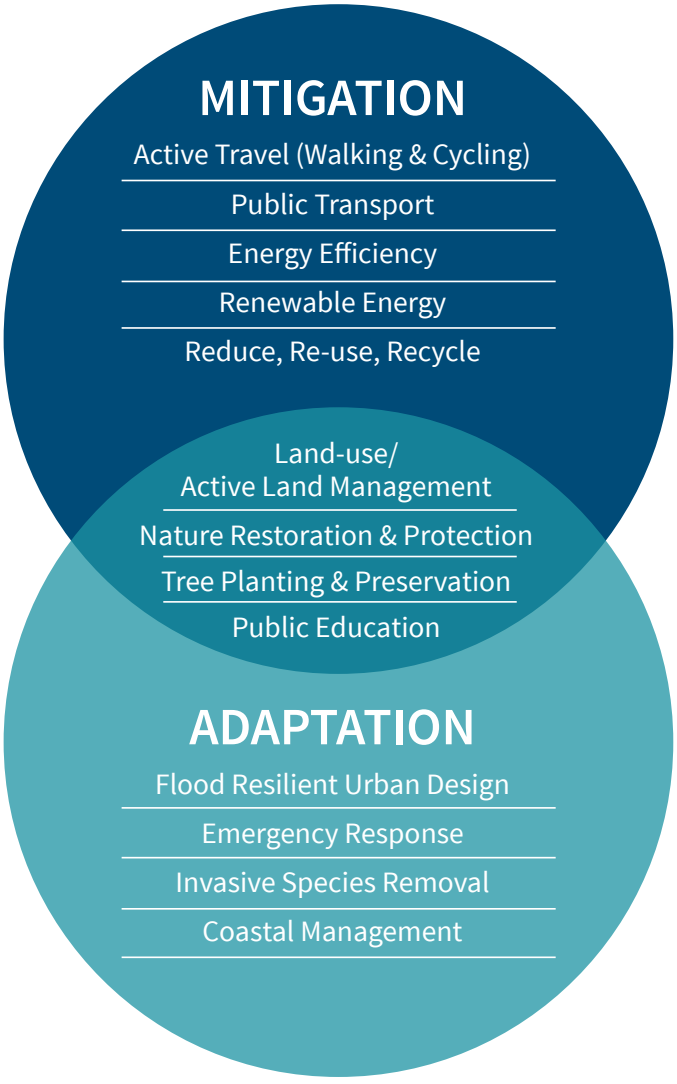


Figure 1 Examples of some Mitigation and Adaptation Solutions and their Crossovers

THE GLOBAL CONTEXT

Responding to climate change is becoming a priority of governments all over the world. Its impacts threaten livelihoods, the environment, security, and economic growth. The commitment of national governments to act on climate change is demonstrated by the unprecedented agreement of 195 states to sign the COP21 Paris Agreement. The recent Intergovernmental Panel on Climate Change (IPCC) Special Report 2018 has underlined the need to meet and exceed the Paris Agreement and achieve meaningful emission reductions before 2030.

> **Pathways limiting global warming to 1.5°C... would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems... These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options**
> - IPCC Special Report 2018[6]

GLOBAL RISKS & PROJECTIONS

The World Meteorological Organisation (WMO) has shown that 2017 was the worst year on record for extreme climate events[7]. Coastal cities bear the brunt of these storms and consequently face extensive recovery costs. However, strengthening storms are not the only form of extreme weather; droughts, increased rainfall, and freezing weather and snow also present risks to urban and rural areas.

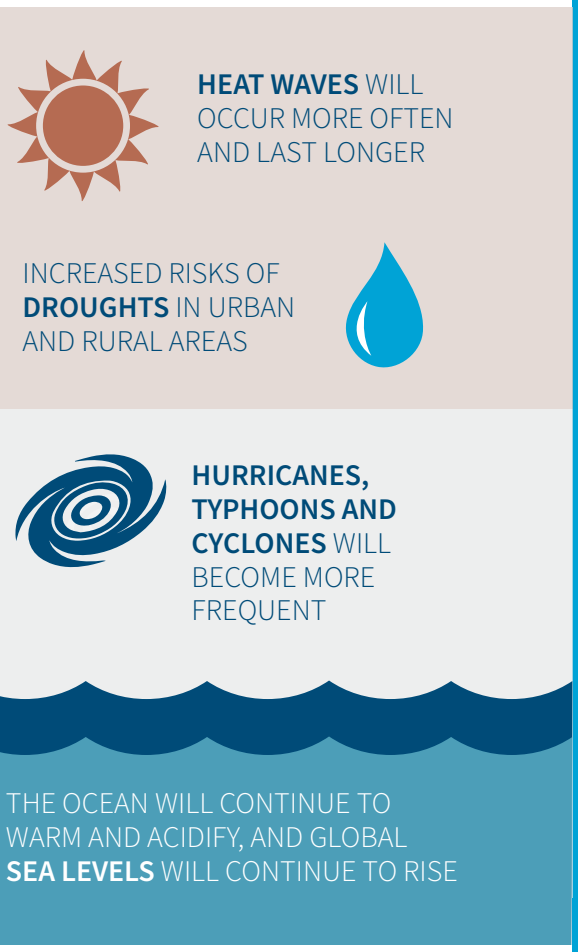
In its Special Report 2018, the IPCC states:

> **Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C.**
> - IPCC Special Report 2018[6]

The recently adopted United Nations Development Programme (UNDP) Sustainable Development Goals[8] underline the importance of climate change for an equal and equitable society. All 17 goals can be related to the impacts and opportunities of climate change, with Goal 7 *Affordable Clean Energy* and Goal 13 *Climate Action* being particularly relevant.

> **Our 2030 vision for Ireland is of a country: that is on-track to achieving a transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050, while also addressing the issue of energy poverty, supported by investment in renewable energy and sustainable transport, together with improvements in the energy efficiency of the built environment**
> - The Sustainable Development Goals, National Implementation Plan 2018-2020[9]

In addressing these climate change impacts, we need to understand the risks. In the World Economic Forum's 2017 Report on Global Risk[10], four of the top five global risks were related to climate change - extreme weather events, water crises, major natural disasters and failure of climate change mitigation and adaptation. This highlights that climate change is not just an environmental issue, but also a social and economic one that calls for integrated and collaborative responses.



THE NATIONAL CONTEXT - IRELAND

The EU has recognised the risks of climate change and subsequently, Ireland has been set national targets under various EU directives that have been transposed as statutory instruments. These require that certain targets for energy efficiency, renewable energy and GHG reductions are achieved by 2020, namely:

- A 20% reduction in non-emissions trading scheme (ETS) greenhouse gas emissions relative to 2005 levels
- Raising the share of EU energy consumption produced by renewable resources to 20% (adjusted to 16% for Ireland)
- A 20% improvement in the EU's energy efficiency
- In line with the National Energy Efficiency Action Plan (NEEAP), the DLAs are committed to achieving a 33% improvement in energy efficiency for their own operations.

New targets for emission reduction have been set for 2030, which remain around 20% for Ireland. This Climate Change Action Plan has been developed with consideration to these international, European, and national agreements, directives, legislation and regulations. These include the Irish government's *Climate Action and Low Carbon Development Act 2015*, *National Mitigation Plan* (NMP), *National Adaptation Framework* (NAF), and *National Planning Framework* (NPF). These various plans are cross-sectoral and involve cooperation between numerous national, regional and local bodies; these relationships are illustrated in Figure 2 below.

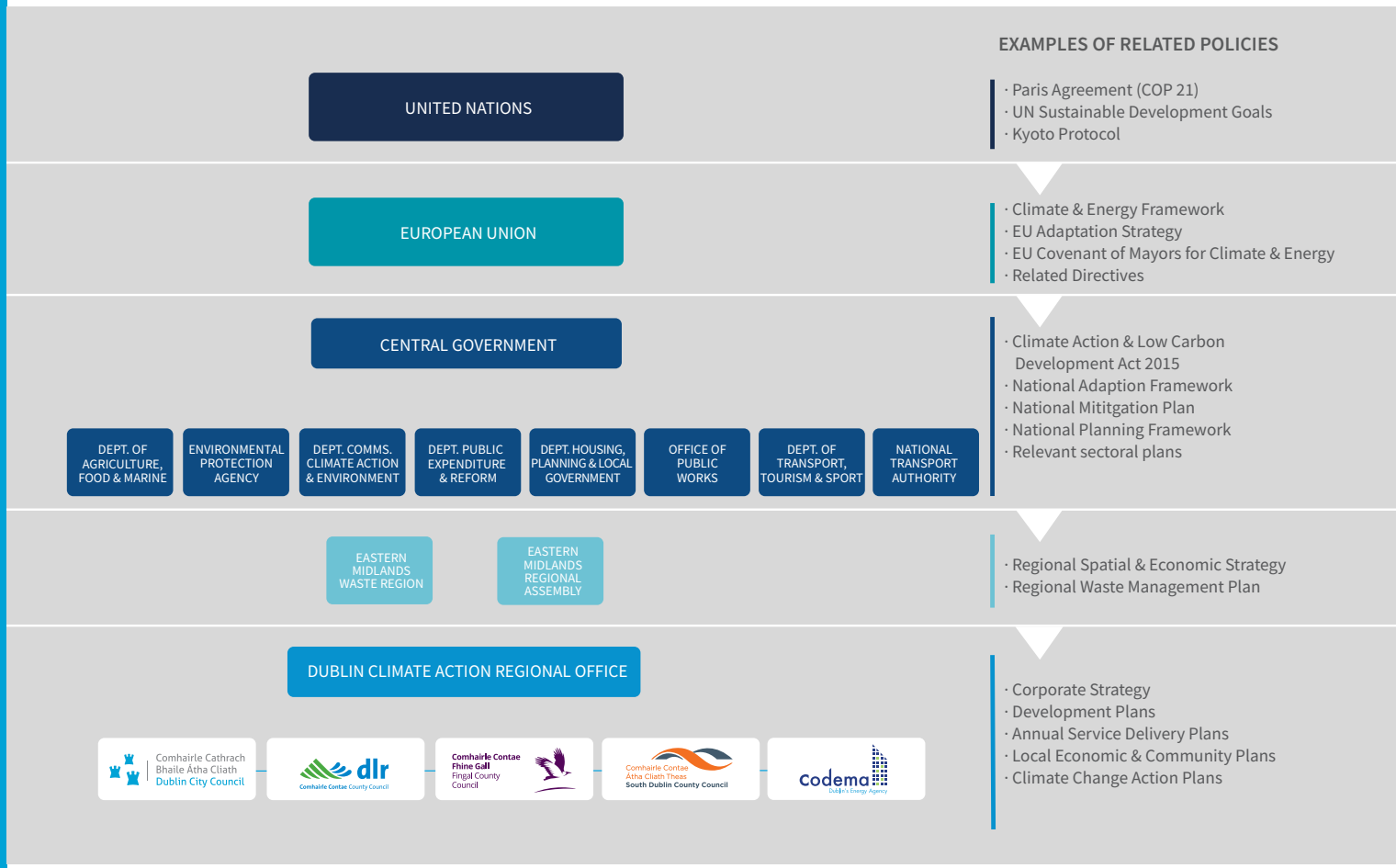


Figure 2 Institutional and Policy Context

THE REGIONAL CONTEXT

Globally, local governments are recognised to be the level of government best suited to address climate change, due to their role in the day-to-day activities of people. The Irish government has recognised this, and local authorities are actively working in consultation with the Department of Communications, Climate Action and Environment (DCCAE) to develop a regional approach to climate action through the establishment of four Climate Action Regional Offices (CAROs). The proposed approach groups local authorities based on similar geographical characteristics so that they can address the threats and impacts of severe weather events and ongoing climate change risks within their region.

THE ROLE AND REMIT OF DUBLIN CITY COUNCIL

Due to provisions in the *Climate Action and Low Carbon Development Act 2015*, local authorities must have regard for the *National Adaptation Framework* and the *National Mitigation Plan* in the delivery of services and operations, and produce adaptation plans in accordance with guidance provided in the *Local Authority Adaptation Strategy Development Guidelines 2018*. In addition, they are asked to assume a leadership role within their local communities to encourage appropriate behavioural change. However, compared to many other countries, local authorities in Ireland are limited in their service delivery and direct legal capacity, and key decisions are often made at the national rather than the local level.

Nonetheless, local planning authorities play an important coordinating role through the formulation and implementation of development plan policies and objectives, and particularly by influencing private sector development through the development management process. In effect, this process helps address mitigation and adaptation requirements, as policies and objectives are implemented in new developments on foot of permissions. County development plans, local area plans and Strategic Development Zone (SDZ) planning schemes can address climate change issues at a local level.

The actions in this plan have been gathered based on this remit. DCC's focus is on climate-proofing the areas for which it has direct responsibility. In areas outside its remit, DCC will work to support the implementation of the sectoral adaptation and mitigation plans developed by, but not limited to, the Department of Housing, Planning and Local Government (DHPLG), the Department of Transport, Tourism and Sport (DTTAS), the Office of Public Works (OPW), the Department of Agriculture, Food and the Marine (DAFM), and the Department of Communications, Climate Action and Environment (DCCAE), thereby supporting the whole of government approach to climate action. Recognising its role as a climate leader, DCC is committed to leading by example; key to this is implementing and monitoring this plan through the Dublin CARO.

CLIMATE ACTION REGIONAL OFFICE (CARO)

The newly-established Dublin Metropolitan Climate Action Regional Office is one of four regional climate change offices that have been set up in response to Action 8 of the 2018 *National Adaptation Framework* (NAF) – *Planning for a Climate Resilient Ireland*. Under the NAF, sectoral adaptation plans are to be developed and implemented that will affect the work of the DLAs. As such, the Dublin CARO will liaise with respective government departments to align actions undertaken by the DLAs with sectoral adaptation plans.

The role of the Dublin Metropolitan CARO is to:

- Assist the local authorities within the region in preparing their own Climate Change Action Plan
- Develop education and awareness initiatives for the public, schools, NGOs and other agencies engaged in driving the climate change agenda and contribute to the National Dialogue on Climate Action on a local and regional basis
- Link with third-level institutions in developing a centre of excellence for specific risks – in the case of the Metropolitan Region, this will be for urban climate effects
- Liaise and interact with the Dublin energy agency Codema

THE ACTION PLAN PROCESS

THE ACTION PLAN PROCESS

The methodology used to develop this plan was based on the International Council for Local Environmental Initiatives (ICLEI) Five Milestone Approach[11], which was developed as a guide to assist members of ICLEI in developing their Climate Change Action Plans. It is a 'plan, do, check, act' process designed specifically for the development of CCAPs. The Milestones were further adapted to meet the specific needs of the Dublin Local Authorities (Figure 3) and harmonised with the process as described in the *Local Authority Adaptation Strategy Development Guidelines 2018*. It should be noted that the current process incorporates Milestones 1 to 3 to produce this plan, while Milestones 4 and 5 concern the plan's implementation and monitoring; this will be developed further in subsequent iterations.

Figure 3 ICLEI Five Milestone Approach, Adapted for the Dublin Context

MILESTONE 1: INITIATE

IDENTIFY CLIMATE CHANGE IMPACTS AND RISKS

A changing climate is impacting the environmental, social and economic wellbeing of the region; the risks that Dublin City encounters are related to its geographic and demographic characteristics. Future projections for climate change indicate that the City will face increasing risks associated with rising temperatures, sea level rise, flooding and an increase in the frequency and intensity of extreme weather events.

A climate change adaptation baseline and risk assessment is needed to determine the frequency and intensity of extreme weather events and trends, and to highlight the sectors in the City most vulnerable to future risks from a changing climate.

A more in-depth analysis about climate change impacts and risks may be found in both the Adaptation Baseline (under Milestone 2 - Research) and in Appendix I - Climate Change Risk Assessment.

DEVELOP A CLIMATE CHANGE STRATEGY

With these high-level risks identified, Codema and the Dublin Local Authorities produced *A Strategy Towards Climate Change Action Plans for the Dublin Local Authorities,* which included a public consultation process. This recognised the need for each of the four DLAs to act on current risks and minimise the projected impact of future ones with mitigation and adaptation actions.

Action areas associated with the remits of the DLAs were identified in order to begin collecting data and actions, and set out how the plans would be developed.

MILESTONE 2: RESEARCH

MEET WITH STAFF AND ARRANGE WORKSHOPS

To develop the adaptation and mitigation baselines, Codema engaged DCC staff through one-to-one meetings, and facilitated a preliminary workshop to introduce the staff to the action plan process, develop risks and impacts, and collect baseline data.

These one-to-one meetings and the first workshop included over 60 staff across the four DLAs. The workshop provided an opportunity for staff to collaborate with each other. DLA staff were asked to elaborate on the key climate change vulnerabilities facing the Dublin Region, and to begin gathering actions needed to address these areas.

COLLECT BASELINE DATA

Codema carried out an adaptation risk assessment on behalf of DCC, which identifies and assesses the current climate change risks facing the City. With support from the Sustainable Energy Authority of Ireland (SEAI), Codema also developed an energy and emissions baseline, which shows the current level of emissions and energy efficiency for DCC's own operations and emissions for the whole City. Research into people's attitudes and awareness was used in order to inform the stakeholder engagement actions of the plan. The following section shows these baselines.

PUBLIC AWARENESS

PUBLIC AWARENESS

One of the biggest challenges to tackling climate change is public acceptance of the risks and the associated demand for solutions to reduce these risks through policy and services. There are two types of solutions - top-down, such as governmental policy and regulations, and bottom-up, led by citizen demand for change. For a successful route to reduce climate risk, both levels of solution need to be addressed.

A 2018 special Eurobarometer report[12] surveyed each member state across differing social and demographic groups and recorded public attitudes to climate change. The survey found that 94% of Irish respondents considered climate change to be entirely or partly due to human activity, with an average of 86% agreeing that extreme weather events (such as heat waves and extreme cold, floods and heavy rainstorms) are to some extent due to climate change. In terms of the impacts of climate change, 64% of Irish respondents thought that there would be increased food and water shortages by 2050. In addition, 97% agreed that measures to promote energy efficiency should be implemented as a solution to climate change, and 90% agreed that subsidies for fossil fuels should be reduced. In addition, 89% of Irish respondents agreed that tackling climate change can present opportunities for jobs and boost the economy, highlighting that there is an appetite for change and a consensus on the seriousness of future impacts.

Over the course of two weekends at the end of 2017, the Citizens' Assembly discussed how the state could make Ireland a leader in tackling climate change[13]. The Assembly heard presentations from a range of experts in areas such as the science of climate change and international policy. Over 1,200 submissions were received from the general public, advocacy groups, professionals and academics. At the end of the process, the Assembly voted on 13 recommendations, all of which were overwhelmingly agreed. The recommendations demand top-down action from the government, in order to encourage and facilitate bottom-up actions from Irish citizens. By prioritising public transport over road networks, higher carbon taxes, provisions for community-owned energy developments and feed-in tariffs for domestic energy production, the conditions would be in place to allow the growth of bottom-up solutions. The Assembly also underlined the need for public bodies to take a leadership role by climate-proofing their own facilities, reducing energy use and applying low-carbon solutions to their services. In addition, risk assessments of critical infrastructure were seen as essential to increase the state's resilience to adverse climate impacts.

This CCAP is cognisant of the role that the DLAs must play in increasing citizen awareness and participation in climate solutions and the unique position that local government holds in interacting with its citizens. The protection of critical infrastructure, facilitating bottom-up solutions and applying regulations, where possible, are at the centre of this plan and will be strengthened in future iterations.

ADAPTATION BASELINE

ADAPTATION BASELINE

Dublin's energy agency Codema has produced this adaptation baseline in line with the guidelines contained in the *Local Authority Adaptation Strategy Development Guidelines 2018* and the *National Adaptation Framework*. This Climate Change Action Plan has been peer reviewed to the requirements of the *Local Authority Adaptation Strategy Development Guidelines 2018*.

The objective of this baseline is to document the occurrence of past climatic events, their frequency, the specific areas in Dublin City that are most vulnerable and the risks associated with such events. This adaptation baseline also highlights the need for emergency planning to be continually updated in line with extreme weather events.

From the adaptation baseline, we can assess the current and future risks that will affect Dublin City. These risks are assessed and addressed by putting actions in place to build a more resilient City that is robust, resourceful and is able to adapt in response to changes in climate and in times of crisis. The actions are a mix of grey and green solutions, which try to balance engineered solutions with nature-based resilience. A more exhaustive list of all actions, including adaptation actions, may be found in each of the action areas contained in this Climate Change Action Plan.

BACKGROUND AND METHODOLOGY

Ireland has a total population of 4,761,865, of which approximately 1.9 million people live within five kilometres (km) of the coast; within this, 40,000 reside less than 100 metres away from the sea[14]. Ireland has a number of climate challenges, such as coastal flooding, sea level rise, coastal erosion, pluvial flooding, extreme weather events and extreme temperatures. Dublin, being an urban City, has different challenges and risks compared to more rural areas.

The Dublin City area is 117 km^2, and comprises of 52 km of coastline, including Dublin Port and the Liffey Estuary. Three main rivers (the Liffey, the Tolka, and the Dodder) flow through the City, in addition to a number of small rivers such as the Wad, Poddle, Santry, Mayne and the Camac. Both the Poddle and Dodder run through most of the south of the City and South Dublin County; these rivers, in turn, flow into the River Liffey via the City Centre.

The River Liffey and River Camac drain areas within County Kildare, South Dublin County, the City Centre and the west side of the City, before flowing into Dublin Bay. Before discharging into Dublin Bay, the River Tolka and its tributaries drain areas within County Meath and north of the Royal Canal.

According to the most recent Census (2016)[14], the Dublin City area currently has a population of 554,554, with 240,553 households, and these figures are expected to rise in the future. The 2016 Census highlights that by 2031, population in the Greater Dublin Area (GDA) will increase by just over 400,000, and this increase would account for approximately two thirds of the total projected population growth in Ireland. A rise in population will increase the impacts of climate change due to additional pressure on drainage systems that are already working near capacity. Also, it is estimated that Ireland will need an additional 550,000 more homes by 2040, compared to 2017[4], and this will lead to a decrease in pervious or green surfaces, exacerbating flooding due to enhanced run-off.

These geographic and demographic characteristics make Dublin City sensitive to a set of climate change risks, which differ from rural, landlocked or sparsely populated regions.

As explained in the previous section, this plan follows the ICLEI Five Milestone Approach. As part of the second milestone (Research), information was collected from a range of departments to gather actions in each area. This was conducted through a series of one-to-one meetings between Codema and staff from all internal departments of Dublin City Council, and collaborative workshops with staff from all four DLAs. Additional data and information was also gathered from multiple national sources, including the Office of Public Works (OPW), Met Éireann and the Environmental Protection Agency (EPA).

BASELINE

Table 1 on the following page summarises the climatic events recorded by Met Éireann that have occurred in the Dublin Region over the last 32 years. These events were recorded due to their unique intensity and abnormal weather patterns. The effects (see description) of these major events are not purely economic; they also highlight social and environmental impacts and vulnerabilities, as further described in the following sections.

Table 1 Major Climatic Events in Dublin (Source: Met Éireann & Flooding.ie)

TYPE	DATE	DESCRIPTION
Hurricane Charley	August 1986	Pluvial – worst flooding in Dublin in 100 years.
Pluvial & Strong Winds	February 1990	Heavy rain and consequently flooding, with long periods of strong winds. All weather stations reported gale gusts.
Pluvial/Fluvial	June 1993	100 mm of rain fell in Dublin and Kildare (more than three times the normal amount).
Extreme Temperatures	June - August 1995	Warmest summer on record, with mean air temperatures over two degrees above normal in most places. Temperatures rose to around 30°C on a number of days and night time minimum temperature remained above 15°C for many weeks.
Windstorm	December 1997	Conditions were severe in much of Leinster, especially the south and east. In the Dublin area there were record gusts of 150 km/h, with maximum 10-minute winds of storm force.
Fluvial	November 2000	250 properties flooded in Dublin, 90.8 mm of rain fell. Significant disruption and damage, especially in the area of the Lower Tolka catchment.
Coastal	February 2002	Second highest tide ever recorded. This caused sea defences to be overtopped. 1,250 properties flooded in Dublin, €60m worth of damage.
Fluvial	November 2002	Similar to the 2000 flood, 80 mm of rain fell in Dublin. This led to high river levels in the River Tolka, which caused extensive flooding along the catchment.
Extreme Temperatures	Summer 2006	Warmest summer on record since 1995.
Pluvial	August - September 2008	North City - 42.9 mm of rain fell in two hours, which was a 1-in-100-year event. 19 areas of North Dublin had severe flooding, many of which had no previous history of such flooding. Over 150 residential properties were inundated, as well as commercial premises, public buildings, major roadways, etc.
Pluvial	July 2009	This was a 1-in-50-year event. Several areas within the Dublin City Council boundary were affected. One of the worst affected areas was Donnycarney in North Dublin. Reports of spot flooding in Raheny, Clontarf, Drumcondra, Finglas, Sandymount, Cabra, Finglas and Glendhu Park in Ashtown.
Extreme Cold	December 2010	It was the coldest of any month at Dublin Airport, Casement Aerodrome and Mullingar in 50 years. Casement Aerodrome's temperature plummeted to -15.7°C on Christmas Day, the lowest temperature ever recorded in Dublin.
Pluvial/Fluvial	October 2011	This was between a 1-in-50 and a 1-in-100-year event across the majority of Dublin. 1,100 properties were flooded, 318 road flooding incidents occurred, 1,200 electricity customers had no power supply in the City Centre, and a fatality in the City as a result.
Coastal	January 2014	The highest tide ever recorded, at 3.014 metres ODM recorded at Alexandra Basin. Four buildings flooded.
Storm Darwin	February 2014	A 1-in-20-year event, with gusts of 100-110 km/h in Dublin. Considerable damage to housing and other buildings. 8,000 ha of forests damaged. Status: Yellow
Storm Ophelia	October 2017	First storm to come from a southerly direction, with damaging gusts of 120 to 150 km/h. 100 large trees blown over in Dublin City. Status: Red
The Beast from the East and Storm Emma	February – March 2018	Met Éireann issued its first Status Red warning on record for snow. Closure of all schools in the City, many businesses affected, water and power restrictions or outages. Status: Red
Extreme Temperatures	Summer 2018	Drier and warmer weather than normal throughout Ireland, with drought conditions in many areas, including Dublin. Temperatures reached 28°C, with above-average sunshine and heat wave conditions. Water restrictions were in place for the country for the majority of the summer. Status: Yellow
Storms Ali and Bronagh	September 2018	Storm Ali brought widespread, disruptive wind, which led to the delay or cancellation of most flights to and from Dublin Airport. Storm Bronagh passed over the east of Ireland bringing heavy rain. Mean wind speeds between 65-80 km/h and gusts between 110-130 km/h. Status: Orange

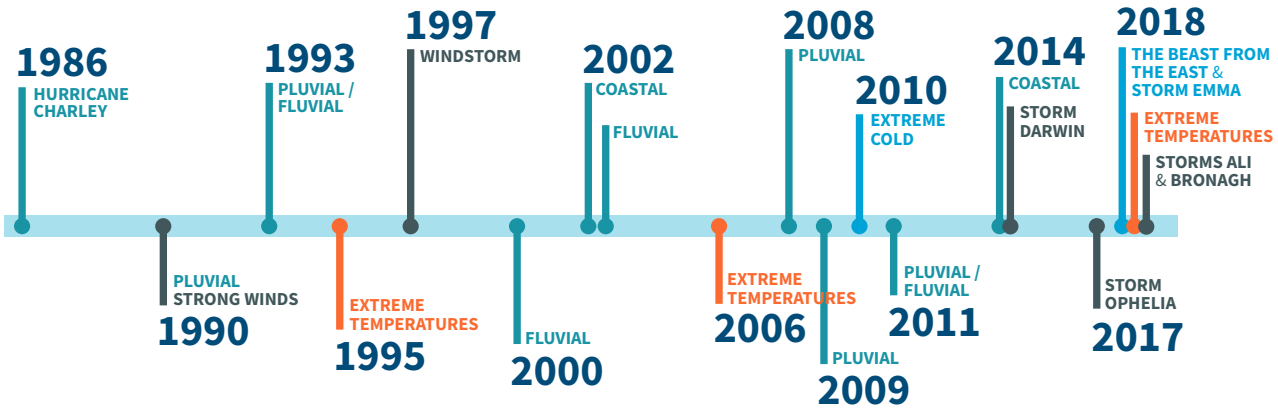


Figure 4 Timeline of Major Climatic Events in Dublin

CLIMATIC EVENTS, TRENDS & RISKS

Dublin City's geographic and demographic characteristics make it vulnerable to certain risks. As a City, Dublin creates its own unique micro-climate and this can intensify current and future climate impacts. An example of this is the urban heat island effect, making it warmer than the surrounding semi-urban and rural areas. This is mainly due to heat absorption from built-up areas in the City, waste heat generated from urban activities and a lack of tree cover, which can reduce temperatures in the City through shading. Flood risks are also higher in cities due to the amount of impervious surfaces and lack of vegetation (pervious surfaces); this results in enhanced rainwater run-off, which may result in flooding.

Risks may be categorised as:

1. **Economic loss**, which includes damage to infrastructure and the disruption of daily activities
2. **Social loss**, including damage to human life, health, community and social facilities
3. **Environmental and heritage loss**, which takes into consideration the sensitivity of the environment (the natural, cultural and historical environment), habitats and species.

Risks in cities are exacerbated, which means we need to assess the impacts of not only extreme weather and climatic events, but also climatic trends, such as urban flooding, sea level rise and increasing temperatures. These events and trends should not be considered as independent, as they influence each other. The slow, gradual increase in temperatures and sea level rise will contribute to the increased frequency and intensity of extreme weather events and flooding.

Table 2 on the following page shows a 30-year overview of different climate variables (cold snaps, heat waves, storm surges, coastal erosion, etc.), which are grouped into three types of events and trends (extreme weather events, sea level rise and flooding). This table summarises the current effects of the climate change variables, projected changes in the next 30 years, and confidence in these projections.

The climatic events and trends that Dublin City is facing are:

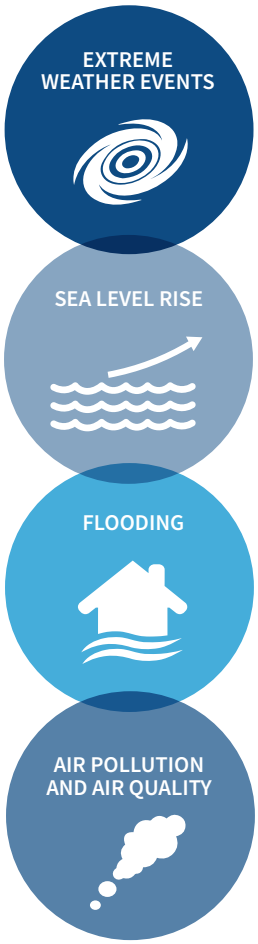
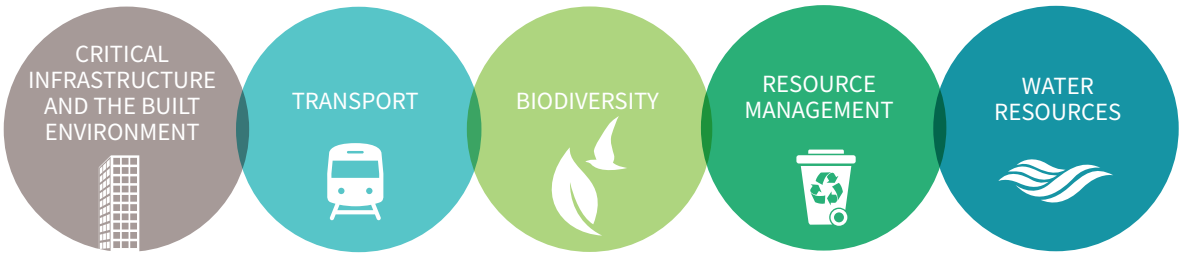


Table 2 Climate Variables Projection: 30 Year Overview

CLIMATIC EVENTS & TRENDS	PARAMETER	OBSERVED	CONFIDENCE	PROJECTED CHANGES
Extreme Weather Events	Cold Snaps	Increasing average air temperatures may result in a decrease in the frequency of cold snaps	Medium	Projections for 2050 indicate an increase in mean annual temperature, in the range of 1-1.6 °C. This will result in milder temperatures and a decrease in the frequency of cold snaps
	Heat Waves	Average air temperatures are increasing and may result in an increase in the frequency and intensity of heat waves	High	Eight heat waves have been recorded in Ireland over the last 30 years (more than 5 days at temperatures exceeding 25°C). Projections for 2050 predict a mean annual temperature increase of 1-1.6°C, which will intensify the temperature and duration of heat waves
	Dry Spells	Precipitation is becoming more seasonal and is likely to cause drier periods in the summertime	High	Ireland as a whole will experience drier summers, with a decrease of up to 20% in summer precipitation under a high emission scenario. This will result in longer periods without rainfall, which will affect water-sensitive regions and sectors
	Extreme Rainfall	The number of days with rainfall greater than 0.2 mm and 10 mm has gradually been increasing	Medium	The frequency of extreme rainfall is expected to keep on increasing over the years, especially in the autumn and winter seasons
	Wind Speeds	Wind speeds are increasing slightly in the winter periods and decreasing over the summer time	Low	Long term trends cannot be determined accurately; although it is anticipated that wind speed will change in a minor way, the frequency of wind storms is expected to increase in the winter periods and decrease in summer
Sea Level Rise	Sea Level Rise	Seas and oceans surrounding Ireland are rising and will keep doing so	High	Future projections indicate a sea level rise of an average of 3-4 mm per year worldwide, but a 6-7 mm rise per year in Dublin Bay was recorded between the years 2000 and 2016
	Wave Heights	Sea waves and wave height are determined by wind speed and direction. As wind speeds and wind storms become more frequent, wave heights also increase	Medium	Projected changes in wave heights remain uncertain. However, significant wave heights (the mean height of the highest 1/3 of waves) show an increasing trend of 14 cm per decade
	Tides	Increasing sea levels are resulting in record high tides (greater than 2.9 metres)	High	Sea levels will continue to rise and will result in increased levels of high tides
	Storm Surges	Surges can become more frequent as extreme weather events, such as intense rainfall and high wind speeds, become more frequent	Low	The frequency of intense cyclones and strong winds is expected to rise in the north-east Atlantic. By 2050, storm surge heights between 50 and 100 cm are likely to increase in frequency
Flooding	Coastal & Tidal	As both sea level rise and wave heights increase, the frequency of coastal and tidal flooding also increases	High	A rise in both sea levels and wave heights is projected to increase, which will lead to an increase in coastal flooding
	Fluvial	Increased rainfall intensity, high river flows and high tides contribute to an increase in fluvial flooding	High	Projections show both high tides and the intensity of rainfall days are increasing, which, in turn, will result in an increase in fluvial flooding
	Pluvial	Increased rainfall intensity will likely lead to an increase in pluvial flooding	Medium	It is predicted that the probability of flood events occurring will increase and the number of heavy rainfall days per year is also projected to increase, resulting in a greater risk of pluvial flooding. This is exacerbated by land use planning, including the covering up of permeable spaces, i.e. front gardens of residential properties
	Groundwater	High tides and the increase in intensity of rainfall are causing groundwater levels in tidal areas to flood more frequently	Medium	It has been projected that high tides will increase as sea levels rise, as will the intensity of rainfall. Both these factors will lead to an increase in groundwater flooding

To better understand the impact that future climate risks have on Dublin City, five impact areas were identified, which include all the different sectors in the City. These are:



These were chosen to mirror the action areas used throughout this Climate Change Action Plan (Energy and Buildings, Transport, Nature-Based Solutions, Resource Management and Flood Resilience), which reflect DCC's remit.

The influence of future risks on the impact areas was assessed through the use of risk matrices. Risk matrices calculate the overall future risk incurred by the different sectors in the City. The projected changes (Table 2) give an overview of the future risks that Dublin City is likely to face in the coming years. A future risk may be defined as a product of likelihood and consequence:

Future Risk = Consequence x Likelihood

The consequences of the future risks (the level of damage caused by a climatic event or trend) range from critical to negligible consequences:

Consequence	
Critical	5
Major	4
Moderate	3
Minor	2
Negligible	1

x

The likelihood is the probability of these future risks occurring, and these range from almost certain, likely, possible, unlikely to rare:

Likelihood	
Almost Certain	5
Likely	4
Possible	3
Unlikely	2
Rare	1

=

Both the likelihood and consequences are given a range of ratings from one to five and the result of their product is the future risk, which can be either high (most urgent to address), medium or low risk:

Future Risk	
High Risk	[15-25]
Medium Risk	[7-14]
Low Risk	[1-6]

Risk matrices for different climatic events and trends may be found in the risk section of Extreme Weather Events, Sea Level Rise and Flooding. A more in-depth analysis about risk matrices and the method by which they are calculated may be found in Appendix I. An additional in-depth analysis of these risks and their consequences on the delivery of the local authority's services and functions will be carried out. Future iterations of this Climate Change Action Plan will benefit from this assessment, and this information may be gathered through the facilitation of climate change risk workshops for the four Dublin Local Authorities.

EXTREME WEATHER EVENTS

Dublin City has experienced an increase in extreme weather events, and this is evident from the Timeline of Major Climatic Events (Figure 4). While we cannot attribute all these events to climate change, they are the most evident consequence of climate change.

Their effects are in the form of prolonged periods of extreme cold or heat, which cause snow and heat waves, hurricane gusts due to violent winds, and heavy rainfall resulting in flooding.

Globally, temperatures are increasing and are expected to continue increasing during summer, with extreme cold spells in the winter months. Meanwhile, average precipitation is expected to decrease during the summer and autumn period, with extreme rainfalls in the winter time. The frequency of extreme wind conditions, particularly during the winter, is also expected to increase.

BASELINE ASSESSMENT

Dublin City has experienced extreme weather events within the last 15 years; many of these are summarised in Table 1 earlier on in this chapter. In February and March 2018, Dublin City experienced its greatest snowfall since the winter of 1982, with depths of up to 55 cm. This was coupled with extreme cold and blizzard-like conditions, as a result of Storm Emma coming from the Atlantic, and the 'Beast from the East', which also impacted most of Europe. Met Éireann issued its first-ever Status Red warning for snow nationwide, which led to severe disruption to the City for a prolonged period. The continuous heavy snowfalls and deep snowdrifts resulted in the closure of all schools across the country, while many businesses in Dublin City were forced to close, and several homes and businesses experienced power outages. High demands were placed on the country's water network, with as many as 1.2 million households and businesses in and around the City affected by water outages or curtailments in the days after Storm Emma[15]. DCC's Corporate Services received a total of 1,875 calls between the 28th of February and the 3rd of March, which included calls related to emergency services, heating and homeless citizens. The Dublin Fire Brigade mobilised a total of 1,354 incidents during the same period.

Dublin's rainfall is also changing - in the last decade, the number of days with rainfall greater than 0.2 mm has been gradually increasing, as are days with over 10 mm of rain. This can be seen in Figure 5 below. Furthermore, data from Met Éireann shows that from 1961-2010, there was a 5% increase in average yearly rainfall[16,17].

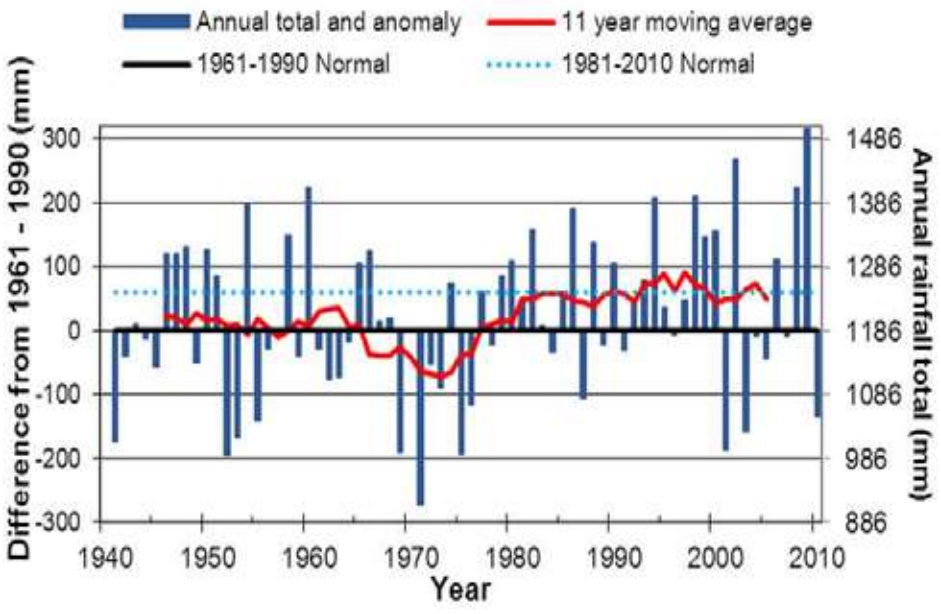


Figure 5 Annual Rainfall (1941-2010) (Source: Met Éireann / Dwyer)

As seen in Figure 6 below, Met Éireann has already identified a 0.5°C increase in temperature, based on available data from 1961-2010, and these temperature rises are set to continue. Based on medium to low emission and high emission scenarios, *"Projections indicate an increase of 1–1.6°C in mean annual temperatures, with the largest increases seen in the east of the country."*[18] This will see new challenges for Dublin City in terms of the urban heat island effect and loss of biodiversity. In addition to surface temperature, sea temperature will also increase, having an adverse effect on the marine environment.

Wind is characterised by speed and direction, which allows us to measure the strength and frequency of weather systems as they move across Ireland. Consistent wind speed data is only available for the last 15-20 years, due to changes in measurement equipment and techniques, so long term trends cannot be determined accurately[19].

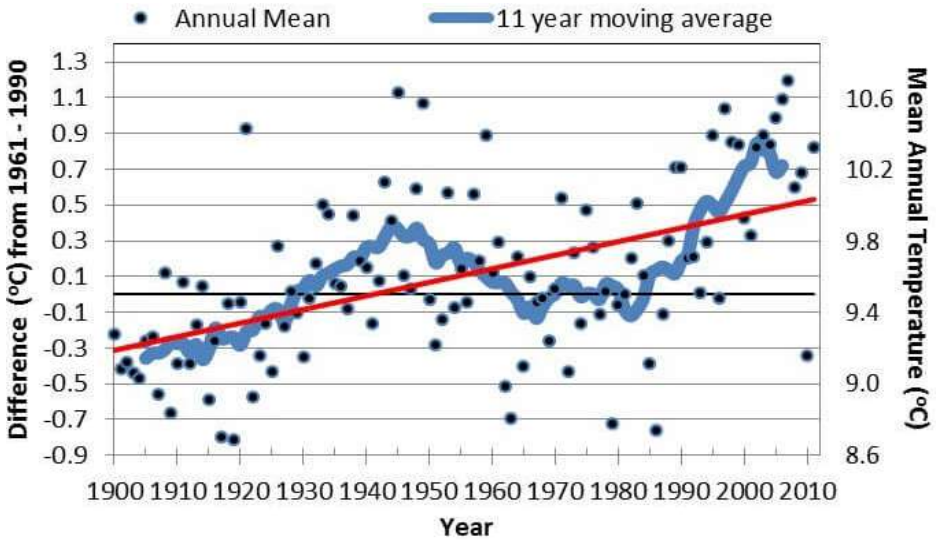


Figure 6 Mean Surface Air Temperature (1900-2011) (Source: Met Éireann / Dwyer)

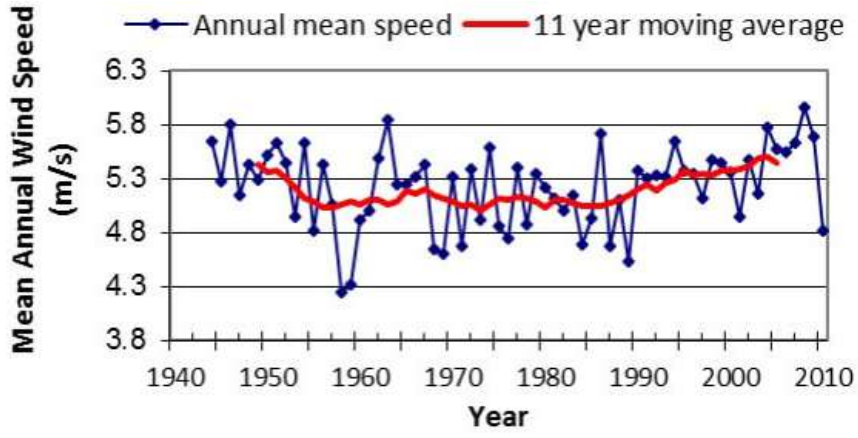


Figure 7 Dublin Airport Wind Trends (1944-2010) (Source: Met Éireann / Dwyer)

EXTREME WEATHER RISKS

Dublin's extreme weather risks are very much linked to the characteristics of the City. Dublin City's temperatures are already increasing, as it experiences urban heat island effects due to its physical characteristics (e.g. prevalence of concrete buildings retaining heat) and a lack of cooling and shading from natural vegetation. Rising temperatures impact the City's air quality, which degrades as the concentration of pollutants increase. Recently, in the summer of 2018, Ireland experienced extreme temperatures, which caused heat wave and drought conditions, and resulted in a hosepipe ban for most of the summer, due to water shortages throughout the country.

URBAN HEAT ISLANDS
Urban heat islands occur as a result of the high thermal capacity of buildings. Research has shown that built-up urban areas retain heat for longer periods of time than rural areas; consequently, urban areas are often 5 to 10 degrees warmer than rural areas.

As shown in the Timeline of Major Climatic Events (Figure 4), the frequency of extreme cold spells in Ireland has increased, and this presents additional risks to Dublin City. During Storm Emma, prolonged periods of cold resulted in water pipes freezing and then bursting as the temperatures started to rise, which left homes in the City without water.

These extreme weather events pose significant risks to critical assets such as electricity infrastructure. Violent gusts of wind during Storm Ophelia caused damage to power networks, resulting in 385,000 homes and businesses being left without electricity across Ireland. Such strong winds also put the City at risk of coastal flooding, due to sea surges caused by both sea level rise and extreme weather. Due to the characteristics of Dublin City, prolonged heavy rainfall events typically result in urban flooding, which is mainly caused by a lack of pervious surfaces. Flooding also puts groundwater supplies at risk, as these can be contaminated due to the high infiltration of flood water.

FUTURE RISKS

Met Éireann predicts that Ireland as a whole will experience wetter and milder winters, with a 10-15% increase in rainfall, and drier summers[16,17]. *"Projections suggest average temperatures will continue to increase, with warming across all seasons. A warming climate may cause stresses to vulnerable populations, such as children and the elderly. This can also affect water quality and may cause pollutant contamination to surface water that may be attributed to a decrease in water flows during the warming summer and autumn months. Areas to the east are expected to see the strongest increase over the coming decades."*[17] Meanwhile, precipitation projections indicate an increase of up to 20% in heavy rainfalls during the winter and autumn seasons[17].

Although no long-term wind speed trend can be accurately determined, it has been projected that extreme wind speeds will increase during the winter periods[17]. This would greatly affect critical infrastructure such as communication and transportation, which may be disrupted by the violent winds. Also, this increase in extreme wind events, coupled with sea level rise and coastal storms, may lead to increased wave heights and could result in habitat loss and damage, due to coastal and soil erosion.

EXTREME WEATHER ADAPTATION ACTIONS

The aim of compiling extreme weather adaptation actions is to reduce the effects of these events. Some of these adaptation actions are also addressed in other sections (Flooding and Sea Level Rise).

Some of the actions that have been adopted by Dublin City Council include:

- Communication at national and local level with the general public, promoting appropriate behaviour and actions to be taken to limit impacts during extreme weather events
- Emergency planning strategies, continually aligned with extreme weather events
- Monitoring and forecasting of extreme weather events, which include accurate and timely weather-related alerts, real-time time surveillance, evaluating and monitoring
- The use of nature-based solutions (such as green roofs and SuDs) to reduce the risk of flooding arising from extreme rainfall events
- Energy-efficient buildings to ensure preparedness to extreme temperatures. DCC has an ongoing Fabric Upgrade Programme to continuously improve the efficiency of its social housing stock. Furthermore, all new developments in Ireland have to be energy efficient, and must comply with nearly Zero Energy Building (nZEB) standards after 31st December 2020 and public sector bodies must be compliant by the 31st of December 2018 for all new buildings

RISK MATRIX

Table 3 Extreme Weather Events Risk Matrix

IMPACT AREAS	DESCRIPTION	PARAMETER	CONSEQUENCE	LIKELIHOOD	FUTURE RISK
Critical Infrastructure & the Built Environment	Projected increases in temperature, wind speeds, cold snaps and rainfall will put a stress on the built environment, particularly on critical infrastructure (such as electricity and communication networks) and residential developments (with the most vulnerable populations being particularly at risk)	Cold Snaps	4	3	**12**
		Heat Waves	2	4	**8**
		Dry Spells	3	5	**15**
		Extreme Rainfall	4	3	**12**
		Wind Speeds	5	2	**10**
Transport	Increases in wind speeds, cold snaps and rainfall will put a stress on transport networks, which may lead to disruption of transport services during extreme events	Cold Snaps	5	3	**15**
		Heat Waves	2	4	**8**
		Dry Spells	2	5	**10**
		Extreme Rainfall	3	3	**9**
		Wind Speeds	4	2	**8**
Biodiversity	Projected increases in temperature, wind speeds, cold snaps and rainfall will put an increased stress on biodiversity, by causing damage, habitat loss and increasing the prevalence of invasive species	Cold Snaps	5	3	**15**
		Heat Waves	4	4	**16**
		Dry Spells	4	5	**20**
		Extreme Rainfall	4	3	**12**
		Wind Speeds	3	2	**6**
Waste Management	Projected increases in temperature, heat waves and droughts may increase the risk of fires in landfill sites and can also increase the prevalence of vermin and odour	Cold Snaps	2	3	**6**
		Heat Waves	4	4	**16**
		Dry Spells	4	5	**20**
		Extreme Rainfall	5	3	**15**
		Wind Speeds	1	2	**2**
Water Resources	Projected increases in temperature, cold snaps and rainfall will affect flows and quality of water resources. Temperature increases and dry spells will result in a reduction of water resource availability, whilst cold snaps can cause disruption of water services	Cold Snaps	5	3	**15**
		Heat Waves	4	4	**16**
		Dry Spells	5	5	**25**
		Extreme Rainfall	5	3	**15**
		Wind Speeds	1	2	**2**

SEA LEVEL RISE

The rise in sea levels in Ireland is mainly due to climate change, and the seas and oceans surrounding our island are rising at approximately 35 mm per decade[20]. The main cause of sea level rise is an increase in temperatures; as these temperatures increase, our oceans absorb more of this heat and expand. As the oceans become warmer, glaciers and polar ice caps start to melt and cause sea levels to rise.

Coastal flooding is influenced by sea level rise, and since Dublin is a coastal City, rises in sea level and coastal tides would significantly impact the City and its infrastructure. Continual rise of sea levels and the increase in the frequency, magnitude and intensity of coastal storms will further exacerbate existing complications of flooding, coastal erosion and deposition.

Coastal and estuarine flooding are both very much affected by sea level rise. Changes in sea levels will cause the extent of estuaries to increase and thus result in the infiltration of tides further upstream in rivers. This would mean that areas along rivers that are already at risk of flooding will be at increased risk of sea level rise. Rising sea levels also provide a higher base for storm surges, which increases their intensity.

Approximately 20% of Ireland's coastline is eroding[20]. These coasts are particularly more susceptible to erosion, as they are typically made up of unconsolidated sediments, as is the case along the eastern coast (Dublin).

BASELINE ASSESSMENT

Following recent extreme flood events and predictions of sea level rise due to climate change, Dublin City Council carried out a review of the capacity of the existing coastal flood defences to provide protection for urban areas. As a coastal City, Dublin is facing rising sea levels. Mean Sea Level (MSL) is the average of all the high and low tides over the course of a year. Over the last 15 years, the Annual Average Sea Level (AASL) in the Dublin Region has been rising faster than initially projected (Figure 8).

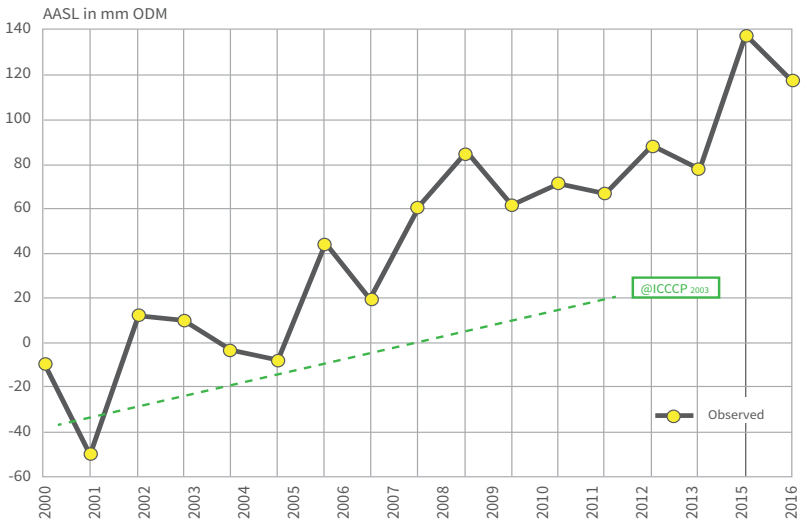


Figure 8 Dublin Annual Average Sea Level 2000-2016 (Source: DCC)

Data collected by DCC shows the AASL for the years 2014, 2015 and 2016 amounted to 78 mm, 138 mm and 114 mm Observed Difference in Mean (ODM), respectively. This compares to values in the period between 2000 and 2004, which were much closer to 0 mm ODM.

The highest tide ever recorded in Dublin City was on the 3rd of January 2014, reaching 3.014 metres at Malin Head. The second highest tide recorded was on the 1st of February 2002, at 2.950 metres at Malin Head. These were the highest tides recorded for the last 400 years, and possibly longer for Dublin Bay. To reduce vulnerability to sea level rise, a minimum safety of four metres above present sea level in the east coast of Ireland is recommended; this accounts for a rise in sea level of 0.5 metres, a storm surge of 2.95 metres, and a safety margin[21].

It is important to note that sea level rise, while an important phenomenon to understand for Dublin City, is only one element that contributes to flooding issues in the City. It is also important to understand the other elements which, when combined with rising sea levels, contribute to flooding. This includes combinations of extreme tide levels, which are made up of astronomic tides and storm surges (fluctuations in water level due to atmospheric pressure, wind speed, seiches, etc.) and wave action.

SEA LEVEL RISE RISKS

Risks associated with sea level rise can be categorised as economic, social and environmental. The risks associated with sea level rise in Dublin City include:

- **Coastal deposition and damage to existing defences** from increased wave heights at the coastline. This will greatly affect coastal habitats, with estuaries and wetlands particularly vulnerable
- **Changes in coastal morphology**, changes in sea level with an increase in intensity of coastal storms tend to exacerbate coastal erosion and deposition risk
- **Salt water intrusion of groundwater** with rising sea levels means that the risk of inundating groundwaters is even greater
- **Increased groundwater levels** in tidal regions, with more flooding of old basements
- **Risks to wastewater infrastructure** - sea level rise can result in overflows from combined drainage systems being unable to function, resulting in increased flood risk on land. Also, as wastewater treatment plants and sewage pumping stations are often located close to the coast, these facilities are at particular risk
- **Damage to critical infrastructure and housing** from coastal flooding and sea level rise. This results in economic and social risks to Dublin City, especially since housing and major infrastructure (roads, DART lines) are along the coast
- **Increased wave heights and high tides** producing damage further inland and upstream. This makes Dublin City especially vulnerable, as increased wave height and high tides can affects tidal rivers like the Liffey

Figure 9 Areas at Flood Risk in Dublin due to Predicted Future Sea Level Rise (Source: DCC - Leahy)

FUTURE RISKS

"In terms of relative land vulnerabilities, Dublin, Louth and Wexford are at highest risk. Under a projected sea level rise of 6m, it is estimated that close to 1,200 km² of land area would be at risk."[17] Future projections indicate continued sea level rise will be 3-4 mm per year globally[20], but 6-7 mm per year is the recorded average sea level rise in Dublin Bay for the period between 2000 and 2016. This, coupled with increased wave heights, tides and frequency of coastal storms, means that coastal communities will face increased economic, social and environmental vulnerabilities. At the same time, intense rainfall will also see fluvial influences in the tidal area downstream.

Figure 9 on the previous page shows the coastline in Dublin City that is at risk in yellow; this is an area of economic and environmental importance to the City, as it is home to a large part of Dublin's technology sector and the Dublin Bay UNESCO Biosphere (see case study on Page 88). An increase in temperature results in a rise in sea surface temperature, which results in the continual increase in sea level rise. A rise in sea levels also has a knock-on effect for other risks, as it increases the intensity of storm activity and wave action. Models comparing 1900-1961 data show that for the period between 2031-2060, storm surge heights of between 50-100 cm will increase in frequency[17]. This will make Dublin City very vulnerable, and would result in increased loss of land, damage to infrastructure and coastal flooding.

The amount of rainfall (specifically in the summer) is expected to decrease as a result of climate change, and Dublin City will become more reliant on groundwater to supply freshwater as a result.

RISK MATRIX

Table 4 Sea Level Rise Risk Matrix

IMPACT AREAS	DESCRIPTION	PARAMETER	CONSEQUENCE	LIKELIHOOD	FUTURE RISK
Critical Infrastructure & the Built Environment	Increases in sea levels and wave overtopping, along with increased occurrence of coastal storms, will put the built environment at risk. This will include housing and critical infrastructure, which are typically built along the coast	Sea Level Rise	5	5	**25**
		Wave Height	4	3	**12**
		Tides	4	4	**16**
		Storm Surges	4	2	**8**
Transport	Projected rises in sea level, wave heights and occurrence of coastal storms will put transport services (such as roads and the DART) that are along the coast and close to tidal rivers at increased risk	Sea Level Rise	4	5	**20**
		Wave Height	4	3	**12**
		Tides	3	4	**12**
		Storm Surges	4	2	**8**
Biodiversity	Rising sea levels, wave heights and occurrence of coastal storms will greatly affect coastal habitats, with estuaries and wetlands being particularly at risk	Sea Level Rise	4	5	**20**
		Wave Height	4	3	**12**
		Tides	3	4	**12**
		Storm Surges	4	2	**8**
Waste Management	Increases in sea levels and tides will put pressure on sanitation systems (these are typically situated at low levels) located close to the coast	Sea Level Rise	4	5	**20**
		Wave Height	4	3	**12**
		Tides	4	4	**16**
		Storm Surges	2	2	**4**
Water Resources	Rising sea levels, wave heights and tides put water supply and aquifers at risk. Therefore, sea level rise will need to be constantly managed to avoid flooding and salt water intrusion of groundwater, which may lead to a greater risk of inundating groundwaters	Sea Level Rise	4	5	**20**
		Wave Height	3	3	**9**
		Tides	4	4	**16**
		Storm Surges	3	2	**6**

SEA LEVEL RISE ADAPTATION ACTIONS

The priority of these actions is to reduce and address the current and future effects of sea level rise. Some of the solutions that have been adopted by Dublin City Council include:

- Approaches that reduce coastal flooding and erosion through the addition of artificial sediments, dune rehabilitation and restoration
- Grey solutions, which include infrastructure such as seawalls that protect nearby infrastructure from coastal flooding and sea level rise. Infrastructure for adaptation is designed to best available information and flood proofed through areas located above current and projected floor levels
- Restoration of wetland ecosystems along the coast, in order to provide natural protection against flooding and erosion
- Regulatory measures such as creating development and buffer zones, to ensure that no development takes place in areas subjected to coastal flooding

Some of these adaptation actions may be seen in Figure 10 below, which depicts the tidal flood extents and the areas that have been defended in the Dodder Catchment.

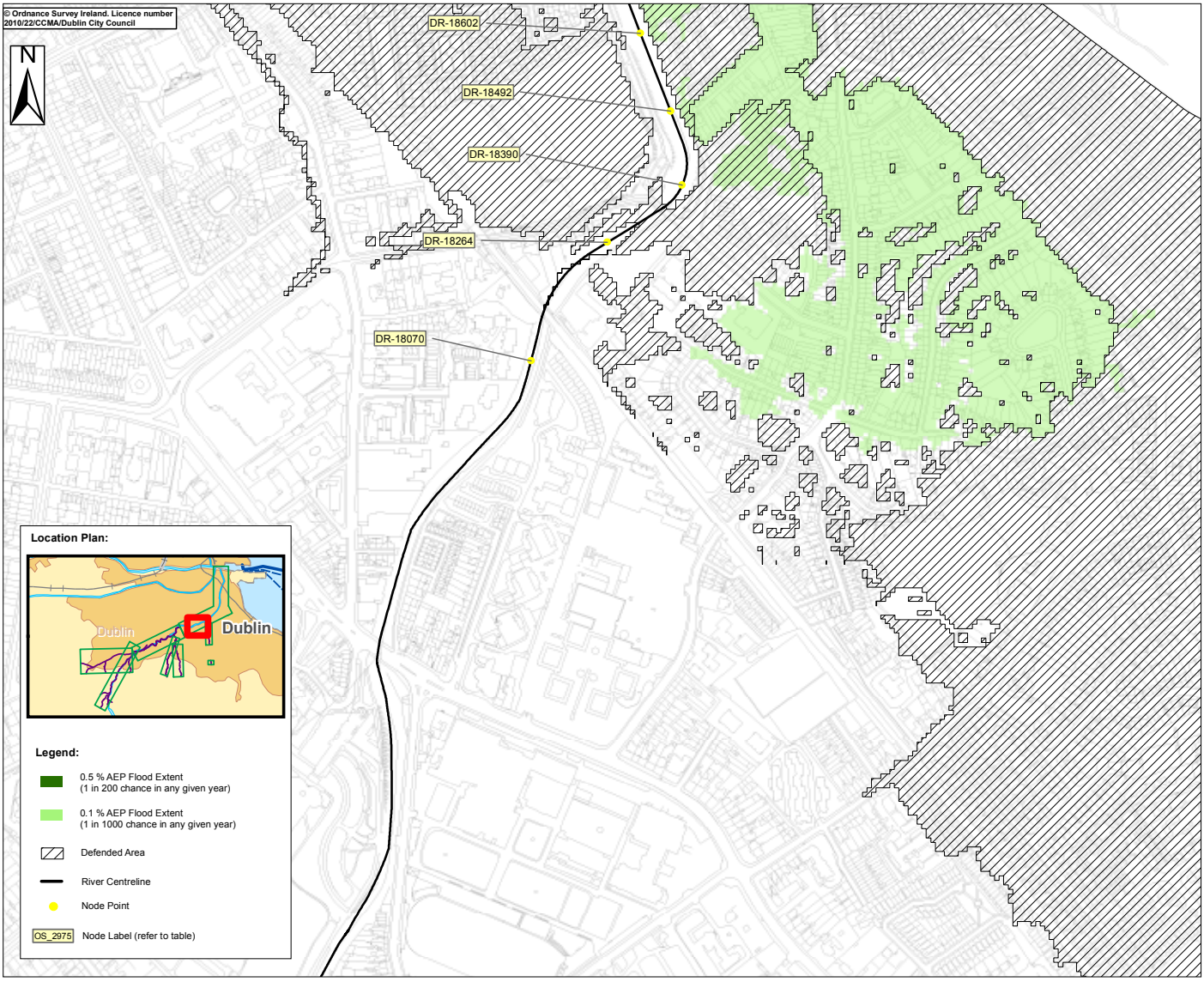


Figure 10 Dodder Tidal Flood Extents (Source: Adapted from RPS/OPW)

FLOODING

The effects of urbanisation and climate change both impact and increase the risk of flooding. This is the case for Dublin City, which is a coastal city and has a complex system of rivers, canals, surface-water sewers, foul sewers and urban watercourses.

Flooding can have multiple causes, including sea level rise, run-off water, heavy rainfall, extreme events, storms and tidal surges. Dublin City experiences several types of flooding, including:

- **Coastal and tidal flooding** resulting from storm surges, wave action causing flooding by overtopping flood defences, or other extreme weather events that cause sea levels to rise above the norm and force sea water onto land
- **Fluvial flooding** is caused by rainfall (extended or extreme), resulting in rivers exceeding their capacity
- **Network flooding** resulting from urban drainage systems being inundated with water and exceeding their capacity
- **Pluvial flooding** from intense and sudden rainfall running over-ground and exceeding capacity of local drainage systems is a key risk across the whole City
- **Groundwater flooding** results when groundwater rises up from an underlying water table and can flood surface and sub-surface infrastructure; occurs during sustained rainfall events and affects low-lying areas of the City
- **Flooding from dam** discharges or breaches

BASELINE ASSESSMENT

As outlined earlier in Table 1, there are very few records of significant flooding events between the years 1986 and 2000. More extreme weather events have been noted between the years 2000 and 2002, and from 2008 onwards, as can be seen from the Timeline of Major Climatic Events (Figure 4), their frequency increased at a significant rate.

It is important to note that flood risks may not be attributed to just one cause and could be due to multiple factors that result in major flooding. This is demonstrated in Figure 11, which shows the locations of the different flooding types that occurred in October 2011. The increased pressure on sewers and drainage systems caused multiple flooding of this critical infrastructure.

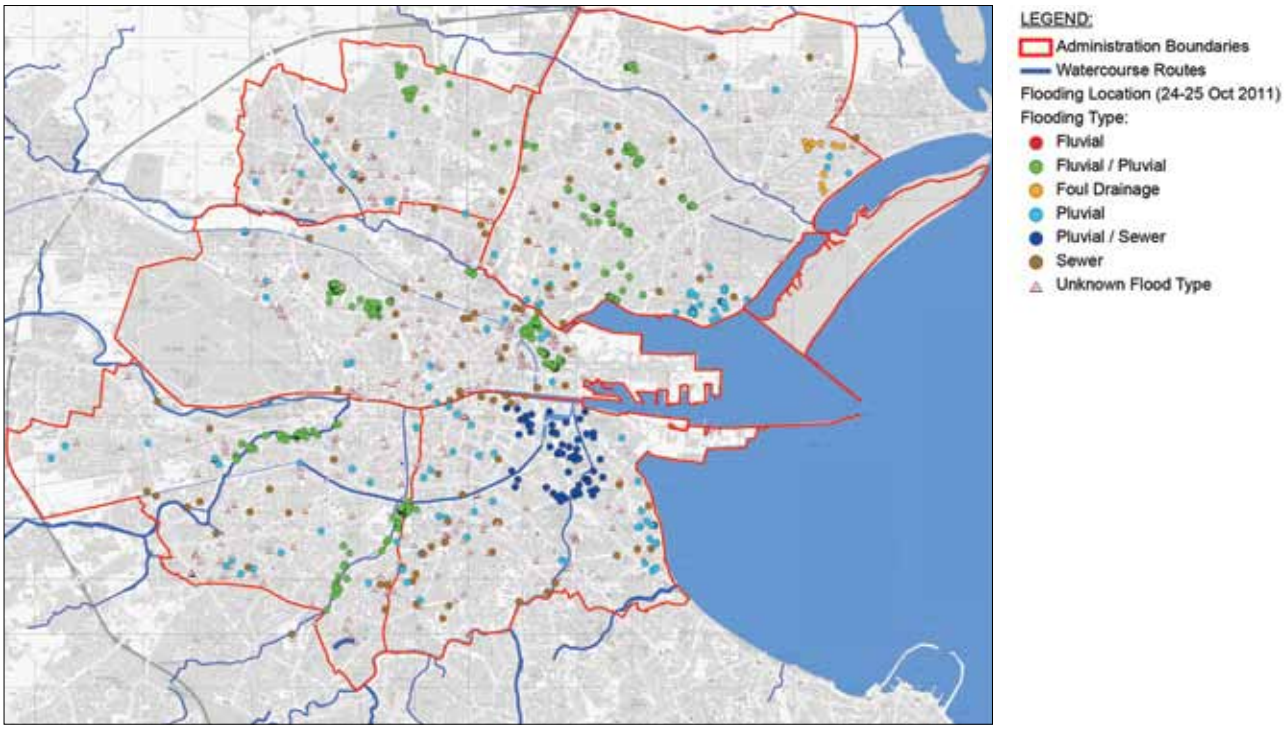


Figure 11 Identified Flood Type at Reported Flood Locations (Source: Adapted from DCC)

FLOOD RISKS

Dublin City faces significant flood risks; in addition to being a coastal City, much of the City is built on reclaimed land at the mouth of the River Liffey, into which the River Poddle, River Dodder and River Camac flow, as shown in Figure 12 (rivers in red are at risk of flooding).

The extent of flood damage due to rivers may also be seen in Figure 13, which depicts the potential risk from the River Dodder. This shows how even just one river flooding would impact on a large population and would cause significant damage to the surrounding area.

Flooding risks are further complicated by riparian rights. Some property or land-owners who own land that is adjacent to a watercourse, or has a watercourse running through it, are riparian owners and have certain legal responsibilities to maintain the watercourse. Dublin City Council therefore works to inform residents and business owners of their riparian responsibilities.

Figure 12 Dublin City Rivers at Risk of Flooding (Source: EPA)

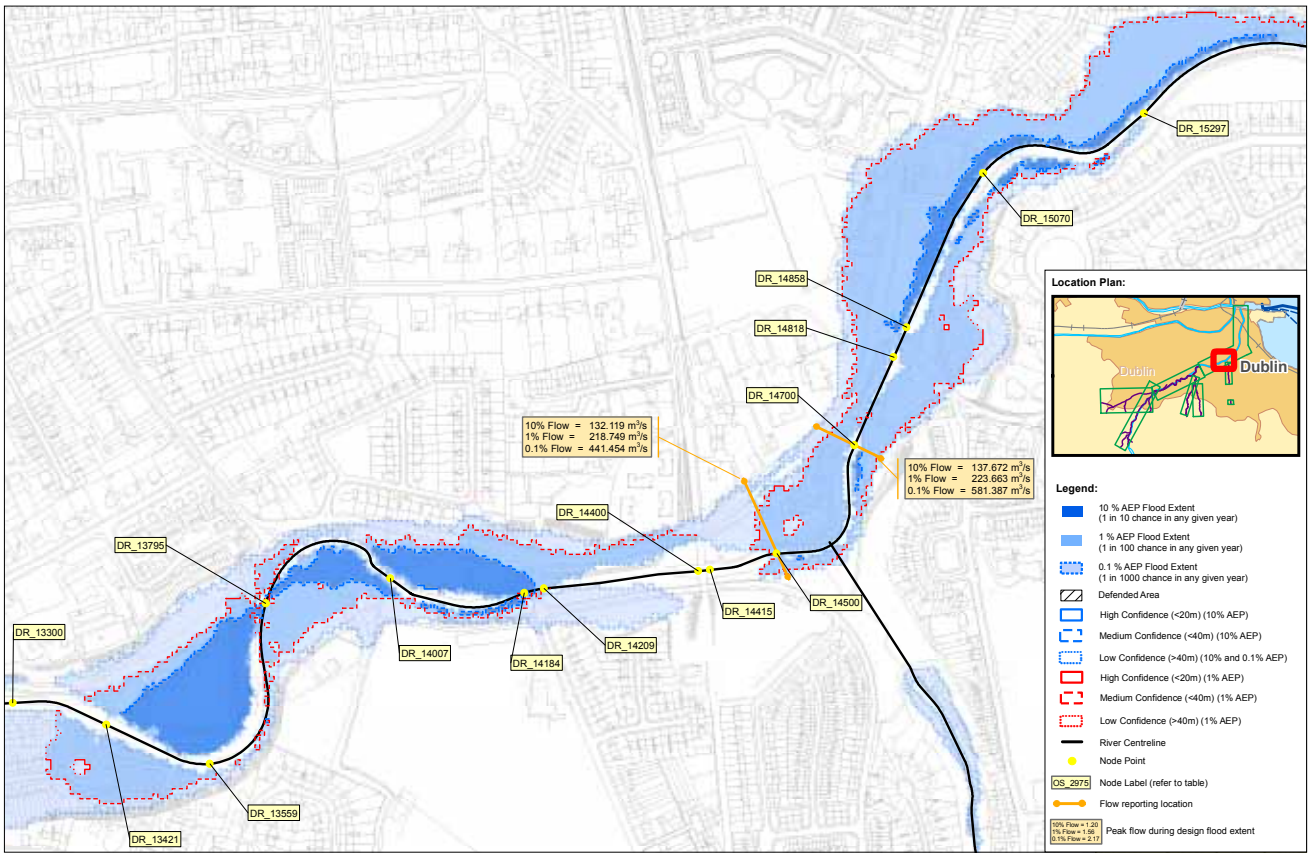


Figure 13 Dodder Flood Extents (Source: Adapted from OPW/RPS)

FUTURE RISKS

With climate change, it is predicted that the probability of flood events occurring will increase, e.g. a 1-in-100-year event may become a 1-in-25-year event instead. The number of heavy rainfall days per year is also projected to rise, resulting in a greater risk of both fluvial and pluvial flooding.

Figure 14 on the opposite page depicts a pluvial study carried out in Dublin City and the Annual Event/ Exceedance Probability (AEP) is used; this is the chance of an event occurring in a year, i.e. there is a 1-in-100 chance that a flood will occur.

Future flood risks will be dependent on urban settlement patterns, land use and the quality of flood forecasting, warning and response systems in place. Dublin City is especially vulnerable to future risks, due to the projected population growth over the coming years. This increased risk of flooding will affect Dublin City's already vulnerable systems, in terms of increased pressure on water and sanitation systems, and damage to critical infrastructure and property.

RISK MATRIX

Table 5 Flooding Risk Matrix

IMPACT AREAS	DESCRIPTION	PARAMETER	CONSEQUENCE	LIKELIHOOD	FUTURE RISK
Critical Infrastructure & the Built Environment	Coastal, fluvial, pluvial and groundwater flooding will put additional stress and risk on the built environment. This additional risk will cause all areas in the built environment to suffer (businesses, residential, critical infrastructure, etc.)	Coastal & Tidal	5	5	**25**
		Fluvial	5	5	**25**
		Pluvial	4	4	**16**
		Groundwater	4	3	**12**
Transport	Increases in coastal, fluvial and pluvial flooding will cause road damage, which can lead to disruptions to all transport services	Coastal & Tidal	5	5	**25**
		Fluvial	5	5	**25**
		Pluvial	4	4	**16**
		Groundwater	4	3	**12**
Biodiversity	Flood events can cause loss of habitats and damage to ecosystems	Coastal & Tidal	4	5	**20**
		Fluvial	3	5	**15**
		Pluvial	2	4	**8**
		Groundwater	2	3	**6**
Waste Management	Flooding of landfill sites increases the risk of surface and groundwater contamination	Coastal & Tidal	4	5	**20**
		Fluvial	3	5	**15**
		Pluvial	4	4	**16**
		Groundwater	5	3	**15**
Water Resources	Increases in flooding incidents put more pressure on water systems, which are typically located at the lowest elevation possible and are therefore at a greater risk of flooding	Coastal & Tidal	5	5	**25**
		Fluvial	4	5	**20**
		Pluvial	4	4	**16**
		Groundwater	5	3	**15**

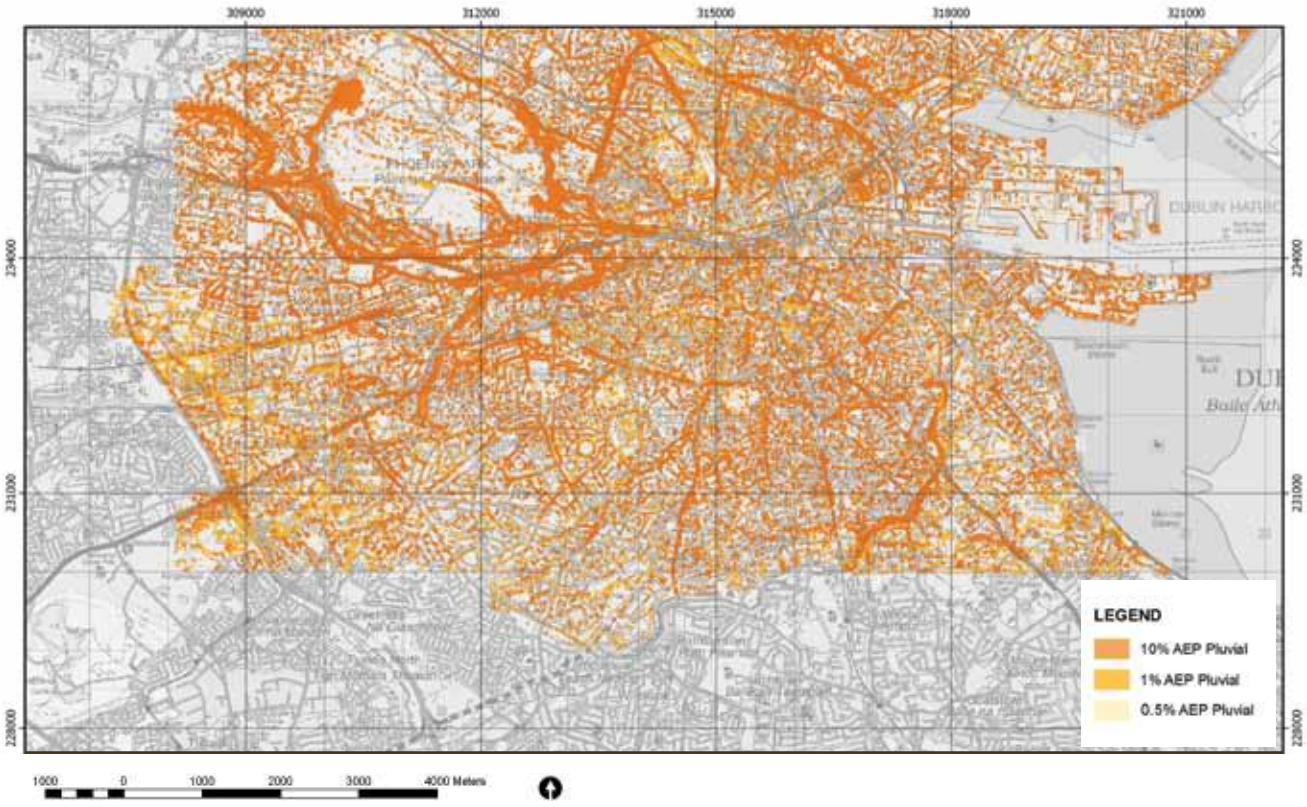


Figure 14 Dublin Pluvial Study (Source: Adapted from Dublin City Council)

FLOODING ADAPTATION ACTIONS

The purpose of flooding adaptation actions is to reduce the effect of flooding events, and they should tackle both current and future risks from flooding. The objectives of flood adaptation actions are:

1. **Economic** – ensure that expenditure for flood risk management is based on risk
2. **Social** – reduce risk to life and health, while protecting key infrastructure and ensuring that there is no increased risk to other areas
3. **Environmental and heritage** – protect, and enhance if possible, biodiversity and cultural heritage

Dublin City has increased flood resilience through the use of spatial planning and infrastructural projects (which include nature-based solutions). Some of these adaptative measures include:

- **Community and business flood resilience measures** – such as coastal flood forecasting and monitoring systems to forecast coastal surges and local flood risk groups. This also includes engaging with local flood risk groups and individual retrofitting flood defence measures
- **Site specific measures** – this may involve using existing natural landscapes or existing infrastructure to reduce flooding
- **Generic measures** – such as Sustainable urban Drainage Systems (SuDS), which is mandatory for all new developments. If SuDS cannot be provided for at the site, then there must be alternative means of reducing run-off. To reduce flood risks in new developments, the *Greater Dublin Strategic Drainage Study* states that no new development is permitted within 10-15 metres on either side of watercourses, planning applications must include a surcharge risk assessment and drainage systems must be isolated from basements
- **Flood management** - the use of *The Planning System and Flood Risk Management Guidelines* from the Office of Public Works (OPW), as a measure for flood management and adaptation. These guidelines are to be properly implemented and included in any development, planning and flood mitigation/adaptation measures
- **Flood resilient design** - provide for flood resilience in the early stage of the design process, including the use of Light Detection and Ranging (LIDAR) surveying methods

This is the case for the Dodder catchment area, where flood risk management measures were used to control and manage flood risk to urban and rural areas. This included:

- Making use of existing defence structures, such as riparian boundary walls
- Operation of the lower Bohernabreena reservoir; this was used as additional storage during a major storm event to reduce flooding in the catchment area
- Raised property floor levels and limited development in the area
- SuDS
- Flood defence asset surveys as part of a Catchment Flood Risk Assessment and Management (CFRAM) study carried out on the Dodder (see Figure 15 on the next page)
- Tidewatch, which is a flood forecasting system
- Overland flow mapping through Light Detection and Ranging (LIDAR)
- Retrofitting flood defence measures such as flood doors, air vent covers, etc.

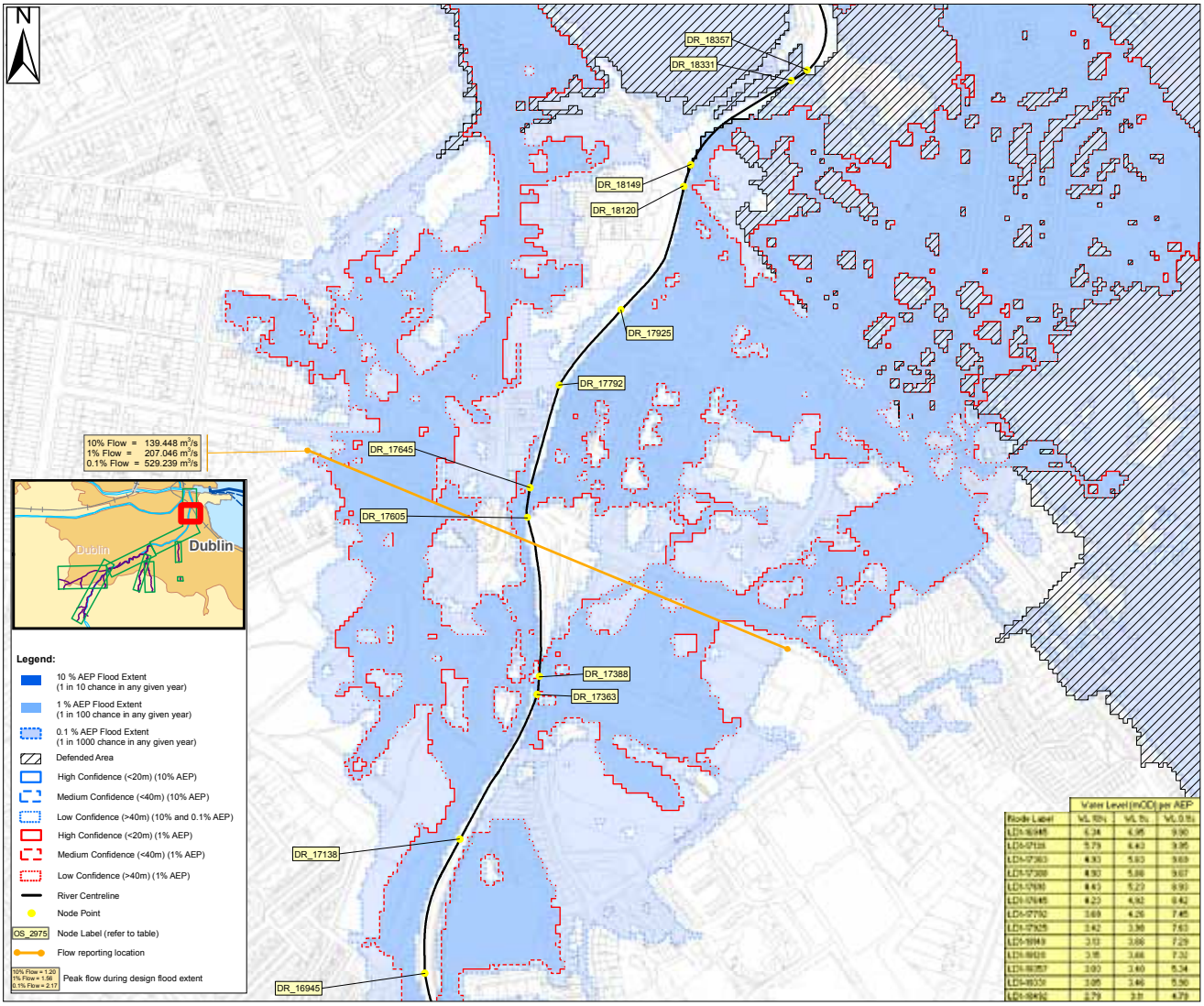


Figure 15 Location of the Surveyed Defended Areas (Source: Adapted from Dodder CFRAM Study)

AIR POLLUTION AND AIR QUALITY

Air quality is a measurement of the concentration of specific pollutants harmful to human health. Changes in climate, especially increases in temperature, will impact the concentration of pollutants in the air; as temperatures increase, so too will the concentration of pollutants. This is also the case with the changing strength and frequency of high wind speeds due to climate change, which may cause pollutant dispersion and could potentially affect a larger area and population.

Air quality policy focuses on the reduction of pollutants, both greenhouse gases (GHGs) and the more immediate, harmful particulates and dioxins. Reducing the concentration of GHGs (i.e. mitigation) means lessening or eliminating the use of carbon-based fuels and moving to renewable sources of energy and carbon absorption by vegetation[22,23,24].

BASELINE ASSESSMENT

Presently, the air quality in the Dublin Region is good, with levels of nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM_{10} and $PM_{2.5}$) all within acceptable levels of European Union (EU) guidance. New guidance from the World Health Organisation (WHO) concentrates on the health implications of air quality (even air quality that is within the acceptable levels) and how to mitigate against this. In order to ensure robust, localised mitigation for health issues, accurate data is needed on the air quality of a region. There are currently 13 active air quality monitoring stations located across Dublin; however, they do not monitor all GHGs and particulate matter at each station. In recognition of the need for more robust data, Dublin City Council is currently working with the EPA to collect data on air quality in the Dublin Region under the new national Ambient Air Quality Monitoring Programme (AAMP). The use of sensors to collect localised, accessible, real-time data will assist in the development of policy to address air quality and pollutants, such as the *National Clean Air Strategy*, which is to be released in 2019.

AIR POLLUTION AND AIR QUALITY RISKS

Air pollutants depend greatly on the climate and characteristics of the area. Dublin's emissions from the transport sector, construction industry and the burning of waste and emissions from industrial activities, all make the City vulnerable to pollutants.

Air pollution and air quality risks mainly relate to health and risks to ecosystems. Vulnerable citizens (children, pregnant women, the elderly and those of ill health) are the most likely to be at risk. The risk to health may include worsening respiratory issues and a reduction in lifespan. Meanwhile, ground level poor air quality may put food production (e.g. crops) at risk due to elevated ozone concentration. Excessive pollutants may result in acid rain from air pollution and eutrophication, which is caused by pollutants being distributed to plants and rivers from run-off water.

This is also exacerbated by prolonged increases in air temperatures. Air quality monitors on the national ambient air quality monitoring network detected elevated ozone concentrations during the summer 2018 heat wave, with increased levels of ground level air pollution.

FUTURE RISKS

Existing risks may be further exacerbated in the future, especially with a projected population growth. As the City's population grows, so does the need for transportation and transport networks, energy, waste disposal and housing. Any new technologies (biomass, etc.) introduced to tackle climate change will need to be assessed for impacts on air quality.

Emissions of air pollutants, particularly PM_{10} and NO_X (nitrogen oxide), from road traffic and residential solid fuel, burning of peat, coal and wood, remain the biggest threat to air quality in urban areas[25]. Even though the new standards for car emissions have resulted in cleaner fuels and reduced emissions, Ireland has still seen an increase in both the number of cars and their engine sizes. Also, there has been a shift to diesel engines in recent years, which are lower in CO_2 but are higher in particulate matter.

Dublin City has had an increase in construction and development over recent years, and construction is projected to grow with the increased demand for housing from a growing population. As construction and demolition in the City increases, so do airborne emissions and dust particles, which further aggravate health issues in the population.

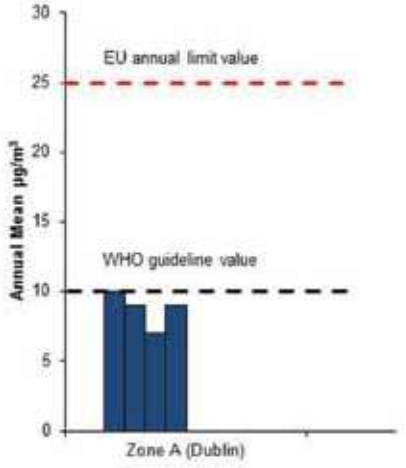


Figure 16 Annual Mean $PM_{2.5}$ (Fine Particulate Matter) Concentrations at Individual Stations in 2016 (Source: EPA)

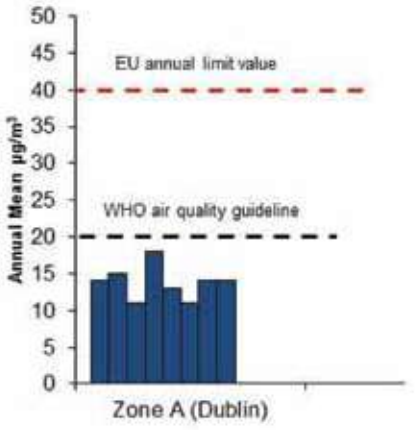


Figure 17 Annual Mean PM_{10} (Particulate Matter) Concentrations at Individual Stations in 2016 (Source: EPA)

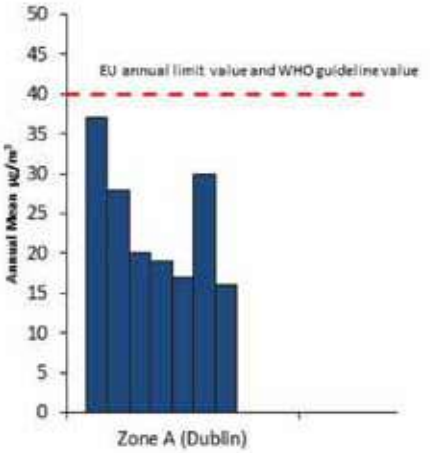


Figure 18 Annual mean NO_2 (Nitrogen Dioxide) Concentrations at Individual Monitoring Stations in 2016 (Source: EPA)

AIR POLLUTION AND AIR QUALITY ADAPTATION ACTIONS

Air pollution and air quality adaptation actions aim to reduce and monitor the effects from air pollution. This is done through policy and legislation to regulate pollutants generated from different energy sectors in Dublin City. The two sectors that impact most on air quality are home heating and transport. A shift from the burning of solid fuel to cleaner, more energy efficient methods of home heating and a move away from the use of private diesel and petrol powered motor cars to alternative modes of transport such as walking, cycling and electric vehicles will result in cleaner air and a healthier environment for citizens. This is especially important in our at-risk urban environments. To incentivise and complement these behavioural changes in the public, it is imperative that Ireland adopts policy solutions that can marry the twin issues of ambient air quality and climate change mitigation. The government's *National Clean Air Strategy*, which is due for publication, should point the way forward in terms of policy solutions for Ireland in this regard.

Actions adopted by Dublin City Council include:

- Effective enforcement controls - *The Air Pollution Act 1987* to regulate and monitor illegal burning, excessive emissions from industry and dust emissions from the construction industry
- Transport policies to reduce pollutants. This includes the provision of cycle routes, increased park and ride facilities, a restriction on heavy goods vehicles in the City Centre and the expansion of Quality Bus Corridors (QBCs)
- Control of development whilst giving preference to high density occupancy developments that are close to public transport routes and amenities
- Environmental Impact Assessment (EIA) and Statements required for large developments that apply for planning permission. EIAs should provide details of impacts that the development will have on air quality
- Reviewing and updating of emission inventories, urban air quality modelling and ambient air quality monitoring

EMERGENCY RESPONSE PLANNING

The adaptation baseline has shown that extreme weather events due to a changing climate are increasing in both frequency and intensity, and can pose a risk to citizens and infrastructure. This highlights the need for emergency planning, with plans that are continually updated in line with these extreme weather events. The Major Emergency Management (MEM) Framework sets out the working relationship between the various agencies that make up the front line emergency response. The MEM Framework defines a major emergency as:

"Any event which, usually with little or no warning, causes or threatens death or injury, serious disruption of essential services or damage to property, the environment or infrastructure beyond the normal capabilities of the principal emergency services in the area in which the event occurs, and requires the activation of specific additional procedures and the mobilisation of additional resources to ensure an effective, co-ordinated response"[26].

The MEM Framework enables Principal Response Agencies (PRAs), which are made up of An Garda Síochána, the Health Service Executive and local authorities, to prepare and make a coordinated response to major emergencies. Small-scale events are dealt with by Principal Emergency Services (PES), which include An Garda Síochána, the Ambulance Service, the Fire Service and the Irish Coast Guard. Defence Forces, voluntary emergency services, transport companies and affected communities can support PRAs by managing major emergencies.

Figure 19 below shows the national, regional and local structures that have been set up to support the development of the Framework.

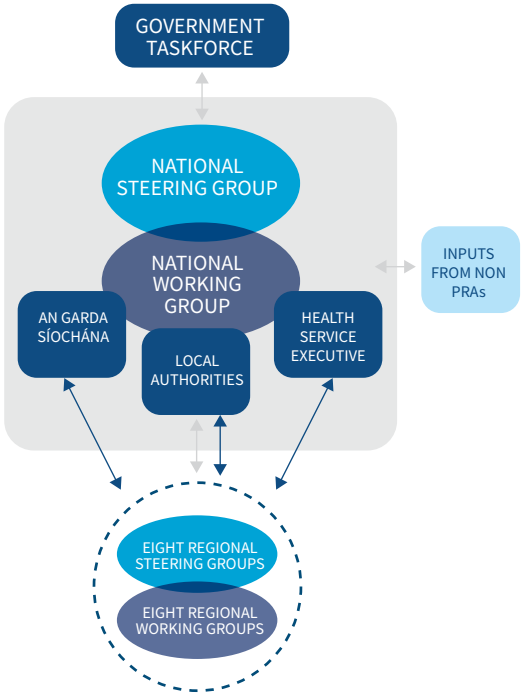


Figure 19 Structures for Implementation (Source: Major Emergency Management Framework)

EMERGENCY RESPONSE AT A LOCAL AND REGIONAL LEVEL

Dublin City Council is part of the Major Emergency East Region, and is a Principal Response Agency (PRA). The Dublin Fire Brigade is DCC's Principal Emergency Service (PES) and the Council administers the Dublin Fire Brigade on behalf of Dún Laoghaire-Rathdown County Council, Fingal County Council and South Dublin County Council. The *Dublin City Council Major Emergency Plan 2015*[27] includes an ongoing emergency programme that involves hazard analysis and risk assessment, response planning, recovery planning and involvement in inter-agency training, exercises and regional forums.

Each Council department undertakes an appraisal of their current procedures and operational plans to ensure compatibility with the major emergency planning documents.

When a major emergency is declared, senior management within the local authority, An Garda Síochána and the Health Service Executive establish a local coordinating group. Key roles in this group include a controller of operations, an on-site coordinator and DCC's Crisis Management Team (CMT).

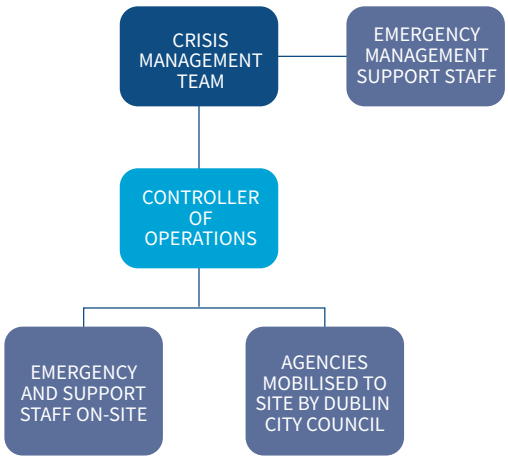


Figure 20 Local Authority Control of Resources (Source: DCC Major Emergency Plan 2015)

The CMT is a strategic level management team within DCC and reports directly to the Chief Executive. The CMT is assembled during a major emergency, and is responsible for the following:

- Manage, control and coordinate DCC's overall response to the major emergency
- Provide support to DCC's Controller of Operations on site and gain resources from DCC or externally
- Liaise with relevant government departments on strategic issues
- Ensure participation of DCC in the inter-agency coordination structures

EMERGENCY RESPONSE SERVICES & RESOURCES

The Dublin Fire Brigade provides the primary response to emergencies in the City. DCC supports this response by providing, amongst others, the following functions:

- Coordinating the delivery of services from all Council departments
- Making buildings such as leisure and community centres available to people displaced by the emergency
- Providing a volunteer Civil Defence organisation
- Providing advice and assistance with clean up after major flooding or pollution
- Assessing structural damage to buildings
- Coordinating and leading multi-agency meetings to plan community recovery

The Dublin Fire Brigade coordinates meetings, activities, training and support for the DCC Crisis Management Team, including carrying out a review of the Major Emergency Plan and Severe Weather Plans.

SUB-PLANS FOR RESPONDING TO SEVERE WEATHER & FLOOD EMERGENCIES

Severe Weather Plans are a sub-plan of the Emergency Plan, and can be activated in preparation, response to or recovery of a major emergency. Severe weather emergencies may pose significant threats to the areas within the local authorities' boundary, so therefore they are the lead agency for coordinating the response to severe weather events in their area. Met Éireann issues public service severe weather warnings to DCC, with the target time for issuing a warning being 24 hours before the start of the event, or up to 48 hours in advance when confidence is high.

DCC's Drainage and Wastewater Services Division has set measures to receive and respond promptly to public service severe weather warnings issued by Met Éireann, and has its own coastal flooding forecasting and monitoring systems to forecast coastal surges.

MITIGATION BASELINE

DUBLIN CITY COUNCIL'S ENERGY USE & EMISSIONS

Dublin City Council (DCC) is responsible for the energy use and emissions from its buildings and facilities, its public lighting, and also from its vehicle fleet. The information from the Sustainable Energy Authority of Ireland's (SEAI's) Monitoring and Reporting (M&R) database shows that DCC consumed a total of 186 gigawatt hours (GWh) of primary energy in 2017. The energy database also shows that DCC improved its energy performance by 29.8% between the baseline year (which is an average of between 2006 - 2008) and 2017, which represented a cumulative absolute saving of 39.9 GWh of primary energy during the same period.

This highlights a gap-to-target of 3.2%, meaning that DCC must improve its energy performance by a further 3.2% between now and 2020, in order to meet its 33% energy reduction target.

The buildings and facilities were the highest energy consumers, accounting for 63% of the Council's overall primary energy consumption. This is mainly due to the large number of Council-owned buildings. Public lighting was the second highest energy consumer, accounting for 25% of the total energy consumption, while the municipal fleet accounted for 12% of the total energy use.

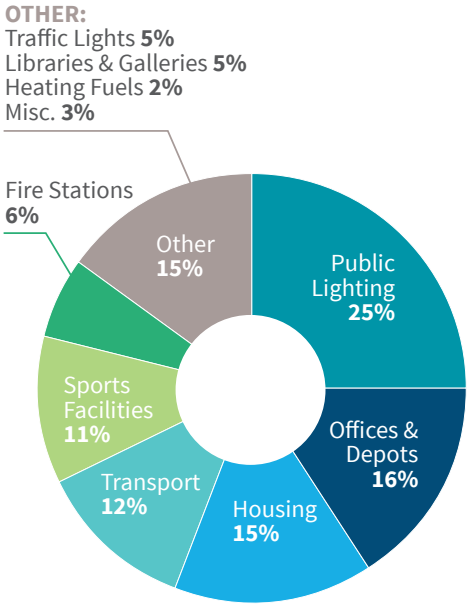


Figure 21 Significant Energy Users

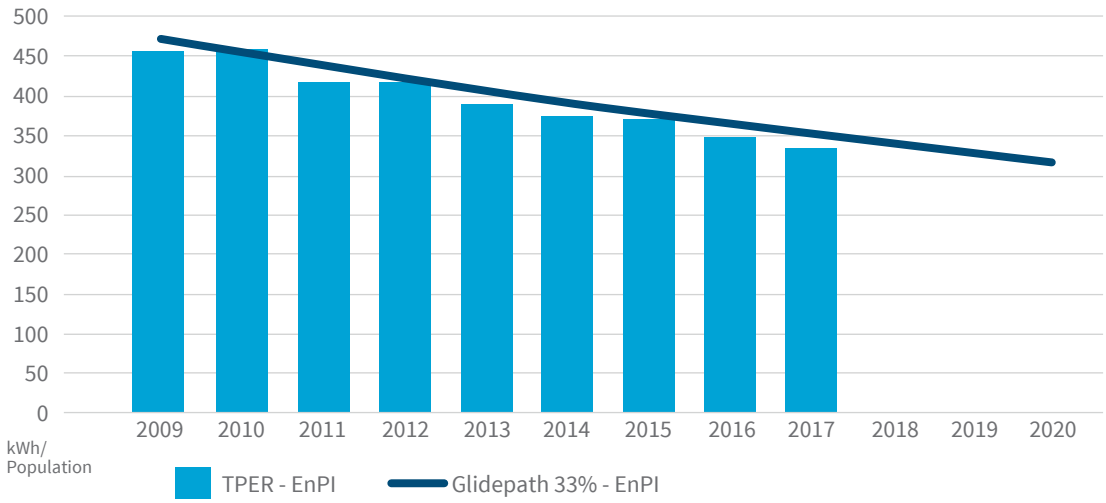


Figure 22 DCC's Annual Energy Performance Compared to the 33% Glidepath

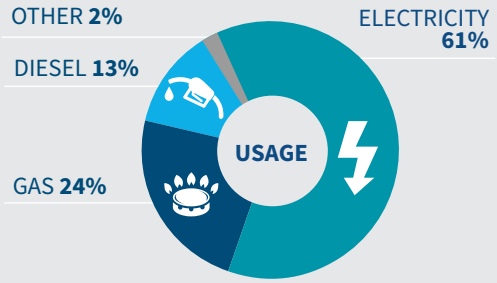
DCC EMISSIONS OVERVIEW

TOTAL EMISSIONS PRODUCED BY DCC IN 2017

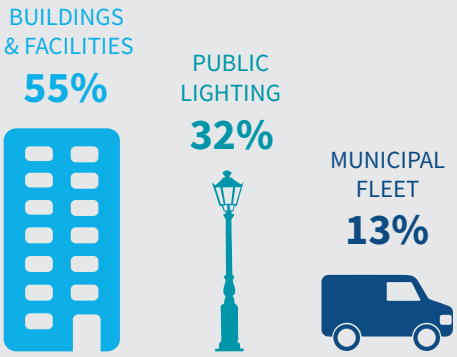
40,370

TONNES OF CO_2

DCC'S EMISSIONS PER FUEL TYPE



DCC'S EMISSIONS PER CATEGORY



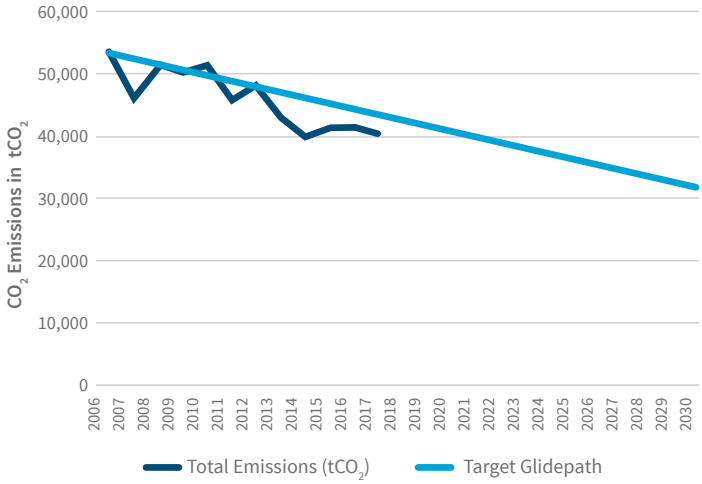


Figure 23 DCC's Emissions 2006-2017, with Projected Glide Path to the 40% Reduction Target by 2030

As a signatory to the Covenant of Mayors for Climate and Energy, DCC is committed to reducing its own carbon emissions by 40% by 2030, compared to the baseline year.

Figure 23 above shows that DCC's emissions decreased from 53,240 tonnes of CO_2 in 2006 to 40,370 tonnes of CO_2 in 2017. This means that DCC is now 8,430 tonnes of CO_2 (16%) away from the 2030 target of a 40% emission reduction from its baseline year.

In 2017, the Council's total emissions amounted to 40,370 tonnes of CO_2. Buildings and facilities were the highest contributors, accounting for 55% of total emissions. This was followed by public lighting and the municipal fleet, each contributing 32% and 13% to the Council's emissions, respectively.

Figure 23 shows DCC's emissions from 2006 to 2017, with a projected glide path to the 40% reduction target by 2030. In 2017, 61% of the Council's emissions came from electricity; this was mainly due to the large amount of electricity used in public lighting and in the Council's buildings and facilities. Natural gas was the second highest contributor of emissions at 24%. The majority of this gas was used for space heating in Council buildings and facilities. Diesel, which made up the majority of the energy used for the vehicle fleet, contributed 13% to the total emissions.

DUBLIN CITY COUNCIL'S SOCIAL HOUSING

Dublin City Council is responsible for the allocation, maintenance and refurbishment of its social housing stock, but not for the day-to-day energy use of its tenants. However, the Council can take steps to reduce these emissions, through energy efficiency upgrades.

The most recently-available information for DCC's social housing is based on the Council's social housing 2016 data and SEAI's Building Energy Rating (BER) Research Tool. A BER is a certificate of energy efficiency of a property. Properties that achieve an 'A1' rating are the most energy efficient, while properties with a 'G' rating are the least efficient. Figure 24 shows the Building Energy Ratings for all of DCC's social housing stock in 2016. The most common rating was F, which made up 21% of the total social housing stock in the City. The majority of buildings with an F rating were constructed between 1919 and 1970.

In 2016, seven social housing units in the City had an A rating, while 30% of the social housing stock was rated C3 or better. The social housing stock in Dublin City is ageing and as a result, newly-built or upgraded dwellings would typically perform better.

Figure 24 also depicts changes in the BERs over an eight-year period from 2009 to 2016. In June 2013, DCC initiated a Fabric Upgrade Programme and is continually upgrading the social housing stock to make it more efficient. Up to 2016, these actions have resulted in a 15% reduction in CO_2 emissions and have caused a shift away from E, F and G ratings, to better B and C ratings.

SOCIAL HOUSING EMISSIONS OVERVIEW

TOTAL EMISSIONS FROM SOCIAL HOUSING SECTOR IN 2016

94,040 tCO_2

30%
RATED C3 OR BETTER

30% OF SOCIAL HOUSING STOCK IN DUBLIN CITY WAS **RATED C3 OR BETTER**, WITH 'F' BEING THE MOST COMMON BER TYPE

15% REDUCTION

IN CO_2 EMISSIONS BETWEEN 2009 AND 2016 DUE TO CONTINUOUS RETROFITTING WORK

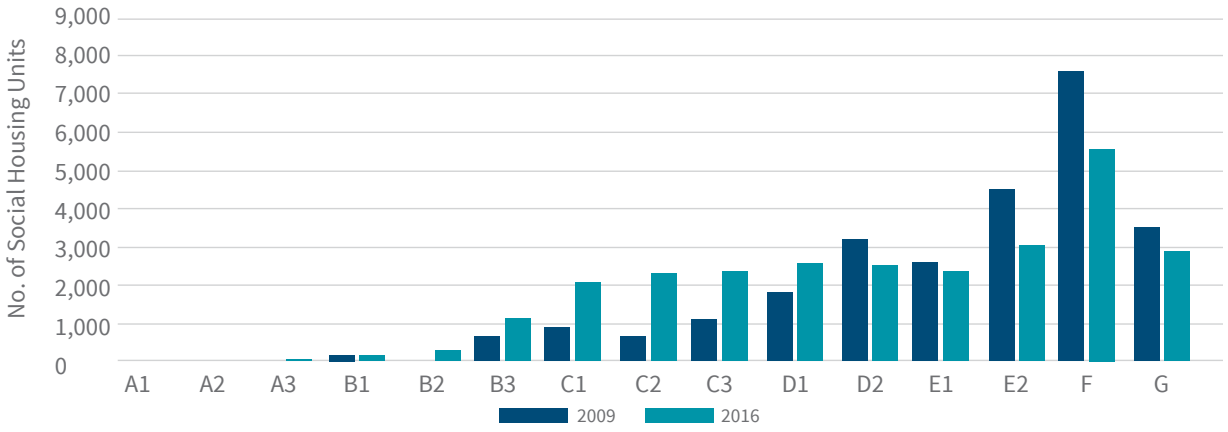


Figure 24 Building Energy Ratings for all the Dublin City Social Housing Stock in 2009 and 2016

TOTAL DUBLIN CITY EMISSIONS

The most recently-available information for total emissions in the entire Dublin City area is based on Census 2016 data. Using this data, Codema was able to calculate that the total emissions for the Dublin City area amounted to 2,810,880 tonnes of CO_2 equivalent in 2016. The sectors that produced the most emissions were the residential, commercial and transport sectors, accounting for 34.7%, 33.2%, and 24.8% of the total emissions, respectively. Dublin City Council's own emissions accounted for 1.4% of this total, with social housing contributing another 3.3%. This highlights the need for collaboration and action from all stakeholders to tackle the remaining 95.3% of emissions from public and private sector sources in Dublin City.

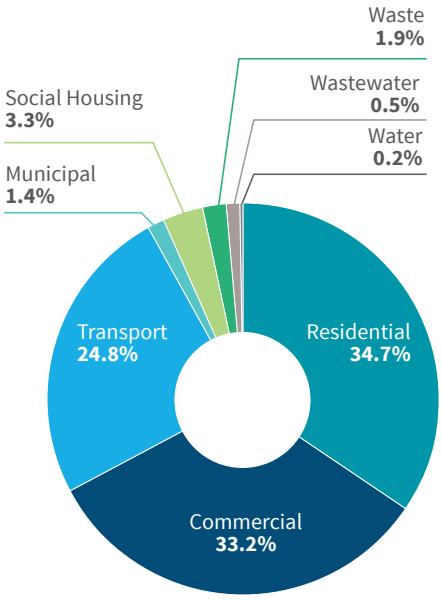
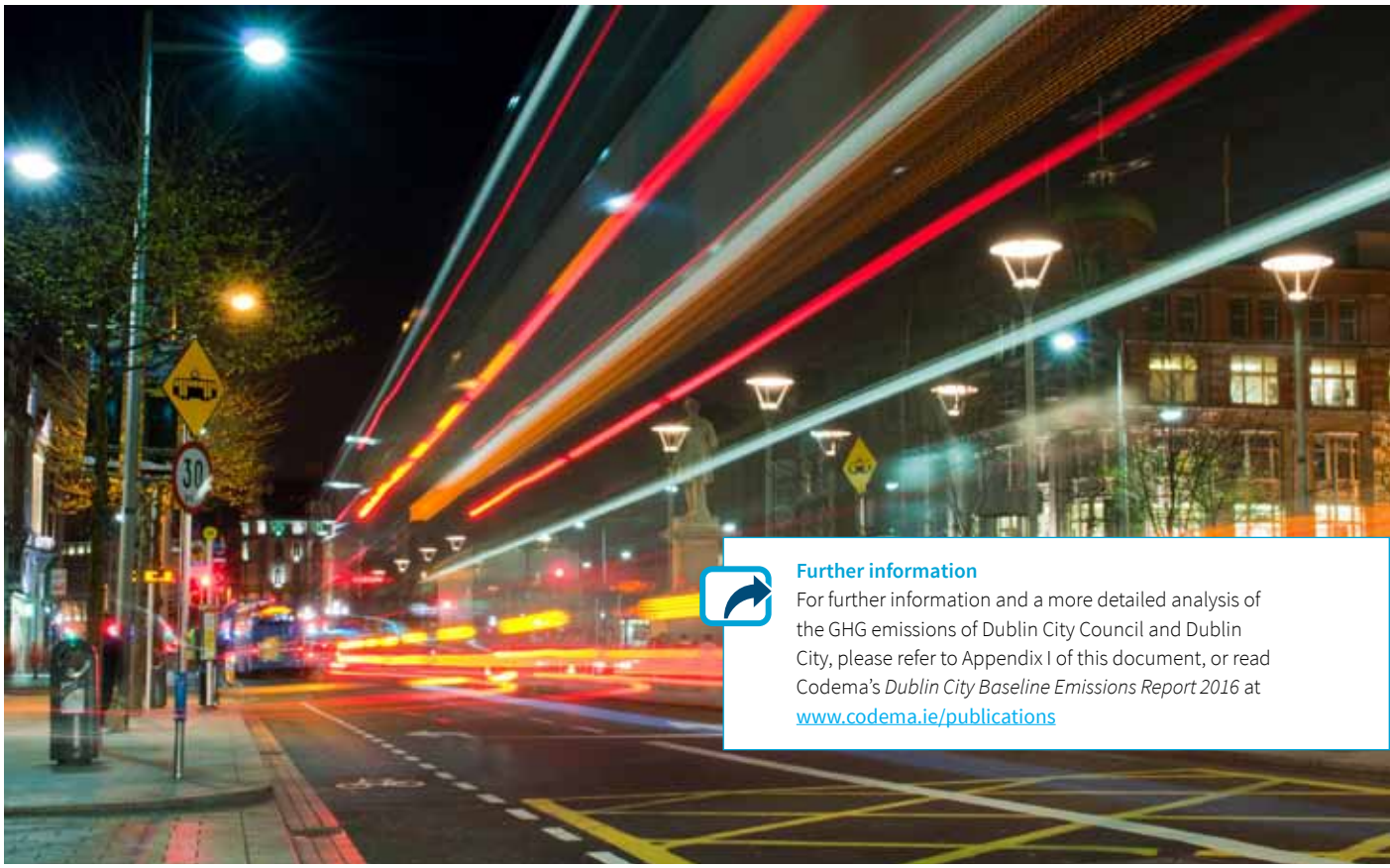


Figure 25 Total GHG Emissions for Dublin City per Sector



Further information

For further information and a more detailed analysis of the GHG emissions of Dublin City Council and Dublin City, please refer to Appendix I of this document, or read Codema's *Dublin City Baseline Emissions Report 2016* at www.codema.ie/publications

MILESTONE 3 – PLAN

Having established the current situation of Dublin City's emissions, vulnerabilities to climate change-related risks and possible future impacts, the next stage was to formulate actions to reduce these risks. The knowledge gathered through one-to-one interviews, research and an initial workshop was continued with a second workshop to refine actions and follow up input from staff. This was also an opportunity for the four Dublin Local Authorities to exchange knowledge and establish regional groups in the various action areas. This section lays out the actions that DCC will undertake to achieve this plan's objectives.

GATHERING ACTIONS & DEVELOPING INDICATORS

The actions have been organised into the following five key areas - Energy and Buildings, Transport, Flood Resilience, Nature-Based Solutions, and Resource Management. These areas reflect DCC's remit with the aim of fostering greater collaboration across the various departments within the Council.

DCC understands that it has a role to play in reducing emissions and creating climate resilience outside its remit, both as a signatory to the Covenant of Mayors for Climate and Energy and contributing to national targets. It will become a climate leader, pursuing new solutions or work practices that can be replicated by citizens, businesses or other public bodies. In order to increase awareness and acceptance of climate change risks, DCC will inform citizens through actions that raise awareness of climate issues and solutions and will facilitate projects undertaken by citizens and businesses towards climate resilience.

Figure 26 Visualising the Action Plan

ACTION AREAS:

ENERGY & BUILDINGS

TRANSPORT

FLOOD RESILIENCE

NATURE-BASED SOLUTIONS

RESOURCE MANAGEMENT

ENERGY & BUILDINGS

OVERVIEW

163 GWh
consumed in 2017

=

35,010
tonnes CO_2

TARGET

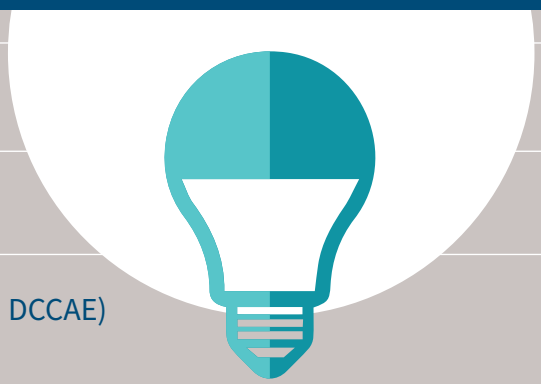
33%
IMPROVEMENT IN ENERGY EFFICIENCY BY 2020

40%
REDUCTION IN COUNCIL'S GHG EMISSIONS BY 2030

EXAMPLES OF MAIN ACTION TYPES

- Energy Master Plan for the Dublin Region
- Public lighting upgrades
- Dublin District Heating System
- Social housing retrofits
- Home Energy Saving Kits in all DCC libraries
- Upgrades in buildings using Energy Performance Contracts

STAKEHOLDERS TO WORK WITH AND INFLUENCE



- PRIVATE BUSINESSES
- PRIVATE CITIZENS
- GOVERNMENT DEPARTMENTS (e.g. DCCAE)
- SEAI
- ENERGY SUPPLIERS
- DEVELOPERS

Our vision is for a zero carbon City with all energy coming from renewable sources. All buildings will have been built or retrofitted to near zero building standards which will provide comfortable, warm, living and working environments.
- Dublin City Development Plan 2016-2022

In 2017, Dublin City Council's buildings and public lighting accounts consumed 163 GWh of primary energy, which amounted to 35,010 tonnes of CO_2. The actions outlined in this section show how, through better energy planning using energy mapping, improvements in building energy efficiency, the use of renewables, and increased innovation, DCC will reduce the emissions from its operations and service delivery. As DCC is not responsible for the upgrading of private buildings in Dublin City, it will provide information on how DCC has retrofitted social housing and Council-owned building stock, and how it has deployed renewable energy systems. DCC is also helping citizens to become more aware of their energy use by making Home Energy Saving Kits available in all of its public libraries.

ENERGY PLANNING

Currently, analyses of energy use and related emissions are carried out at a national level and are used to develop strategic national level energy policies. However, local level energy planning allows the identification of low-carbon solutions that are specifically designed to the distinct energy characteristics of the region examined.

In 2015, Codema produced the *Dublin City Spatial Energy Demand Analysis* (SEDA) to better understand the current and future energy demand and local energy resources of the City within a spatial context. Its methodology allowed for 'energy character areas' to be defined, i.e. areas with distinct types of energy needs, consumption patterns and fuel types used. These needs were then matched to the best-available technical solution incorporating renewable resources and energy-efficient solutions.

The Dublin City SEDA was the starting point for holistic energy planning in the City and, building on this work, Codema will develop an Energy Master Plan for the Dublin Region as a whole.

CASE STUDY

Photo Source: Failte Ireland / David Soanes

The Dublin Region Energy Master Plan
The Dublin Region Energy Master Plan, which will be supported by SEAI's Research, Development and Demonstration (RD&D) programme for over two years, will create evidence-based, realistic, and costed pathways for the Dublin Region to achieve its carbon emission reduction targets to 2030 and 2050. The scenario analyses will include all areas of energy use in the Dublin Region, and will be evaluated based on the socio, economic and environmental impacts. The resulting scenarios will give local authority and regional level planners, architects, engineers and other policy-makers the tools to create effective, low-carbon policies and make strategic decisions to influence the use of energy in Dublin. The plan will focus on the areas where actions can be taken to introduce energy efficiency measures and reduce CO_2 emissions, such as district energy systems and renewable energy technologies.

Across Europe there is a recognised need for increased local authority led integration between planning for climate change and spatial planning tools and strategies. In the Dublin context, County Development Plans and other plans and strategies have a key role in directing evidence-based policy responses to both climate change mitigation and adaptation.

The key objectives of advancing evidence-based climate change policy at the local level are:

- To develop a closer link between European and national climate change policy and spatial planning policy for both climate change mitigation and adaptation
- To base climate change policies and objectives on a robust spatial understanding of the existing and future energy profiles across sectors at a local authority scale
- To promote the generation and supply of low-carbon and renewable energy alternatives, having regard to the opportunities offered by the settlement hierarchy of local authority areas, the variety of land uses present, and the built environment
- To stimulate the development of a more evidence-based regional methodology for spatial mapping of future climate risks and vulnerabilities and climate change adaptation policy development
- To educate local authorities, public and private sector organisations and climate stakeholders on measures and responses that are most relevant at the local level
- To encourage greater local authority involvement and leadership in the roll-out of climate change projects in partnership with other stakeholders
- To inform and support the EU Covenant of Mayors for Climate and Energy initiative, a key aim of which is to act 'together towards sustainable, climate-resilient and vibrant cities'

With regards to the preparation of future County Development Plans, Strategic Development Zone Planning Schemes and Local Area Plans, there is an opportunity to develop or further develop integrated and standalone 'Climate Change' chapters that address both climate change mitigation and adaptation. Future spatial planning policies and objectives can become more spatially based, having regard to mapping areas suitable for energy networks, district heating projects, larger scale renewable energy projects, areas suitable for sustainable urban drainage systems and green infrastructure etc., in the urban context.

CASE STUDY

Photo Source: Fáilte Ireland

Dublin District Heating System

Through the North Lotts and Grand Canal Dock and the Poolbeg Strategic Development Zones, DCC is developing the Dublin District Heating System (DDHS) to supply low-carbon heat to houses and businesses in these areas. Waste heat will be taken from the Poolbeg Waste-to-Energy Plant and delivered through insulated pipes to the buildings connected to the system, replacing fossil fuel heating systems and therefore reducing air pollution and GHG emissions.

The project will consist of three phases; Phase 1 will focus on connecting buildings in the Poolbeg SDZ, Phase 2 will include buildings in Ringsend and Irishtown and Phase 3 will connect buildings in the North Lotts and Grand Canal Dock. This project will be the largest district heating network in the country and will save over 16,000 tonnes of CO_2 when the three phases are up and running.

Codema has already produced a Detailed Financial Appraisal and Market Research Report and Communications Strategy on behalf of the Council and the project has now secured €20 million through the Climate Action Fund. Through detailed feasibility studies, the project has shown to be technically and economically viable for a public sector investment, and once all funding is secured, the project team will procure a qualified Economic Operator to deliver the project. This project is expected to begin delivery phase in 2019/2020.

ENERGY MANAGEMENT

Monitoring and Reporting

Under S.I. No. 426 of 2014, the DLAs have an obligation to report annually on their energy performance. In practice, this annual reporting entails compiling full data of their previous year's energy consumption. This comprises mainly of MPRN data for all electricity accounts and GPRN data for all natural gas accounts, along with the annual consumption data for non-metered public lighting, heating oil and transport fuels. Codema has supported DCC with this statutory reporting to the national energy Monitoring and Reporting (M&R) system operated by the Sustainable Energy Authority of Ireland (SEAI) on behalf of the Department of Communications, Climate Action and Environment (DCCAE).

Annual Energy Reviews

Codema has produced Energy Reviews for DCC for 2016 and 2017. The aim of these Energy Reviews is to help DCC in its energy planning programme, in order to meet the public sector 2020 energy target. The Energy Reviews show a breakdown of DCC's energy use for these years, highlighting where energy was used, what drove its consumption, and where the greatest energy savings can be achieved.

This data allows Codema to develop a specific list of energy-saving recommendations, which will guide DCC on how best to tackle their Significant Energy Users (SEUs). Codema will continue to produce these annual Energy Reviews on behalf of DCC's Energy Oversight Committee (see below), in order to guide the Council on the best action to take to meet the 2020 target.

Energy Oversight Committee

Based on the findings from its Energy Reviews and the appointment of its Energy Performance Officer (EPO), Dublin City Council established an Inter-Departmental Energy Oversight Committee in 2017. Codema helped facilitate these committee meetings in order to identify and cost potential projects in areas such as Public Lighting, Offices and Depots, Housing, Fire Stations, Sports Centres, Libraries, and Transport, which will help the Council stay on track of the 2020 energy target. The first project proposals were finalised in December 2017, and are earmarked for completion in 2019. Codema will continue to work with the Energy Oversight Committee, and will aim to develop an Energy Management System within DCC, as part of this process.

Display Energy Certificates (DECs)

The information from Codema's energy database and energy surveys is used to prepare Display Energy Certificates for DCC's public buildings with a floor area greater than 250m^2, as required under the regulation S.I. No. 243 of 2012. Codema assisted DCC with the annual inspection and certification of 44 public buildings in total in 2018. This information was entered into the SEAI system and Codema issued certificates to the managers of all of these DCC buildings, along with information on how much energy would need to be saved in the following year to improve their energy rating. Each building manager also received a copy of Codema's *Guide to Display Energy Certificates in Local Authority Buildings* to accompany these certificates and encourage direct action.

ENERGY EFFICIENCY AND RENEWABLES

Council Buildings

DCC will increase its renewable energy uptake and energy efficiency through retrofits of its buildings and social housing stock. For example, the Council has already implemented energy efficiency actions in its Civic Offices, which has reduced its electrical energy consumption from 5,220 megawatt hours (MWh) in 2012 to 3,770 MWh in 2017. This has been achieved through a wide range of measures such as boiler upgrades, new pumps and a rooftop solar photovoltaic (PV) system. These PVs generate 43,000 kilowatt hours (kWh) per year and reduce DCC's dependency on fossil fuels.

PV panels were also installed in three of the Council's library branches (Cabra, Coolock and Raheny), and as a result, have cut the libraries' electricity bills by an average of 20%. DCC will aim to replicate these PV projects in other suitable buildings across the City.

In the next few years there are plans to implement further energy efficiency measures in Civic Offices and to demonstrate climate change adaptation measures (i.e. green walls and rainwater harvesting).

For example, DCC is investigating the potential to install a combined heat and power (CHP) unit in its Civic Offices to provide electricity to the building and backup power in the case of a blackout. This project aims to save 80 MWh of primary energy and 30 tonnes of CO_2. Dublin City Council is also committed to investing €2.5 million over the next three years to upgrade the HVAC systems within the Civic Offices and there is an ongoing programme to replace the lights in the building with LEDs and install additional motion sensors.

The Council is also planning on retrofitting a number of additional buildings throughout the City, including its homeless facilities, senior citizen units and social housing complexes. These upgrades will include measures such as insulation, window and door replacements, gas boiler replacements, heating controls, LED lighting, solar PV panels and heat pumps, and the combined projects could save 3.2 GWh in total, or 837 tonnes of CO_2.

A number of large projects are in planning to regenerate flat complexes by upgrading the existing buildings, and often adding additional apartments on the site. The upgrade involves not only a deep energy retrofit but also better space standards, better accessibility and better use of external spaces.

Work is under way at Phase 1 of Dolphin House. Feasibility studies carried out for Constitution Hill, Ballybough House and Gardiner Street flats suggest that upgrading the buildings may be an economic option. At other complexes, it may be more economic to replace the older buildings. These are all deep retrofit projects, exceeding the nearly Zero Energy Building (nZEB) level as defined in the Technical Guidance Document Part L 2017[28] for existing buildings (120 kWh/m^2) and aiming for the target of achieving the same energy efficiency as a new building (70 kWh/m^2).

CASE STUDY

DCC Fabric Upgrade Programme

Dublin City Council is continually upgrading its social house units through its Fabric Upgrade Programme. Since 2013, over 8,000 units have been refurbished, resulting in significant energy and cost savings, and improved comfort levels for residents. This includes the recent fabric upgrade works undertaken at St Bricin's social housing scheme at Arbour Hill, Dublin 7.

The energy upgrades carried out as part of Phase 1 of the programme involved measures such as attic, water tank and pipe insulation, new windows, lagging jackets for hot water cylinders and cavity wall fill insulation.

Altogether, the Fabric Upgrade Programme has saved an estimated €29.6 million on energy bills to date; Phase 2 of the programme is ongoing, and will provide external insulation to a further 5,243 units.

CASE STUDY

Energy Performance Contracting

DCC, in partnership with Codema, is using Energy Performance Contract (EPC) projects to improve the energy use and efficiency of its sports and fitness centres across the City. An EPC is a contractual agreement by an Energy Service Company (ESCo) to guarantee energy savings over an agreed period of time.

In 2016, DCC awarded its first EPC for the upgrade of three of its largest leisure centres (Markievicz, Finglas and Ballymun Sports and Fitness Centres). These upgrades included the following measures:

- New LED lighting
- New or refurbished combined heat and power systems to efficiently heat the swimming pools
- Improved building control systems for effective management of all equipment

The works on the three leisure centres were completed by December 2016, and Codema is now overseeing the project's Measurement and Verification (M&V) process. The latest figures show that in its first year alone, the project has saved the Council €122,228 on energy and maintenance costs, and has achieved average energy savings of 38%. Based on this successful model, Codema is now developing a second EPC project with DCC, which will involve an upgrade to the existing lighting, heating and ventilation systems across seven Council buildings. The largest building is Ballyfermot Sports and Fitness Centre; the other six buildings are dry sports halls - St Catherine's Community Centre, Ballybough Community Centre, Cabra Parkside, Irishtown Sports and Fitness Centre, Bluebell Sports Centre, and Poppintree Community Sports Centre. Boiler upgrades may also be considered, including a review of the existing CHP system in Ballyfermot. Expected savings are in the region of 25% to 30% in total.

Council Depots

The Transformation Unit in Dublin City Council is working with all of the operational areas in developing a consolidated depot model, which will result in the construction of two large-scale depot facilities, one on the northside of the City, and the other on the southside. The northside depot was granted planning permission in February 2017 and will be located along St Margaret's Road in Ballymun. Fourteen depots from across a variety of divisions such as waste management, road maintenance, housing maintenance and electrical services will be based in this proposed new facility, which will include an office and welfare building, workshop facilities and a central store. This large-scale depot will be designed and constructed to nZEB standard and the move could result in savings of 2.1 GWh of primary energy and 672 tonnes of CO_2.

Public Lighting

Public lighting is one of the largest energy users within the Council, accounting for 25% of DCC's total primary energy consumption in 2017. Within the Council's stock of public lighting, there is currently over 20,500 SOX lamps. The manufacture of these lamps is currently being phased out, so these will have to be replaced, and LED lights, with their very high energy efficiency, are the obvious replacement. Up to 5,500 have already been replaced. By replacing a further 4,000 of these SOX lamps by 2020, DCC could achieve savings of 1.7 GWh of and 388 tonnes of CO_2. This would have a significant impact on the Council's 2020 target.

Dublin Fire Brigade

The Dublin Fire Brigade is looking to replace the old boilers at the O'Brien Institute with a more carbon-neutral alternative, such as a condensing gas boiler and micro CHP hybrid system, to reduce both the electrical and gas consumption within the facility. Another option is to install a heat pump and micro CHP hybrid system. Codema is also looking at an Energy Performance Related Payment (EPRP) contract for this project, which will incentivise the contractor to remain involved until savings are established, thereby reducing the risk to the Council. Codema is currently facilitating the design and procurement of the new heating system for this project, which could result in a saving of 198 MWh and 41 tonnes of CO_2.

The Dublin Fire Brigade has also committed to retrofitting its lighting stock to LEDs. This will be achieved by integrating a new policy within their maintenance contracts that states that any failed fittings should be replaced with LEDs. These LEDs will also comply with local government procurement rules and will be on the SEAI Triple E register.

RESEARCH AND INNOVATION

To maximise the benefits of advances in technology, DCC is using its Smart Dublin programme as a platform to engage with academia, the private sector and citizens, to co-create solutions to the challenges facing the Dublin Region. The Smart Dublin programme was established in 2016 to enable the four Dublin Local Authorities to collaboratively take advantage of some of the big tech trends that are transforming how we live and work. In partnership with Enterprise Ireland, Smart Dublin runs Small Business Innovation Research (SBIR) competitions, which challenge smart technology providers, researchers and citizens to come up with solutions that will improve the operation and resilience of the Dublin Region. To date, €750,000 in funding has been awarded to small businesses to develop solutions in areas such as cycling, wayfinding, illegal dumping and flooding.

Phase 2 of the SBIR competition was launched in April 2018, and has a further €800,000 in funding to develop solutions for areas such as bathing water quality, staff workplace mobility and last mile delivery in urban centres.

ENERGY AWARENESS

> **DCC works closely with Codema to continuously implement initiatives and projects to raise awareness of energy issues, monitor energy use, and increase the share of renewable energy and improve energy efficiency at work and in the home.**
> - Dublin City Development Plan 2016-2022

A key aspect of reducing energy use is public awareness, as retrofits, technology and innovation can only achieve a portion of DCC's goals. DCC, in partnership with Codema, is actively engaging with staff and citizens about energy, from the benefits of renewables to providing tips on small steps that can be taken to reduce energy use and save money on their bills.

CASE STUDY

Home Energy Saving Kits

Dublin City Council's Public Libraries partnered with Codema to pilot the Home Energy Saving Kits in a selection of library branches in 2016. The kits contain six tools for householders to assess how energy-efficient their homes are and were available for the public to borrow free-of-charge from these libraries.

The pilot year was very successful, with huge demand from the public. As a result, the scheme was expanded to all of DCC's public library branches in 2017 and the Council also partnered with Codema and SEAI to host energy-saving workshops in Cabra, Raheny and Rathmines libraries, which provided the public with a range of information on saving energy at home, from low-energy lighting, right through to draught-proofing and insulation. Codema also ran two staff trials of the kits, so that Council staff could assess the energy efficiency of their homes and bring this awareness into the workplace.

The scheme is the first of its kind in Ireland, and has had great success, garnering awards and recognition, both nationally and at an EU level. The Home Energy Saving Kits were expanded once again in 2018 to other DLA areas and to selected libraries across Ireland.

Locally, DCC and Codema will continue to work together to build on this initiative over the coming years, and energy-saving information and events will continue to be made available by the Council through its public libraries.

ENERGY & BUILDINGS

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
ACTIONS CURRENTLY BUDGETED					
ENERGY PLANNING					
1	Create Energy Master Plan for the Dublin Region	2018 onwards	Codema	Website with e-Map	
2	Requirement for all new developments to be district heating-enabled in Poolbeg West, North Lotts and Grand Canal SDZs	Ongoing	Planning and Property Development	# of buildings DH-enabled	
3	Prepare Dublin City Sustainable Energy and Climate Action Plan	2019	Codema	SECAP complete	
4	Evidence-based climate change chapter in *County Development Plan 2022-2028*	2020 onwards	Planning and Property Development	Chapter with policies and development management standards	
ENERGY MANAGEMENT					
5	Develop ISO 50001 compliant energy management system	Ongoing	Environment and Transportation	System developed and ISO 50001 compliant	
6	Annual Monitoring & Reporting to SEAI	Annually	Codema	DCC's energy use monitored and reported	
7	Publish Energy Review annually	Ongoing	Codema	Review published, # of recommendations implemented	
8	Display Energy Certificates for public buildings	Ongoing	Codema	Compliant with legislation	
ENERGY EFFICIENCY & RENEWABLES					
9	Dublin District Heating System	2023	Environment and Transportation	# of buildings connected	
10	Identify sites for trialling renewable energy projects, including solar PV	2019	Planning and Property Development	Properties identified, project plans	
11	Energy efficiency works in 30 Council owned and operated buildings	Ongoing	Housing	# of buildings upgraded	
12	Dublin Fire Brigade energy efficiency works	Ongoing	Dublin Fire Brigade	# of buildings upgraded	
13	Continue the Fabric Upgrade Programme of housing stock	Ongoing	Housing	Completion of 100 - 200 retrofits per annum, to C1 level	
14	Develop and implement Public Lighting Master Plan	2019	Environment and Transportation	% public lighting converted to LEDs	

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
ACTIONS CURRENTLY BUDGETED					
15	Landlord lighting upgrades in 15 complexes across the City	Ongoing	Housing	# of lights retrofitted	
16	Facilitate EPC project in 7 leisure centres/dry sports centres across Dublin City	2019	Culture, Recreation and Economic Services, Codema	EPC project delivered	
17	Install PV panels on Council buildings in Dominick Street, North King Street, Cornamona Court	2019	Architects	PVs installed	
18	New nZEB Super Depots	2020	Transformation Unit	Completion of depots, # of depots merged into super depots	
RESEARCH & INNOVATION					
19	Develop proposal to use Docklands SDZ to test smart public lighting infrastructure	2020	Smart Dublin	Proposal developed	
20	Expand and develop Small Business Innovation & Research (SBIR) programme	Ongoing	Smart Dublin	Energy and climate change challenges identified for yearly SBIR challenge	
21	Work with CARO on research and project proposals for grant funding	2019 onwards	CARO, Codema	# of research projects initiated	
ENERGY AWARENESS					
22	Continued staff energy awareness in Council buildings	Ongoing	Codema	# of staff participating in events and activities	
23	Engage with students about energy and buildings through CPD Programme/Engineers Week	Ongoing	Environment and Transportation	# of students participating in events and activities	
24	Provide citizens with energy awareness material in public buildings	Ongoing	Communications	# of materials available in public buildings	
25	Provide City Council tenants with energy awareness materials at home, particularly at the time of taking up new tenancy	Ongoing	Housing	% tenants receiving information	
26	Monitor and develop the Home Energy Savings Kits in DCC's public libraries	Ongoing	DCPL, Codema	# of kits borrowed	

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
ACTIONS AWAITING BUDGET					
27	*Develop research and funding opportunities for renewable and efficiency projects*	*2018 onwards*	*Codema*	*Research and funding management group established*	
28	*Undertake programme of flat complex regenerations*	*2022 onwards*	*Housing, City Architects*	*Complete 200 regenerated flats to nZEB standard each year from 2022*	

EXAMPLES OF RELEVANT LEGISLATION/POLICIES/GUIDANCE

- Technical Guidance Document L – Conservation of Fuel and Energy – Dwellings 2017
- Technical Guidance Document L – Conservation of Fuel and Energy - Buildings other than Dwellings 2017
- Climate Action and Low Carbon Development Act 2015
- Docklands SDZ (Objective SI14)
- Dublin City Development Plan 2016-2022 (Policies C2; CC3; CCO7; CCO8; CC09; CCO10; CCO12, QH12)
- Dublin City Sustainable Energy Action Plan (SEAP)
- Energy Act 2016
- Energy Efficiency Directive (Article 14)
- Ireland's National Renewable Energy Action Plan (NREAP) - Energy White Paper
- National Energy Efficiency Action Plan (NEEAP)
- S.I. No. 243/2012 - European Union (Energy Performance of Buildings)
- S.I. No. 426/2014 - European Union (Energy Efficiency) Regulations
- Support Scheme for Renewable Heat

TRANSPORT

Photo Source: Mark Dalton / Pexels.com

OVERVIEW

22.7 GWh

CONSUMED IN 2017 = **5,360** TONNES OF CO_2

980

VEHICLES IN COUNCIL FLEET

TARGET

33%

IMPROVEMENT IN ENERGY EFFICIENCY BY 2020

40%

REDUCTION IN COUNCIL'S GHG EMISSIONS BY 2030

EXAMPLES OF MAIN ACTION TYPES

STAKEHOLDERS TO WORK WITH AND influence

GENERAL PUBLIC

COMMUNITY GROUPS

NATIONAL TRANSPORT AUTHORITY, RSA

ENVIRONMENTAL AND INTEREST GROUPS

DUBLIN BUS, IRISH RAIL, BUS ÉIREANN, LUAS

GOVERNMENT DEPARTMENTS AND AGENCIES

> **Council will continue to work with its neighbouring local authorities and the National Transport Authority to achieve a doubling of all active travel and public transport trips and to halve private vehicle trips to Dublin by 2030.**
> - Dublin City Development Plan 2016-2022

Dublin City Council, through its own development plan strategy and policies, promotes the integration of land use and transportation, and works with a range of stakeholders to improve transportation in the City, and to encourage modal shift away from private cars to more sustainable transport methods.

For example, DCC is working with the National Transport Authority and its neighbouring local authorities to implement the *Greater Dublin Area Transport Strategy 2016-2035*, which sets out a strategic vision for transport in Dublin. With private car journeys currently accounting for 32% of the modal split, the Strategy aims to double trips made by walking, cycling and public transport, while significantly reducing private car journeys by 2030.

Other measures that DCC has taken to date to encourage more active and sustainable travel in the City are a reduction in speed limits to 30 km in certain areas and the introduction of traffic calming measures to improve the safety of the streets.

OPERATIONS

In 2017, Dublin City Council's transport fleet consumed 22.7 GWh of energy, which amounted to 5,360 tonnes of CO_2. The Council has 980 vehicles in its fleet, which are broken down into 24 different vehicle types, including cars, vans, lorries and road sweepers.

As transport accounts for 12% of DCC's overall energy use, the Council is steadily replacing the fleet with newer, more fuel efficient vehicles, including electric vehicles. DCC currently has three electric vehicles that can be used by staff and booked through an online system within the Council. A further 13 small electric vans have also recently been procured for use in the Council's depots and DCC will aim to fully electrify its fleet by 2030.

The Council is also developing a smart mobility hub within the Civic Offices, which will give staff access to bikes, electric bikes and electric cars so that they can move efficiently from one Council building to another.

CASE STUDY

Smart Workplace Mobility Hub
There are approximately 1,500 staff members that work in Dublin City Council's Civic Offices on Wood Quay. According to the Smart Travel Workplace Survey 2016, these 1,500 staff members use the following transport methods to get to and from work:

- Walk: 8%
- Cycle 15.5%
- Public Transport 38%
- Car 33%
- Motorcycle 2%
- Car-pooling 3.5%

There are currently 280 parking spaces in the staff car park in Wood Quay.

Through the 2018 call of the Smart Dublin SBIR Challenge, DCC and the SEAI (Sustainable Energy Authority of Ireland) are looking to test shared mobility options for staff through the piloting of a smart mobility hub that will include e-cars, e-bikes and push bikes, with the aim of promoting more sustainable travel.

CASE STUDY

Carbon Offsetting for Staff Flights
DCC has teamed up with Vita, which is an Irish overseas development agency providing African families with efficient stoves, solar lighting and clean water programmes to help them create food and energy.

These programmes reduce carbon emissions by over 60% and create saleable carbon credits, which Vita then sells on to organisations like Dublin City Council, that may not be obliged to offset their carbon footprint, but choose to do so in order to lead by example.

As the first local authority in Ireland to partner with Vita's Green Impact Fund, the Council was able to offset the carbon associated with its business flights in 2017, which amounted to 119 tonnes of CO_2. This initiative will be repeated by the Council on an annual basis.

PLANNING & PUBLIC REALM

Key to encouraging people to walk and cycle is the design of streets and the public realm. DCC is working to implement street design guidelines that make the streets more inviting and improve the public realm, by taking a corporate cross-departmental approach. Two important corporate plans - *Public Realm Strategy Your City Your Space 2012* and *The Heart of Dublin Public Realm Masterplan for the City Core 2016* - seek to improve the quality and experience of Dublin's public realm and to make Dublin a pedestrian-friendly City. DCC is also in the process of developing a public lighting master plan that will improve the ambiance and safety of streets for pedestrians, cyclists and drivers.

Traffic Calming Measures

Over the last decade, there has been a gradual lowering of speed limits throughout Dublin City and its suburbs, in order to reduce pollution levels and make the City safer and more enjoyable for cyclists and pedestrians to get around. The 30 kilometre speed limit currently applies to the north and south quays in the City Centre and all residential areas between the Royal and Grand Canals. Dublin City Council is now considering extending the 30 kilometre speed limit to all remaining suburbs within the Council's boundary. The Special Speed Limit Bye-Laws 2018 were accepted by the Council in May 2018 and were put forward for public consultation throughout June and July. In August 2018, DCC also launched a new publicity campaign with the Road Safety Authority to make citizens aware of the speed limits in their area and along the routes they travel, and to highlight the quality of life benefits for communities living in a 30 kilometre 'Slowzone' area.

Dublin City Centre Transport Study 2016

The Dublin City Centre Transport Study has been prepared in order to integrate the transport policies and proposals of DCC and the National Transport Authority (NTA) and inform an agreed framework for strategic investment in the City's transport system. The study relates directly to the policies and objectives set out in the DCC Development Plan and is guided by the *Transport Strategy for the Greater Dublin Area 2016-2035*. The study examines the issues relating to the management and movement of people and goods to, from and within Dublin City Centre, and proposes a series of specific measures and changes to the transport network in order to ensure that transport in Dublin can continue to function effectively and has the capacity to cater for the City's future growth.

Last Mile Delivery

Dublin City Council is currently planning to develop a number of delivery hubs that will enable trucks and vans to drop off goods at certain points instead of travelling all the way into the City Centre. Couriers will then collect the parcels from the hub and deliver them to locations in the City Centre using sustainable transport methods. This is part of a 'last mile delivery' initiative that aims to reduce traffic and pollution in the City Centre. It follows on from a successful pilot scheme involving the Council and the international delivery company UPS in the north inner City, which has removed 200 vehicle movements a day from the City Centre. The Council has drafted bye-laws to expand this scheme and recently carried out a consultation with businesses and potential operators.

To complement this initiative, the Smart Dublin programme has also launched an all-island joint SBIR challenge involving Dublin City and Belfast City Councils. Both cities are looking for ways to enhance the efficiency and effectiveness of these deliveries, reducing the number of goods vehicles in their respective urban centres, which, in turn, will improve air quality, noise pollution and road safety.

ACTIVE TRAVEL & BEHAVIOUR CHANGE

> **Less dependency on the private car for routine trips and replacement by public transport, walking and cycling will result in a reduction in consumption of non-renewable resources and CO_2 emissions, helping to meet national emission reduction targets. It will also bring health benefits. This is all the more important when we consider that the population of the inner City is expected to grow by over 40,000 by the year 2020.**
> - Dublin City Development Plan 2016-2022

Schools and Communities

Since 2010, DCC has been developing and implementing successful behavioural change programmes to encourage more sustainable forms of transport. For example, the safe routes to school scheme and the Green Schools programme, in partnership with An Taisce, are encouraging thousands of children and their parents to walk, cycle or scoot to school.

Cycling

Of the transportation modes that DCC can influence and shape, cycling has been the predominant focus. DCC has had immense success with the dublinbikes scheme and there is continuous demand to expand this programme, which will help to reduce emissions and provide more options for sustainable modes of transport.

DCC is also actively working to improve cycling infrastructure through the development of segregated cycle paths where possible, such as the Sutton-to-Sandymount Cycleway, Dodder Greenway, Royal and Grand Canal Cycleways and the Clontarf-to-City Centre Cycle Scheme. DCC will also work with relevant transport bodies and businesses to expand the availability of bicycle parking to enable people to cycle to and from key public transport nodes, such as the recent addition of the Drury Street bike parking facilities.

CASE STUDY

Hike It! Bike It! Like It! Drimnagh

Hike It! Bike It! Like It! Drimnagh was set up in 2011 in partnership with the Drimnagh Smarter Travel Community Campaign. It aimed to promote active travel to local schools and to the staff of Crumlin Children's Hospital.

The project has resulted in a 52% increase in people cycling to work or school in the Drimnagh area. Local schools have also recorded a large increase in the number of students walking to school, with almost 70% of students now travelling on foot each day.

The project was a finalist in both the 2013 Green Awards and the Excellence in Local Government Awards. It was also a winner of an international Energy Globe Award in 2016. Importantly, and due to its local success, DCC then expanded the programme city-wide in September 2017.

CASE STUDY

Council Bike Schemes

The Just Eat dublinbikes scheme is one of the most successful bike rental schemes in the world, with more than 66,000 subscribers and 25 million journeys since its launch in 2009. On its busiest day to date, (September 16th 2016) 18,041 journeys were made in one day. The scheme currently has 1,600 bikes available at 115 stations around the City. The scheme has been a huge success since its launch and this is partly down to the careful selection of the station locations, the high level of maintenance of the bikes, as well as the low annual fee.

In addition to the Just Eat dublinbikes, DCC launched a new stationless bike scheme in 2018 that made over 200 more rental bikes available in the City, with more planned for the near future. The scheme, which is operated by two Irish companies, Urbo and BleeperBike, differs to the dublinbikes scheme in that the bikes do not need to be picked up or dropped off at specific locations but must be returned to metal Sheffield stands located around the City. A user can locate a bike via an app, which unlocks the bike and completes the journey when returned to one of the stands.

The Council plans to eventually expand these services to outer suburban areas in the City, with BleeperBike already operating in other Dublin Local Authority areas.

CASE STUDY

Smart Dublin Cycling Challenge
The Smart Dublin cycling challenge was launched in 2016 to help improve cycling across Dublin using smart technology.

Five companies were selected to work on Phase 1 and received funding to research and demonstrate their solutions. Of the five companies, four were awarded further funding to pilot their solutions, which were:

- BikeLook, which monitors bicycle usage and deters and detects bicycle theft.
- Fluidedge, which allows cyclists to record actual or perceived obstacles to aid safe cycling in Dublin.
- A See.Sense ICON intelligent and connected bicycle light, which collects anonymised, crowd-sourced data such as road surface conditions, collisions and near-miss hotspot areas. 500 people in the Dublin Region took part in this pilot from September to December 2017 and this provided information on cycling habits not available before.
- Smartcharge, which aids cyclists in predicting the ease of a journey, improving safety along the way and creating a secure parking facility at the end of the journey.

Car Sharing

Dublin City Council supports car sharing and the expansion of car clubs across the City. Bye-laws regulating the licensing of car clubs were introduced in 2013. Two licenses have been issued to GoCar and YUKO Toyota Car Club.

CASE STUDY

GoCar
GoCar is Ireland's largest car sharing operator, with almost 500 vehicles across 15 counties, and has over 30,000 members. In the last three years, the operator has seen 600% growth in monthly journeys.

GoCar provides a convenient, cost-effective, and sustainable alternative to car ownership. By allowing multiple people to use the same vehicle at different times, car sharing reduces car ownership and car dependency, congestion, noise and air pollution, and frees up land traditionally used for parking spaces.

Each GoCar replaces approximately 10-20 private cars, is environmentally friendly, and creates more liveable cities by encouraging people to sell their cars and only use a car when essential, while walking and using public transport more often too. International studies have also shown a reduction in the number of kilometres travelled per year of more than 60% for car-sharing users.

PUBLIC TRANSPORT

> **In order to ensure an efficient, reliable and effective bus system, it is intended, as part of the Strategy, to develop the Core Bus network to achieve, as far as practicable, continuous priority for bus movement on the portions of the Core Bus Network within the Metropolitan Area. This will mean enhanced bus lane provision on these corridors, removing current delays on the bus network in the relevant locations and enabling the bus to provide a faster alternative to car traffic along these routes, making bus transport a more attractive alternative for road users.**
> - Transport Strategy for the Greater Dublin Area 2016-2035, NTA

DCC will continue to work with the relevant transportation bodies (National Transport Authority, Transport for Ireland, Dublin Bus, Luas, Irish Rail, Bus Éireann, Road Safety Authority and private operators) to introduce measures to achieve modal shift and to make it easier for citizens to switch from one public transport system to another.

CASE STUDY

Canal Cordon Count

For over 20 years, DCC has been conducting its Canal Cordon Count, which is conducted between 7am - 7pm over a period of eight days. This exercise provides DCC with information on how people are travelling into and out of the City from 33 points along the Grand Canal and the Royal Canal. This allows DCC to assess the impacts of policies that affect the movement of people and its progress in achieving modal shift. The 2017 survey indicates that from 2006, inbound private car travel into the City Centre has decreased by 15%, while pedestrians have increased by 46%. The number of cyclists has increased by 157% in the same period[29].

TRANSPORT

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
ACTIONS CURRENTLY BUDGETED					
OPERATIONS					
1	Develop strategy to convert fleet to low emission vehicles	2018 onwards	Environment and Transportation	Strategy produced	GHG
2	Pilot more electric vehicles within Council fleet	Ongoing	Environment and Transportation	Report on pilot and plan for scaling up	GHG
3	Conduct detailed study of staff modal split	2019 onwards	Environment and Transportation	Yearly survey	GHG
4	Promote Cycle-to-Work Scheme to DCC staff	Ongoing	Environment and Transportation	# of staff availing of scheme	GHG,
5	Implement Smart Mobility Hub in Civic Offices	2019 onwards	Smart Dublin	# of staff using hub	GHG
6	Carbon offset programme for staff flights	Ongoing	Environment and Transportation	Tonnes of CO_2 offset	GHG
7	Occupational driver training for fleet staff	2018 onwards	Fleet Management Services	# of staff trained	GHG,
8	Assess potential for using an e-mobile for real time air quality monitoring in the City Centre	2019	Environment and Transportation	Assessment report complete	,
PLANNING & PUBLIC REALM					
9	Implement the measures outlined in the *Dublin City Centre Transport Study 2016*	Ongoing	Environment and Transportation	# of measures implemented	GHG
10	Implement traffic calming programme	Ongoing	Environment and Transportation	# of traffic calming measures	GHG
11	Expand 30 km/h speed limit zones to all residential areas of the City	2018 onwards	Environment and Transportation	# of residential areas with 30 km/h speed limit	GHG
12	D30 public awareness campaign of speed limits in City	2018 onwards	Environment and Transportation	# of citizens engaged	GHG,
13	Regular maintenance of regional and local roads	Ongoing	Environment and Transportation	# of complaints regarding obstructions	GHG
14	Rolling out last mile delivery eco hubs in the City Centre area	2019 onwards	Environment and Transportation	# of last mile delivery eco hubs established	GHG
15	Develop 'last mile' delivery solutions, as part of SBIR challenge	2018 onwards	Smart Dublin	# of solutions trialled	GHG

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
16	Phase I Pedestrian Zones (2016-2022): - Liffey Street - Mary Street - Talbot Street - Castle Street/Cork Hill - Barnardo's Square - Temple Bar Public Realm	2016-2022	Planning and Property Development	Schemes completed	GHG
17	Phase II Pedestrian Zones (2023-2028): - Dame Street West - Lord Edward Street - Parnell Street - O'Connell Bridge - D'Olier Street - Lombard Street - Westland Row - Nassau Street - Aungier Street/ Valentine District - Merrion Square - Pearse Street - North Lotts - North Quays	2023 - 2028	Planning and Property Development	Schemes completed	GHG
18	Phase III Pedestrian Zones (2029 and beyond): - South Quays - Tara Street - Parkgate Street	2029 onwards	Planning and Property Development	Schemes completed	GHG
19	To investigate the introduction of traffic-free areas on sections of: - Drury Street - South William Street - Exchequer Court - Dame Court - Dame Lane retaining access for car parks and deliveries	2019	Planning and Property Development		GHG
20	World Car Free Day	Annual	Environment and Transportation	Promotion of EU event	
21	European Mobility Week	Annual	Environment and Transportation	Promotion of events	
22	DCC to liaise with NTA on BusConnects programme	Ongoing	Environment and Transportation	# of meetings	GHG
23	2 EV charging point trials in the Docklands	2019	Environment and Transportation, Smart Dublin	2 charging points installed	GHG
24	Assessment of Council public car parks for trickle and rapid charge EV points	2019	Environment and Transportation	Assessment complete	GHG

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
ACTIVE TRAVEL & BEHAVIOUR CHANGE					
25	Organise Pedestrian Days in areas with high footfall	2019 onwards	Environment and Transportation	# of pedestrian days held	GHG,
26	Identify and promote use of new routes on Hike It! Bike It! Like It! platform	Ongoing	Environment and Transportation	# of communities / areas involved	GHG,
27	Develop cycle network strategy	Ongoing	Environment and Transportation	Plan completed	GHG
28	Dodder Greenway (Pedestrian and Cycle Improvement) - 7.5 km section	Ongoing	Environment and Transportation	Planning application approved	GHG
29	4 km Clontarf-to-City Centre Cycle Scheme	2018 onwards	Environment and Transportation	Drawings of route completed	GHG
30	Liffey Cycle Route	2018 onwards	Environment and Transportation	Review of route completed	GHG
31	Fitzwilliam Cycle Route - 1 km route with upgrades for junctions	2019	Environment and Transportation	Consultant appointed	GHG
32	Sandyford-to-City Centre Cycle Scheme - proposal and options for 9 km route	2018 onwards	Environment and Transportation	Report completed	GHG
33	Royal Canal Phase 3 - 2.1 km two-way cycle track with pedestrian route	2018 onwards	Environment and Transportation	Tender issued	GHG
34	Grand Canal Premium Cycle Route - 4.4 km addition to route linking Portobello to Blackhorse	2018 onwards	Environment and Transportation	Feasibility study completed	GHG
35	Pedestrian and cycle bridges over the Royal Canal at North Wall Quay	2020	Environment and Transportation	Planning permission submitted	GHG
36	Cycle Training Programme for 6th Class students / Pedal Power Labs	Ongoing	Environment and Transportation, Schools	# of students participating	GHG,
37	Emissions-linked parking charges in City Centre	2019	Environment and Transportation	# of parking spaces	GHG
38	Increase number of public bike parking facilities	Ongoing	Environment and Transportation	# of parking spaces added	GHG
39	Expand Stationless Bike scheme	Ongoing	Environment and Transportation	# of bikes available	GHG
40	Expand dublinbikes scheme	Ongoing	Environment and Transportation	# of dublinbikes, # of locations	GHG
41	Implement policy to increase modal shift to cycling	Ongoing	Environment and Transportation	# of additional cycle lanes provided, # of cordon count results	GHG
42	DCC to host Velo City 2019	2019	Environment and Transportation	Event hosted	

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
43	Install pilot Electric Vehicle charging station at John Rogerson's Quay	2019	Environment and Transportation	EV charge point installed	GHG, Public Awareness
44	Assessment of Rediscovery Centre car park in Ballymun for trickle or rapid electric vehicle charging station	2019	Environment and Transportation	EV charge point installed	GHG, Public Awareness
45	Samuel Beckett Bridge segregated cycle lane	2019	Environment and Transportation	Segregated lane complete	GHG
PUBLIC TRANSPORT					
46	Sustainable transport hubs – various locations	2020	Environment and Transportation	# of hubs	GHG
47	Develop bus routes including the Bus Connects programme	Ongoing	Environment and Transportation	# of routes	GHG
48	Carry out Canal Cordon Count	Ongoing	Environment and Transportation	Results from count	GHG
49	Implement policy to increase modal shift to public transport	Ongoing	Environment and Transportation	# of additional bus lanes provided, # of cordon count results	GHG
50	Implement policy to give bus priority on core bus network	Ongoing	Environment and Transportation	# of bus priority junction interventions	GHG
ACTIONS AWAITING BUDGET					
51	*Develop a strategy to promote car sharing*	*2019 onwards*	*Environment and Transportation*	*Strategy document developed*	GHG, Public Awareness
52	*Expand availability of EV charging points*	*Ongoing*	*Environment and Transportation*	*# of charging points*	GHG
53	*Replace diesel hand sweepers/power washers with electric models*	*Ongoing*	*Waste Services*	*% reduction*	GHG
54	*Dublin City Council to promote Mobility-as-a-Service (MaaS) initiatives in the City to increase active travel options*	*2020*	*Planning and Property Development*	*MaaS platform created*	GHG, Public Awareness

EXAMPLES OF RELEVANT LEGISLATION/POLICIES/GUIDANCE

- Climate Action and Low Carbon Development Act 2015
- Design Manual for Urban Roads and Streets (DMURS)
- Dublin City Centre Transport Study 2016
- Dublin City Council Corporate Plan 2015-2019
- Dublin City Development Plan 2016-2022 (Policies CC4; MTO1; MT7; MT8; MT9; MT10; MT14, MT20; SN29; SC1; SC3; SCO8; SCO9; SC19)
- Electric Vehicle Grant Scheme and VRT Relief
- Greater Dublin Area Transport Strategy 2016-2035
- National Cycle Policy Framework 2009-2020
- National Transport Authority's Permeability Best Practice Guide
- Public Realm Strategy - Your City Your Space 2012
- Public Transport Act 2016
- Smarter Travel: A New Transport Policy for Ireland 2009-2020
- The Heart of Dublin Public Realm Masterplan for the City Core 2016

FLOOD RESILIENCE

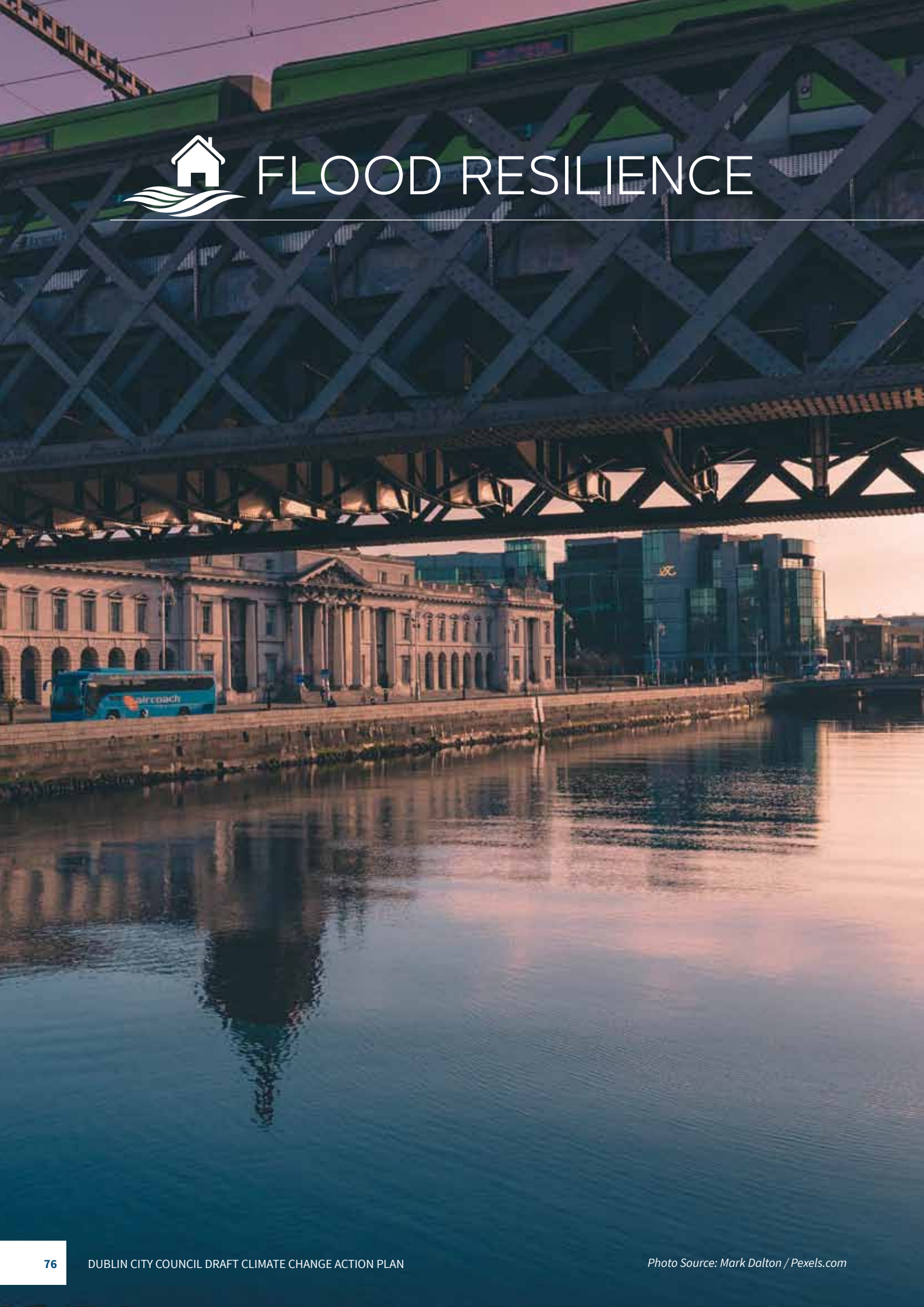


Photo Source: Mark Dalton / Pexels.com

OVERVIEW

3 MAIN RIVERS:
LIFFEY, DODDER, TOLKA

52 km
COASTLINE IN DUBLIN CITY

TARGET

A CLIMATE-RESILIENT REGION

REDUCTION/MITIGATION OF FLOOD RISKS IN DUBLIN CITY

EXAMPLES OF MAIN ACTION TYPES

STAKEHOLDERS TO WORK WITH AND INFLUENCE

- OFFICE OF PUBLIC WORKS
- GOVERNMENT DEPARTMENTS
- GENERAL PUBLIC
- COMMUNITY GROUPS
- ENVIRONMENTAL GROUPS
- DEVELOPERS

Dublin City Council's policies and objectives intend to provide high-quality public infrastructure which aims to minimise waste, provide flood protection, reduce flood risk in Dublin City as far as possible, mitigate where possible and adapt to the impacts of climate change, protect and improve water resources/water dependent ecosystems and to support the green infrastructure network.
- Dublin City Development Plan 2016-2022

Flooding is a key climate change risk facing the Dublin Region. Climate change increases the frequency and intensity of heavy rainfall events and storm surges, which increase the risk of pluvial, fluvial and coastal flooding in vulnerable areas of the City. Extreme rainfall and weather events can also place additional pressure on the urban drainage network and water supply, which can result in network flooding and water shortages. Together with the Office of Public Works (OPW) and neighbouring local authorities, DCC is actively working to implement projects and programmes that align with the EU Floods Directive and Water Framework Directive, which call for member states to undertake strategic flood risk assessments and to favour nature-based solutions such as integrated wetlands, green infrastructure, and Sustainable urban Drainage Systems (SuDS,) to be used for adaptation and mitigation responses to achieve flood resilience.

CASE STUDY

FloodResilienCity Outcomes

DCC participated in the EU Interreg IVB project, 'FloodResilienCity' (FRC). This project built on work completed in the Strategies and Actions for Flood Emergency Risk (SAFER) project, which ran from 2002 to 2008 and resulted in the development of a tidal flood forecasting and warning system, emergency response procedures and coastal flood maps. FRC ran from 2008 to 2012 with the aim of making Dublin a more flood resilient capital. This involved the development of a pluvial flood risk management strategy for Dublin, based on modelling and mapping of Dublin's pluvial flood risk. The results of FRC have informed this action plan and DCC's strategy to mitigate and adapt to pluvial flood risk. Through the project, DCC has identified three categories of measures with options for reducing pluvial flood risk in Dublin, such as:

1. Community & Business Flood Resilience:
- Awareness raising and education
- Rainwater harvesting
- Domestic rain gardens

2. Site Specific Measures
- SuDS storage and infiltration
- Green infrastructure / bioswales
- Surface conveyance

3. Overall Measures
- Flood warning
- Land-use management
- Vegetation management

FLOOD RISK MANAGEMENT

In partnership with the OPW and neighbouring local authorities, DCC is working to adapt areas that are vulnerable to flooding by using comprehensive flood risk mapping. DCC is looking at measures that include natural and engineered solutions, and has adopted a FAB Plus Strategy:

- **Flood** risk mitigation
- **Amenity** enhancement
- **Biodiversity** opportunity
- **Plus:** Carbon reduction/sequestration, waste reuse, potential for regeneration, recreational enhancement

CASE STUDY

Triton and Tidewatch
Triton and Tidewatch are two tidal flood forecasting and warning systems that were developed following the coastal flood event in February 2002. Both systems make use of weather and/or surge forecasts in the Irish Sea to provide future predictions of tide levels, with Tidewatch providing forecasts up to five days in advance and Triton two days in advance.

The forecasts are used to implement emergency response procedures such as closing of flood gates within existing flood defences. For example, the flood defences along Spencer Dock, the South Campshires and the River Dodder contain a number of flood gates and demountable defences, which require closing during an extreme event and when closed, ensure that a 1-in-200-year standard of protection is provided by these defences. Thus, the tide forecasts form an important and integral element of the flood defences in these areas.

CASE STUDY

Gully Monitoring SBIR Challenge
The Smart Dublin Gully Monitoring SBIR Challenge was launched in 2017 with the aim of using technology to monitor gullies, especially in high-risk areas. This monitoring involves implementing a system that provides real-time information on high-risk gullies in the City during a flood event, through a wireless network of low-cost water sensors (over 30 are now deployed). The system then notifies the closest available drainage team with this real-time information, so that City Operations can provide the most optimised response. Six companies were involved in Phase 1; three of these have now progressed to Phase 2 and have been awarded additional funding to further develop their solutions.

CASE STUDY

Connect Flooding Demonstrator
As part of the Smart Dublin programme, DCC is working in collaboration with Intel and the CONNECT Centre to build a network of low-cost, low-powered rainfall sensors. This pilot project was initiated to revolutionise rainfall and water level monitoring around the City and to demonstrate how the Internet of Things (IoT) and smart technology can deliver smart, affordable and scalable solutions. The long-term goal is to build an experimental flood prediction and response platform. Phase 1 of the project involved the placement of eight sensors at five different locations, while Phase 2 involved the placement of a further 16 sensors at a total of eight locations across the City, which are configured to send updates to the Council every two hours. DCC will add up to 10 river-level monitors and four weathers stations, and will begin exploring the link between the data sets in relation to early flood prediction and prevention in Dublin City.

FLOOD DEFENCE

While flood alleviation incorporating nature-based solutions is DCC's preferred response, there are certain areas of the City that are not suited to soft solutions. Therefore, DCC is building physical flood defences, specifically walls and Dutch dams along the North and South Campshires that take into consideration increased risk from climate change. Additionally, DCC is actively researching alternatives to physical flood defences, such as zoning policies to restrict further development in at-risk areas.

CASE STUDY

Clontarf Promenade
DCC aimed to provide a solution that would not only protect homes and businesses, but would provide a solution that would add value to the area. The end result is a wall that includes a segregated cycle path, providing an additional recreational option, whilst protecting homes and business properties from storm surges and flood events. The project is now serving as a model for the Sutton-to-Sandycove Cycle Way.

CASE STUDY

Liffey Flood Defence
The River Liffey is the heart of Dublin, but as a tidal river, it poses unique challenges for the City in terms of flood risk. Protecting the river and the City walls calls for a mix of solutions. For example, where access needs to be maintained (onto the Boardwalks, for example) DCC has incorporated Dutch dams within the flood walls at these gaps. These demountable defences can be closed manually when a flood risk has been forecasted by one of the operational flood forecasting systems.

Further upstream, DCC has implemented soft solutions such as increasing the buffer distance from the river's edge to reduce dependency on the hard defences downstream. Additionally, developments adjacent to the River Liffey have been required to incorporate Sustainable urban Drainage Systems and green infrastructure features to absorb rainfall; this is now required for all new developments across the City, as it increases the City's flood resilience.

FLOOD RESILIENCE

ACTIONS CURRENTLY BUDGETED

FLOOD RISK MANAGEMENT

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
1	Implement flood risk management guidelines	2018 onwards	Multi-departmental	# of projects following guidelines	Resilience
2	Coordinate Emergency Response Plans	Ongoing	Multi-departmental	Plans completed	Resilience
3	Implement flood awareness campaign with the OPW	2019	Multi-departmental	Campaign implemented	Resilience, Public Awareness
4	Monitoring of flood forecasting and warning system	2019	Multi-departmental	System maintained	Resilience
5	Produce new Design Guide for SuDS	2019 onwards	Culture, Recreation and Economic Services	Guide developed	Resilience
6	Implement Sustainable urban Drainage Guidelines in Council buildings	2019 onwards	Multi-departmental	# of buildings with SuDS measures implemented	Resilience
7	Build demonstration sites to show options for SuDS	2019 onwards	Multi-departmental	# of demonstration sites developed	Resilience, Public Awareness
8	Establish a Dublin Bay Sentinel Group, led by DCC and including other key stakeholders, to monitor tide levels and other marine related flood risk issues in Dublin Bay	2019	Multi-departmental	Group established, medium and long term action plan developed	Resilience
9	Develop and implement Coastal Zone Management plan for Dublin Bay, aligned with County Climate Change Action Plans for Dublin and other local authority plans and strategies	2019 onwards	Culture, Recreation and Economic Services, Environment and Transportation	Plan developed	Resilience
10	Implement the Dublin Bay Biosphere work programme	2018-2020	Multi-departmental, NPWS, Dublin Port	Work programme developed and implemented	Resilience
11	Trial hemp baskets for flood protection	2019	Culture, Recreation and Economic Services, Environment and Transportation	Trials implemented, report on findings	Resilience
12	Identify areas for integrated constructed wetlands	2020	Culture, Recreation and Economic Services	Areas identified and report published	Resilience
13	Expansion of rainfall sensors and weather stations, as part of the Connect Flooding Demonstrator programme	Ongoing	Smart Dublin	# of sensors installed, # of weather stations added	Resilience
14	Phase 2 of Gully Monitoring SBIR Challenge	Ongoing	Smart Dublin	# of solutions developed and implemented	Resilience
15	Develop a climate change impact GIS risk map with scenarios for the Dublin Region	2020	Climate Ireland, Environment and Transportation, multi-departmental	GIS map developed	Resilience

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
16	Develop template to capture impacts, response and costs for all major climate events	2019	Environment and Transportation	Template developed and issued	
17	Establish a Working Group to deal with the issue of pluvial flood risk. This shall include: • How to manage "urban creep" and the increase in impermeable surfaces • Promotion of SuDS early in design process • Development of pluvial flood forecasting through use of point rainfall forecasting • Interim use of DCC "FLAG"meetings as a model for DLAs in relation to pluvial flood forecasting and response • Water quality	2019	Multi-departmental, Water Framework Directive Office	Working group established	
18	Update DLA urban drainage and flooding policies for current knowledge of flood risk and the latest best practice in drainage design	2019	Multi-departmental	Policies updated	
19	Risk workshops to assess impacts on Council services	2019	All departments	Risks identified	
FLOOD DEFENCE					
20	South Campshires Flood Defence	Ongoing	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
21	Sir John Rogerson's Quay flood alleviation scheme	2020	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
22	North Campshires flood alleviation scheme	2025	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
23	Clanmoyle flood alleviation scheme	Ongoing	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
24	Wad flood alleviation scheme	2021	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
25	Poddle flood alleviation scheme	2019	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
26	Camac flood alleviation scheme	2020	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
27	Dollymount flood alleviation scheme	Ongoing	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
28	Clontarf Promenade flood alleviation scheme	2019	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
29	Sandymount Promenade flood alleviation scheme	Ongoing	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
30	Sandymount Phase 2 flood alleviation scheme	2019	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
31	Chapelizod flood alleviation scheme	2020	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
32	Island Bridge flood alleviation scheme	2020	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
33	Santry River Regeneration Project	2018	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project completed	
34	River Dodder flood defence works in the fluvial section upstream of Ballsbridge	Ongoing	Environment and Transportation, Culture, Recreation and Economic Services, OPW	Project ongoing	

ACTIONS AWAITING BUDGET

35	*Study impacts and benefits of increased buffer distances to watercourses*	*2019*	*Environment and Transportation, Culture, Recreation and Economic Services, Finance*	*Study completed*	
36	*Promote and encourage community involvement in the retrofit of SuDS in existing developments*	*2019*	*Culture, Recreation and Economic Services, Communications, Planning*	*# of communities involved*	

EXAMPLES OF RELEVANT LEGISLATION/POLICIES/GUIDANCE

- Arterial Drainage Acts
- Catchment-Based Flood Risk Management Plans (CFRMP)
- Dublin Bay Biosphere Biodiversity Conservation and Research Strategy 2016-2020
- Dublin City Biodiversity Action Plan 2015-2020
- Dublin City Development Plan 2016-2022 - Strategic Flood Risk Assessment (SFRA)
- Dublin City Invasive Alien Species Action Plan 2016-2020
- Dublin City Tree Strategy 2016-2020
- Eastern Catchment Flood Risk Assessment and Management (CFRAM) Study 2011-2016
- EU Birds Directive 2009/147/EC
- EU Environmental Liability Directive 2004/35/EC
- EU Floods Directive 2007/60/EC
- EU Habitats Directive 92/43/EEC
- Greater Dublin Strategic Drainage Study
- National Landscape Strategy for Ireland 2015-2025
- Planning System and Flood Risk Management Guidelines
- The Ramsar Convention on Wetlands
- The 2nd Cycle River Basin Management Plan 2018 - 2021
- Water Framework Directive 2000/60/EC
- Water Services Strategic Plan (2015)

NATURE-BASED SOLUTIONS

OVERVIEW

54 PUBLIC PARKS MAINTAINED BY DUBLIN CITY COUNCIL

300 KM² DUBLIN BAY UNESCO BIOSPHERE

10% ESTIMATED AVERAGE TREE CANOPY COVER IN CITY

TARGET

CONTINUOUS GREEN SPACE ALONG RIVERS

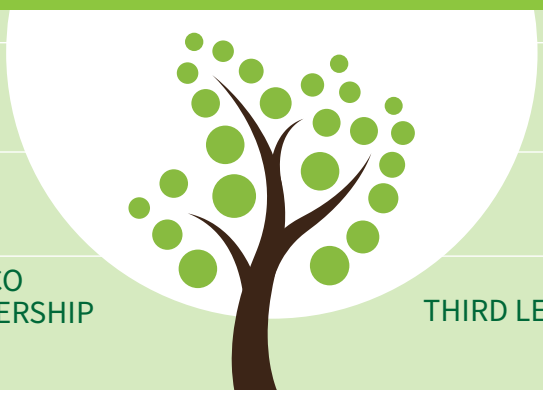
REDUCE AREA OF SOIL SEALING IN DUBLIN

PROTECTING NATIVE SPECIES, PARKS AND TREE COVER

EXAMPLES OF MAIN ACTION TYPES

- Implementing Biosphere Work Programme
- Constructing wetland habitats in parks and city-wide
- Green roofs on civic buildings
- Developing the City's green infrastructure
- Implementing action plans for conservation of species sensitive to climate change
- Protecting, planting and maintaining trees across the City

STAKEHOLDERS TO WORK WITH AND INFLUENCE



- GOVERNMENT DEPARTMENTS
- ENVIRONMENTAL GROUPS
- DUBLIN BAY UNESCO BIOSPHERE PARTNERSHIP
- COMMUNITY GROUPS
- GENERAL PUBLIC
- SCHOOLS AND THIRD LEVEL INSTITUTIONS

> **A green city is a healthy city. Protecting and enhancing open spaces for both biodiversity and recreational use has benefits for the city's sustainability and attractiveness as a place to live, work and visit. As Dublin city intensifies and consolidates some natural assets, open spaces and recreational areas may come under increased pressure. The City Council must respond by balancing the need of the city to consolidate with the need to protect and enhance vulnerable natural areas.**
> - Dublin City Development Plan 2016-2022

Nature-based solutions are defined by the International Union for Conservation of Nature as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[30].

Nature-based solutions are critical in climate change adaptation; they can play an important role not only for biodiversity and ecosystems, flood prevention and carbon sequestration, but also in temperature regulation, water quality, erosion prevention, and filtering pollutants from the air and water. Nature-based solutions are used in a smart, 'engineered' way to provide sustainable, cost-effective, and adaptable measures that support climate resilience.

Examples of nature-based solutions currently deployed as ecosystem services within the City include green roofs and tree pits as part of sustainable urban drainage systems (SuDS), constructed wetlands to improve water quality and prevent flash flooding, increased biodiversity, and more tree canopy cover to regulate urban heat, improve air quality and provide shade and corridors for movement of wildlife within the City.

GREEN INFRASTRUCTURE AND NATURE CONSERVATION

> **Green infrastructure is an interconnected network of green space that conserves natural ecosystem values and functions that also provides associated benefits to the human population. It is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas.**
> - Dublin City Development Plan 2016-2022

Dublin City Council Biodiversity Action Plan 2015-2020

The overarching aim of DCC's *Biodiversity Action Plan 2015 -2020* is the conservation of biodiversity within the City using a combination of different approaches including direct and appropriate management of biodiversity at a local and regional level, identification and protection of important conservation value areas, enhancing biodiversity conservation within the green infrastructure network, raising biodiversity awareness and facilitating public behaviour towards increased protection and appreciation of nature and wildlife.

Dublin's Natural Capital

Dublin City Council is responsible for 54 public parks (not including the Phoenix Park, St Stephen's Green, the Iveagh Gardens, the War Memorial Gardens, and the Botanic Gardens, which are all operated by the OPW) that it will protect to ensure that future generations can enjoy the benefits these amenities offer in terms of recreation, health and well-being. The flora and fauna in Dublin are vital in adapting to climate change and mitigating future impacts, as they act as carbon sinks and provide flood protection.

The biodiversity of Dublin City includes:

- Wildlife and habitats found at North Bull Island and along the City's coastline
- The rivers and canals that cross the City
- Open spaces linked to historic, educational and other public buildings
- Roadsides, railway tracks, and footpaths
- Residential 'greens', private gardens, walls and buildings

TREE MANAGEMENT

> **The Tree Strategy provides the vision and direction for long-term planning, planting, protection and maintenance of trees, hedgerows and woodlands within Dublin City.**
> - Dublin City Development Plan 2016-2022

Trees have multiple benefits in reducing the risk of climate change impacts. Through their root systems they reduce soil erosion, and sequester atmospheric carbon as part of the carbon cycle, meaning that over its lifetime, a single tree can absorb several tonnes of atmospheric carbon dioxide. The right tree in the right place can provide shelter from both wind and sun and help to reduce the urban heat island effect. The *Tree Canopy Study* carried out by UCD's School of Geography has highlighted that in Dublin City, where 97% of the land is built up, trees cover just 10.2% of the total area; this can be as low as 3% for some urban areas[31]. In response to this study, DCC is actively working to increase its canopy cover by implementing the City's Tree Strategy. DCC's policy will involve not only the planting of more trees, but also their ongoing maintenance and care, as it is important to identify ageing and diseased trees to maintain and improve canopy cover in the City and to reduce storm related damage.

CASE STUDY

Photo Source: Fáilte Ireland / Matthew Thompson

Tree Promotion Initiatives
The Native Tree Trails programme was developed by DCC Parks and Landscape Services in 2008 and includes at least one programme in each electoral area. DCC also supports further tree planting activities with schools including the annual National Tree Week and National Tree Day in cooperation with the Tree Council of Ireland. DCC further supports tree-planting with businesses for corporate social responsibility initiatives.

SuDs AND WATER-BASED SOLUTIONS

> **SuDS reduces flood risk, improves water quality and provides amenity through the use of permeable paving, swales, green roofs, rainwater harvesting, detention basins, ponds and wetlands. Furthermore, SuDS offer the opportunity to combine water management with green space, which can increase amenity and biodiversity. Dublin City Council will carry out on-going maintenance and monitoring of the sustainable drainage systems within the public domain.**
> - Dublin City Development Plan 2016-2022

Water related nature-based solutions

Wetlands, floodplains, lakes, rivers and reservoir ecosystems play an important role in the regulation of floods in inland systems. They also provide protection from the adverse consequences of climate related flood risks by acting as 'storage' or buffers during extreme precipitation events. They also play a role in temperature regulation and are home to a rich biodiversity of flora and fauna.

Coastal regions are both vulnerable to and vital to climate change risk. Again, these areas can act as buffer zones for maritime-related climate change impacts, such as storm surges, rising sea levels and pressure on tidal rivers. DCC has developed a range of plans and strategies to protect these areas and its biodiversity. As Dublin's natural ecosystems have a critical role in the international migration of various bird species, it is important to protect and conserve these habitats. The expansion of the Dublin Bay UNESCO Biosphere area to include the area between Howth Head and Dalkey will further protect the biosphere's varied ecological systems. This is an opportunity for Dublin to be a world leader in biodiversity management in the urban context.

CASE STUDY

Dublin Bay UNESCO Biosphere

In 1981, UNESCO recognised the importance of Dublin Bay by designating North Bull Island as a biosphere because of its rare and internationally important habitats and species of wildlife. UNESCO's concept of a biosphere has evolved to include not just areas of ecological value, but also the areas around them and the communities that live and work within these areas. There have since been additional international and national designations, covering much of Dublin Bay, to ensure the protection of its water quality and biodiversity.

In 2015, the existing North Bull Island UNESCO Biosphere was expanded to cover all of Dublin Bay, an area of 300 km^2 with a population of 300,000 people. This includes a core area of high biodiversity value such as North Bull Island, the Baldoyle and Tolka Estuaries, Booterstown Marsh, Howth Head, Dalkey Island and Ireland's Eye.

The Dublin Bay UNESCO Biosphere contains three different zones, which are managed in different ways:

- The core zone of the Dublin Bay UNESCO Biosphere comprises of 50 km^2 of areas of high natural value, including Howth Head, North Bull Island, Dalkey Island and Ireland's Eye
- The buffer zone comprises 82 km^2 of public and private green spaces that surround and adjoin the core zones
- The transition zone comprises 173 km^2 and forms the outer part of the biosphere. It includes residential areas, harbours, ports and industrial and commercial areas.

CASE STUDY

Tolka River Valley Greenway

The Tolka River Valley Park is a part of the Strategic Green Network of Dublin City. The parkland is multi-functional and accommodates playing pitches, pitch and putt, cycling, access for angling and riverside walks, which will now be extended by 2.4km. To enhance habitat diversity, the new wetland ponds will be planted with aquatic and marginal vegetation, new hedgerows, thousands of trees and seven hectares of wildflower meadow will be established. The new wetlands will take the surface water from roads, trap pollutants and treat it before it enters the river. The Tolka Valley is considered an exemplar of green infrastructure planning as a multi-disciplinary and multi-agency design and management process. The success of the Tolka Valley Project is clearly illustrated by the recording in 2011 of numbers of juvenile wild Atlantic salmon in the river at Glasnevin and Finglas, the first record of wild salmon (which only survives in clean water) in the Tolka for at least 100 years.

NATURE-BASED SOLUTIONS

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
ACTIONS CURRENTLY BUDGETED					
OPERATIONS					
1	Establish regional working group on nature-based solutions	2019 onwards	Culture, Recreation and Economic Services	Working group established	
2	Agree joint action plans to protect native habitats and species across all 4 DLAs	2019	Culture, Recreation and Economic Services	Action plans agreed	
3	Establish a cross-departmental Trees and SuDS Working Group to promote and pilot water sensitive urban design incorporating urban tree planting	2019 onwards	Multi-departmental	Working group established	
4	Workshop on trees and SuDS	2019	Multi-departmental	Workshops held, report of outcomes	
5	Produce regional river basin management guidelines. Use Santry River as demonstration	Ongoing	Multi-departmental	Guidelines produced	
6	Facilitate an annual workshop for information exchange between biodiversity experts	2019 onwards	Culture, Recreation and Economic Services	Workshop organised	
7	Collect data to inform the preparation of a list of habitats and species in Dublin City vulnerable to climate change	Ongoing	Culture, Recreation and Economic Services	Data compiled	
GREEN INFRASTRUCTURE					
8	Develop Green Infrastructure Strategy for region	2021	Culture, Recreation and Economic Services	Strategy completed	
9	Implement Public Open Space and Parks Strategy	Ongoing	Culture, Recreation and Economic Services	Strategy completed	
10	Map access to green space in City to identify areas of need	Ongoing	Culture, Recreation and Economic Services	Spaces mapped, areas identified	
11	Continued development of the Dodder Greenway	Ongoing	Culture, Recreation and Economic Services	Greenway completed, any habitats remediated	GHG
12	Assess the feasibility of green walls	2019	Culture, Recreation and Economic Services	Report complete	
TREE MANAGEMENT					
13	Implement *Dublin City Tree Strategy*	Ongoing	Culture, Recreation and Economic Services	Completion of guide	

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
14	Continue to map and collect data on trees in Dublin City	Ongoing	Culture, Recreation and Economic Services	Data mapped and collected	
15	Promote and expand Native Tree Trails programme	Ongoing	Culture, Recreation and Economic Services	# of tree trails	
16	Produce guidance on species of public trees for urban planting in accordance with Action 3.1 of the *Dublin City Tree Strategy*	2019	Culture, Recreation and Economic Services	Guide produced	
17	Tree-planting activities with schools including annual National Tree Week and National Tree Day	Ongoing	Culture, Recreation and Economic Services	# of trees planted	GHG
18	Investigate the use of the DAFM NeighbourWood Planting scheme for use in suitable urban area as part of the DCC Tree Strategy	2019	Culture, Recreation and Economic Services	Report complete	
NATURE CONSERVATION					
19	Implement *Dublin City Council Invasive Alien Species Action Plan*	2020	Culture, Recreation and Economic Services	Plan completed and reviewed, any eradications achieved	
20	Promote international World Wetlands Day	Annually	Culture, Recreation and Economic Services	Event organised	
21	Provide data to RAMSAR	Ongoing	Culture, Recreation and Economic Services	Data submitted	
22	Prepare and publish *Flora of Bull Island*	2020	Culture, Recreation and Economic Services, Dublin Naturalists Field Club	Book published	
23	Conduct a common cord-grass management study and monitoring for North Bull Island SPA	2019	Culture, Recreation and Economic Services, FCC, NPWS	Study conducted	
24	Prepare a GIS-based ecological sensitivity map of Dublin Bay Biosphere	2020	Culture, Recreation and Economic Services	Map complete	
25	Participate in the INTERREG-funded Acclimatize research project	2021	Culture, Recreation and Economic Services	Project complete	
26	Conduct light-bellied brent goose roost survey	2021	Culture, Recreation and Economic Services	Survey complete	
27	Implement the North Bull Island Management Plan	Ongoing	Culture, Recreation and Economic Services	Plan implemented	
ACTIONS AWAITING BUDGET					
28	*Pilot projects for green roofs on civic buildings*	*2020*	*Multi-departmental*	*# of pilots*	GHG
29	*Develop demonstration sites to showcase nature-based solutions with existing land uses*	*2020*	*Culture, Recreation and Economic Services*	*# of sites developed*	GHG

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
30	*North East Inner City Greening Strategy*	*Ongoing*	*Culture, Recreation and Economic Services*	*Strategy implemented*	
31	*Develop urban woodland strategy*	*2020*	*Culture, Recreation and Economic Services*	*Strategy developed*	
32	*Incorporate tree and shrub planting in all new Council housing developments*	*2019*	*Housing, City Architects*	*# of trees per new dwelling, # of shrubs per new dwelling*	
33	*Assess feasibility of urban orchards*	*2020*	*Culture, Recreation and Economic Services, Planning and Property Development*	*Feasibility report*	
34	*Produce A Guide to Sustainable Living in Dublin City*	*2018 onwards*	*Multi-departmental, Dublin Community Growers Association*	*Guide produced and available in libraries*	
35	*Identify sites suitable for community gardens for local food production*	*Ongoing*	*Multi-departmental, Dublin Community Growers Association*	*# of sites identified*	
36	*Assessment of causes and impacts of Ectocarpus brown algal growth in Dublin Bay*	*2023*	*Multi-departmental*	*Assessment complete and actions developed*	
37	*Prepare a preliminary list of species and habitats vulnerable to climate change for informing environmental impact assessments*	*2024*	*Culture, Recreation and Economic Services*	*List prepared*	
38	*Prepare an analysis of soil sealing in Dublin City to determine levels of permeability*	*2021*	*Multi-departmental*	Analysis done	

EXAMPLES OF RELEVANT LEGISLATION/POLICIES/GUIDANCE

- All-Ireland Pollinator Plan 2015-2020
- Dublin Bay Biosphere Biodiversity Conservation and Research Strategy 2016-2020
- Dublin City Biodiversity Action Plan 2015-2020
- Dublin City Development Plan 2016-2022 (Policies CC4; GI1; GI10; GI12; GI14; GI19; GI29; GI30; SCO1; SI18, SN3; Section 16.2.1.2; Appendix 23)
- Dublin City Invasive Alien Species Action Plan 2016-2020
- Dublin City Tree Strategy 2016-2020
- Dublin Tree Canopy Study (2017)
- EU Biodiversity Strategy
- EU Birds Directive 2009/147/EC
- European Communities (Birds and Natural Habitats) Regulations 2011 S.I. 477 of 2011
- EU Environmental Impact Assessment Directive 2014/52/EU
- EU Habitats Directive 92/43/EEC
- EU (Planning and Development) (Environmental Impact Assessment) Regulations 2018 S.I. 296 of 2018
- EU (Invasive Alien Species) (Freshwater Crayfish) Regulations 2018
- EU Regulation on Invasive Alien Species - EU Regulation 1143/2014
- EU Strategy on Green Infrastructure 2013
- National Biodiversity Action Plan 2017-2021
- National Landscape Strategy for Ireland 2015-2025
- The Heart Of Dublin: City Centre Public Realm Masterplan 2016
- Water Framework Directive 2000/60/EC
- Wildlife (and Amendment) Acts 1976-2012

RESOURCE MANAGEMENT

OVERVIEW

APPROXIMATELY **35 TONNES** OF RECYCLED MATERIAL IN COUNCIL BUILDINGS IN 2017

WASTE AND WASTE-WATER ACCOUNTED FOR **2.4%** OF THE CITY'S TOTAL EMISSIONS IN 2016

TARGETS

50% RECYCLING RATE OF MANAGED WASTE BY 2020

REDUCE TO 0% THE DIRECT DISPOSAL OF UNPROCESSED RESIDUAL MUNICIPAL WASTE TO LANDFILL

10% REDUCTION IN WASTE GENERATED BY LOCAL AUTHORITIES

EXAMPLES OF MAIN ACTION TYPES

- Running Council staff recycling awareness campaign
- Running anti-dumping and anti-litter campaigns for general public
- Developing pilot projects for recycling
- Installation of solar compactor bins planned for the City
- Creating food waste campaign for businesses/schools
- Implementing water conservation campaign in civic buildings

STAKEHOLDERS TO WORK WITH AND influence

- GENERAL PUBLIC
- GOVERNMENT DEPARTMENTS
- IRISH WATER
- PRIVATE BUSINESSES
- EASTERN MIDLANDS WASTE REGION
- COMMUNITY GROUPS, TIDY TOWNS, IBAL

> **The Waste Management Plan for the Eastern-Midlands Region is the framework for the prevention and management of wastes in a safe and sustainable manner. The scope of the waste plan is broad and ultimately it needs to provide policy direction, setting out what we want to achieve and a roadmap of actions to get us there.**
> - Eastern-Midlands Regional Waste Management Plan (2015-2021)

In partnership with the Eastern-Midlands Waste Region, the Dublin Local Authorities develop and implement the policies and actions laid out in the region's Waste Management Plan. DCC is working to reduce the production of waste and protect the environment from contamination by hazardous waste materials and general litter. Most recently, to address illegal dumping across the region, two challenges have been launched - one through DCC Beta Projects and another through Smart Dublin's SBIR programme. DCC has also run anti-dumping initiatives in 2017 and 2018 (targeting illegal dumping) in cooperation with the Department of Communications, Climate Action and Environment.

WASTE MANAGEMENT

> **Plan Target - Reduce to 0% the direct disposal of unprocessed residual Municipal waste to landfill (from 2016 onwards) in favour of higher value pre-treatment processes and indigenous recovery practices.**
> - Eastern-Midlands Regional Waste Management Plan (2015-2021)

DCC has a comprehensive waste prevention and recycling programme within the Council and strives to reduce consumption and the waste produced in DCC's buildings and operations. Central to preventing the production of waste is changing the procurement of products used in Council buildings and operations. A priority for DCC is to review procurement procedures and identify opportunities to source local, environmentally-friendly products for use in its operations.

CASE STUDY

Photo Source: Goran Ivas / Unsplash

Conscious Cup Campaign - Citizen Led Initiatives

Ireland currently uses well in excess of 200 million disposable cups every year. This is a major issue as the majority of this waste is not recyclable. As part of its waste prevention programme, Dublin City Council is helping to reduce the use of disposable coffee cups both within the Council and the City. This will be done in collaboration with the Conscious Cup Campaign (CCC), which is a partnership between VOICE and the Eastern-Midlands Regional Waste Office.

Internally, the overall aim will be to remove disposable, plastic waste from Dublin City Council buildings. Canteens in the Civic Offices, Marrowbone Lane, Smithfield and the Dublin Fire Brigade Training Centre are encouraging staff to use reusable mugs, instead of disposable cups. The first phase involves tackling the "takeaway culture" on Council premises by switching to biodegradable, single-use cups and reusable cups.

The second phase will see the removal of all biodegradable cups from Council canteens in 2019 and focus purely on reusables. In addition, to tackle the issue city-wide, Dublin City Council, along with Fingal and South Dublin County Councils, carried out a three-week advertising campaign in June 2018 to promote the initiative to the public through various channels (e.g. buses, digital media and radio advertising).

For example, DCC is committed to reducing the use of disposable cups by supporting the Conscious Cup Campaign in its staff canteen and encouraging staff to use reusable cups. This will be further strengthened by the recent announcement by the Government that all public bodies will not purchase single-use plastic beverage cups, cutlery and drinking straws after 31 March 2019 and will be required to report to its respective Minister by end-November 2019 on the measures it is taking to minimise waste generation and maximise recycling.

LITTER & RECYCLING IN THE PUBLIC REALM

Plan Target – Achieve a Recycling Rate of 50% of Managed Municipal Waste by 2020.
- Eastern-Midlands Regional Waste Management Plan (2015-2021)

Part of reducing waste is encouraging people to recycle. DCC is planning to maintain and promote the availability of recycling infrastructure, such as bring centres, across the City. DCC is also actively working with the Eastern Midlands Regional Waste (EMRW) team to inform people about what they can and cannot recycle.

CASE STUDY

Solar Compactor Bins
Dublin City Council currently has more than 3,200 bins across the City, with about 1,200 of these located in the City Centre.

The Council has now awarded a contract to provide solar-powered "compactor" bins in the City, which could reduce the number of on-street litter bins by 20 per cent. These smart bins will have real-time information, which will alert waste collectors when a bin is full and will prevent unnecessary travel for waste collections. The bins have compactor technology to crush rubbish, which enables them to store significantly more waste than normal litter bins.

In addition to this, the Council has also tagged and mapped the City's bins, so it can ensure that the bins are being prioritised in certain locations, such as areas with high footfall, retail spaces, schools and major transport hubs.

CASE STUDY

Recycling Ambassador Programme
The Recycling Ambassador Programme officially launched on November 29th 2017 and ran until December 2018. It was Ireland's first large scale community based social marketing project. RAP was funded by the DCCAE, managed by the three RWMOs and delivered by environmental NGO, VOICE.

The programme trained citizens about current recycling practice so that they could become champions of that knowledge within their communities. The pool of community ambassadors hosted interactive recycling workshops, which emphasised the correct presentation of recyclable materials in the green bin and the importance of avoiding contamination, as well as discouraging the use of disposable items.

While the RAP had a national target of directly engaging 15,000 people, it was anticipated that the reach of the project would be far wider, as those attending the workshops were incentivised to spread the word within their social circle and neighbourhood.

WATER CONSERVATION

Whilst the Dublin Region and Ireland has an abundance of water, this however, does not equate to treated water suitable for drinking. As demonstrated in the aftermath of the snow and storms in the spring of 2018 and the subsequent heat wave during the summer, there are challenges with water supply and delivery in Ireland. While DCC is no longer responsible for water delivery, it will work with Irish Water to ensure that people have security of supply. As such, actions in this plan are also focused on public education around conservation and protection of this valuable resource.

CASE STUDY

Water Conservation in the Civic Offices
Reducing water use in all Council buildings is a priority for DCC. Beginning with the Civic Offices, a range of measures are being implemented to reduce consumption. Motion sensors taps are being installed in all toilets throughout the building, while waterless urinals have been installed throughout Block 2, with plans to expand this to the whole building. The potential for using rainwater and grey water is also being explored.

Energy Efficiency
GHG Reduction
Resilience
Public Awareness

RESOURCE MANAGEMENT

ACTIONS CURRENTLY BUDGETED

WASTE MANAGEMENT

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
1	Monitor and enforce waste regulation	Ongoing	WERLA and Waste Regulation	Environmental Performance Assessment from EPA	GHG
2	Assess waste in Council buildings and plan actions	Ongoing	Facilities Management, EMWR	Assessment completed	GHG
3	Run staff recycling awareness campaign	Ongoing	Facilities Management, Waste Management Services	% of staff recycling	GHG, Public Awareness
4	Identify areas in need of civic amenity sites and waste transfer stations	Ongoing	EMWR	# of areas identified	GHG
5	Apply for LAPN (Local Authority Prevention Network) grants	Ongoing	Waste Management Services and EMWR	# of grants for waste-related projects	GHG
6	Create Stop Food Waste campaign for businesses and schools	Ongoing	Local Enterprise Office, Waste Management Services, EMWR	Campaign developed and implemented	GHG, Public Awareness
7	Promote Reuse Month annually	Ongoing	Waste Management Services, EMWR	# of promotional activities	GHG, Public Awareness
8	Use €co-Merit programme to advise businesses on reducing waste	Ongoing	EMWR, Local Enterprise Office, Waste Management Services	# of businesses participating	GHG, Public Awareness
9	Promote recycling to householders through a range of workshops, talks and programmes	Ongoing	EMWR, Waste Management Services	# of workshops and attendees	GHG, Public Awareness
10	Continue to work with the Rediscovery Centre to promote sustainability	Ongoing	Environment and Transportation	# of collaborations	Resilience, Public Awareness
11	Research and implement sustainable procurement guidelines	2019	CARO, Procurement, Codema	Research complete, findings implemented	GHG, Energy Efficiency, Resilience

LITTER & RECYCLING IN THE PUBLIC REALM

12	Run anti-dumping and anti-litter campaigns	Ongoing	Waste Management Services, Communications	# of campaigns	Resilience, Public Awareness
13	Support and promote Marine Litter clean up days	Ongoing	Waste Management Services, An Taisce	# of days	Public Awareness
14	Solar Compactor Bins provided in City	2018 onwards	Smart Dublin, Waste Services, Roads	# of smart bins added, reduction in waste collections	GHG

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
15	Mapping and tagging of City bins	Ongoing	Waste Management Services	# of bins tagged and mapped	GHG
16	Identify areas in need of recycling infrastructure	2019	Waste Management Services	Areas of need identified	GHG
17	Develop pilot projects for recycling	Ongoing	Waste Management Services	Pilots developed	GHG
18	Engage with relevant stakeholders and deliver an energy efficiency, circular economy and sustainability training programme targeting micro and small enterprises	2019	Local Enterprise Office	SME sign up and roll out training programme	GHG
19	Investigate introducing a leaf composting programme across the City	2019	Waste Management Services, Roads, Parks and Biodiversity	Composting programme introduced, # tonnage of leaves diverted to composting	
20	Support and promote Tidy Towns/ Green Schools/ City Neighbourhoods initiatives	Ongoing	Waste Management Services, Area Departments	# of participants yearly	
21	Develop sustainability guidelines and terms and conditions for any events supported, facilitated or organised by DCC	2019	Waste Management Services, Events Unit, DCC Climate Change Team	Guidance produced, # of events with sustainability terms and conditions	
22	Review terms and conditions for all events approved by DCC to incorporate possible sustainability conditions	2019	Waste Management Services, Events Unit	Guidance produced on terms and conditions	GHG
23	Any events supported, facilitated or organised by DCC will not permit balloon or Chinese lantern releases	Ongoing	Waste Management Services, Events Unit	# of events	
24	DCC to consult with the events industry on alternatives to non-compostable single use food and beverage containers at DCC events	2019	Waste Management Services, Events Unit	Consultation undertaken and submissions received	GHG
25	DCC to select an appropriate event as a pilot to trial alternatives to non-compostable single use food and beverage containers	2019	Waste Management Services, Events Unit	Event selected and trial undertaken	GHG
26	Phase out the use of single use plastic cups from all DCC canteens and replace with the use of ceramic cups and personal reusable cups	2018/2019	Waste Management Services	No single use plastic cups in use in all Dublin City Council canteens	GHG
27	Identify pilot locations for water access points	2019	Environment and Transportation	Sites identified	

NO	ACTION	TIMEFRAME	LEAD DEPT(S)	INDICATORS	TARGET(S) IMPACTED
28	Host and select sites for the Composting Demonstration using Master Composter EPA Stop Food Waste Programme or similar programme to assist sustainable gardening and management of landscaping waste	Ongoing	Parks and Landscape Services, CRES	# of sites	
29	Continue to investigate best practice in street recycling facilities	Ongoing	Environment and Transportation	Report produced	
30	Explore collaboration with Refill.ie to reduce single use drinking water bottles	2019	Environment and Transportation	Feasibility assessed	
WATER CONSERVATION					
31	Implement water conservation campaign in civic buildings	Ongoing	Facilities Management	% reduction in water consumed	
32	Develop and implement an education programme to tackle climate issues related to the water sector	2027	Water Framework Directive Office	Education programme established	

ACTIONS AWAITING BUDGET

33	*Investigate the introduction of green street cleaning; use biodegradable cleaning agents*	*2019*	*Waste Management Services*	*% of agents replaced*	
34	*Develop sustainable construction waste policy*	*2020*	*Housing, Architects*	*Policy developed and implemented*	
35	*Trial of low flush toilets in Council headquarters and social housing*	*2020*	*Architects*	*Trial completed*	
36	*Research feasibility of rainwater harvesting in Council buildings and social housing*	*2019*	*Architects*	*Feasibility study completed*	

EXAMPLES OF RELEVANT LEGISLATION/POLICIES/GUIDANCE

- Climate Action and Low Carbon Development Act 2015
- Directive 2008/98/EC on Waste (Waste Framework Directive)
- Dublin City Development Plan 2016-2022 (Policies CC4; GI1; GI14; SCO1; SIO5; SI19; SN3; SN29)
- Dublin City Council Litter Management Plan 2016-2018
- Dublin City Local Economic and Community Plan (LECP) 2016 – 2021
- Eastern-Midlands Regional Waste Plan (Policies B.2.4; B.4.3; C.1.1; C.1.3)
- Water Services Strategic Plan (2015)

MILESTONE 4: IMPLEMENTATION

Ownership and implementation of this Climate Change Action Plan (CCAP) resides with Dublin City Council (DCC). This plan demands a whole-of-Council approach, as the climate actions listed cut across multiple departments and sections within the Council. There is no single solution; instead, success in combating climate change will be achieved through numerous individual actions.

DCC has established a Climate Team, which aims to gather and coordinate individual actions to address the interconnected challenges of climate mitigation, climate adaptation and carbon-free sustainable energy. The Climate Team consists of representatives from across the departments that are crucial to tackling climate change.

The mandate of Dublin City Council's Climate Team will be to:

- Climate-proof existing and future corporate strategies, development plans, and local economic development plans
- Incorporate climate change into its procurement policies
- Set up a monitoring and reporting structure, including quarterly schedule of meetings to evaluate progress
- Gather new actions and develop targets
- Coordinate work on actions
- Follow up with respective departments on progress
- Develop a new action plan every five years
- Be a point of contact for the public to learn about climate action in the Dublin Region

Codema, Dublin's Energy Agency, is continuing to provide support to many individual actions in the areas of research, planning, technical assessment, cost-benefit analyses, procurement, project management, funding applications and communications.

It is also clear that climate change is a transboundary challenge; it does not stop at political and geographical borders, and therefore a Dublin regional approach has been agreed by the four Dublin Local Authorities (DLAs) whereby they collaborate closely in the implementation of their action plans. Ultimately, the CCAPs for the four DLAs are the starting point to building climate resilience, through present and future action on climate change throughout the region.

The newly-established Dublin Metropolitan Climate Action Regional Office (CARO) will oversee the implementation of the CCAPs. It is one of four regional climate change offices that have been set up in response to Action 8 of the *National Adaptation Framework* (NAF). Under the NAF, sectoral adaptation plans are to be developed and implemented that will affect the work of the DLAs. As such, the CARO will liaise with respective government departments to align actions undertaken by the DLAs with sectoral adaptation plans.

The role of the Dublin Metropolitan CARO is:

- Assist the local authorities within the region in preparing their own Climate Change Action Plan
- Develop education and awareness initiatives for the public, schools, NGOs and other agencies engaged in driving the climate change agenda and contributing to the National Dialogue on Climate Action on a local and regional basis
- Link with third level institutions in developing a centre of excellence for specific risks – in the case of the Metropolitan Region, this will be for urban climate effects
- Liaise and interact with the Dublin energy agency Codema

Internationally, DCC will liaise closely with the Covenant of Mayors for Climate and Energy and other established networks of European cities and associations. In association with Codema, DCC will seek technical and financial supports from EU programmes. Private commercial opportunities will be encouraged where possible to deliver solutions. Existing and new third level research partnerships and new areas of research will be incorporated into relevant actions.

MILESTONE 5: MONITORING AND ITERATION

Monitoring and verifying progress on the implementation of actions to reduce or avoid greenhouse gas emissions is an ongoing process. Monitoring begins once actions are implemented and continues for their lifetime, providing important feedback that can be useful to improve roll out over time.

In order to guarantee the success of this Climate Change Action Plan, the Climate Team within Dublin City Council (working in close association with the CARO) will report directly to the Environment Strategic Policy Committee (SPC), and to the Chief Executive's Office, through the Assistant Chief Executive for Environment and Transportation. This will help to track regular progress and updating of this Climate Change Action Plan. This reflects best practice of cities globally, which have acknowledged that progress on climate change adaptation and mitigation calls for cross-departmental action and coordination with all stakeholders.

A critical challenge in the implementation and monitoring of this plan is data. While staff are able to identify and discuss the vulnerabilities stemming from climate change and the actions to address them, the need for localised, reliable and valid data was emphasised for developing action indicators. Presently, the DLAs are reliant on various central government departments (not just the Central Statistics Office) for data on air quality (EPA), transportation (NTA), energy (SEAI) and flood risk (OPW). This challenge of accessibility and availability of localised data impacts on policy decisions, and the ability of the DLAs to monitor their progress on climate change actions.

Overall, this Climate Change Action Plan will be monitored and updated on an annual basis, with a review and revision every five years. This Climate Change Action Plan was developed through the Environment SPC of Dublin City Council and approved by the full City Council. The Assistant Chief Executive for Environment and Transportation will report on progress to the SPC annually and the SPC will monitor progress towards the set targets. Every five years there will be a full review and revision of the plan taking into account demographic, technical and other changes that have occurred and any new targets that have been introduced.

KEY PERFORMANCE INDICATORS

The Dublin Metropolitan CARO agrees relevant Key Performance Indicators (KPIs) with the national Local Authority Climate Change Steering Group which, in turn, monitors the performance of the CARO against those agreed KPIs.

This Steering Group additionally links in with Department of Communications, Climate Action and Environment (DCCAE), the Environmental Protection Agency (EPA), the Office of Public Works (OPW), Met Éireann and the national Climate Change Advisory Council. This facilitates engagement with the different government departments and helps to align the local authority KPIs with the national and EU climate policy objectives.

COVENANT OF MAYORS FOR CLIMATE AND ENERGY

Dublin City Council, along with over 7,000 cities and regions in 57 countries, is a signatory to the Covenant of Mayors for Climate and Energy, which is the world's largest movement for local climate and energy actions. The signatory cities pledge action to support implementation of the EU 40% greenhouse gas reduction target by 2030 and the adoption of a joint approach to tackling mitigation and adaptation to climate change.

Accordingly, DCC commits to submitting a Sustainable Energy and Climate Action Plan (SECAP), outlining the key actions they plan to undertake, and this must be submitted within two years of signing up to the initiative. The plan will feature a Baseline Emission Inventory to track mitigation actions and a Climate Risks and Vulnerability Assessment. This commitment marks the beginning of a long-term process, with cities committed to reporting every two years on the implementation progress of their plans.

APPENDIX I: CLIMATE CHANGE RISK ASSESSMENT

A climate change risk assessment is needed to determine which sectors in the City are the most vulnerable to future risks from a changing climate. Codema carried out a medium-term risk assessment up to the year 2050. The risk assessment was carried out once a baseline of climatic events and trends affecting Dublin City had been established.

METHODOLOGY

The first step of conducting a climate change risk assessment is to determine a projection of different climate variables (such as wind speeds, heat waves, sea level rise, flooding, etc.). Codema used various sources to project climate parameters up to 30 years. This climate variables projection can be found in the Adaptation Baseline section.

To determine the effects of a changing climate on Dublin City, Codema identified five action areas that include the different sectors in the City:

1. Critical infrastructure and the built environment
2. Transport
3. Biodiversity
4. Waste management
5. Water resources

The action areas chosen reflect the action areas used throughout this Climate Change Action Plan (Energy and Buildings, Transport, Nature-Based Solutions, Resource Management and Flood Resilience), which reflect DCC's remit. Once the action areas had been identified, the next step was to calculate the risk of these areas to a changing climate. This was done using the risk equation below to quantify future risks:

Future Risk = Consequence x Likelihood

Consequence is the level of damage caused by an event and likelihood is the probability of that same event occurring.

Both the likelihood and consequences are given a range of ratings from one to five and the result of their product is the future risk. The consequences are an estimation of future disruptions caused by the climate variables. Table 6 on the following page (adapted from the European Commission Non-paper Guidelines[32]) shows the consequence scoring matrix, with ratings that range from critical to negligible.

The likelihood rating is based on the level of confidence attributable to the projections of change in the climate variable projections. The likelihood ratings can be either almost certain, likely, possible, unlikely or rare.

Once the ratings for both the consequence and likelihood have been determined, then a climate risk matrix for each of the climate variables affecting the action areas is set up to determine the potential future risks. The future risks range from high risk to low risk; this is depicted in Table 7 on the following page, with the high risks (most urgent and should be addressed first) shown in red and dark orange, and the low risks shown as green (least urgent).

Consequence	
Critical	5
Major	4
Moderate	3
Minor	2
Negligible	1

Likelihood	
Almost Certain	5
Likely	4
Possible	3
Unlikely	2
Rare	1

Future Risk	
High Risk	[15-25]
Medium Risk	[7-14]
Low Risk	[1-6]

Table 6 Consequence Scoring Matrix

CONSEQUENCE					
	ASSET DAMAGE/ ENGINEERING	HEALTH & SAFETY	ENVIRONMENT	SERVICE PRIORITY	REPUTATION
Critical [5]	Disaster with potential to lead to shut down or collapse of the asset/network	Single or multiple fatalities and permanent injuries	Significant harm with widespread effect. Recovery longer than one year. Limited prospect of full recovery	Complete failure to deliver on a service priority	National, long term impact with potential to affect stability of government
Major [4]	A critical event that requires extraordinary/ emergency business continuity actions	Major injury leading to long term incapacity/ disability, multiple significant injuries	Significant harm with local effect. Recovery longer than one year. Failure to comply with environmental regulations	Major impact on a service priority	National, short term impact on public opinion, negative national media coverage
Moderate [3]	A serious event that requires additional emergency business continuity actions	Moderate injury requiring professional intervention or multiple minor injuries	Moderate harm with possible wider effect. Recovery in one year	Moderate impact (positive or negative) on a service priority	Local, long term impact on public opinion with adverse local media coverage
Minor [2]	An adverse event that can be absorbed through business continuity actions	Minor injury requiring minimal intervention or treatment	Localised within site boundaries. Recovery measurable within one month of impact	Minor impact (positive or negative) on a service priority	Localised, short term impact on public opinion
Negligible [1]	Impact can be absorbed through normal activity	Minimal injury only requiring first aid	No impact on baseline environment. Localised to point source. No recovery needed	Positive impact on a service or priority	Localised temporary impact on public opinion

Table 7 Climate Risk Matrix to Identify Potential Future Risks

CONSEQUENCE	LIKELIHOOD				
	RARE [1]	UNLIKELY [2]	POSSIBLE [3]	LIKELY [4]	ALMOST CERTAIN [5]
Critical [5]	**5**	**10**	**15**	**20**	**25**
Major [4]	**4**	**8**	**12**	**16**	**20**
Moderate [3]	**3**	**6**	**9**	**12**	**15**
Minor [2]	**2**	**4**	**6**	**8**	**10**
Negligible [1]	**1**	**2**	**3**	**4**	**5**

Table 8 Dublin City's Climate Change Risk Matrix

IMPACT AREAS	CLIMATE RISKS	DESCRIPTION	PARAMETER	CONSEQUENCE	LIKELIHOOD	FUTURE RISK
Critical Infrastructure & the Built Environment	Extreme Weather Events	Projected increases in temperature, wind speeds, cold snaps and rainfall will put a stress on the built environment, particularly on critical infrastructure (such as electricity and communication networks) and residential developments (with the most vulnerable populations being particularly at risk)	Cold Snaps	4	3	**12**
			Heat Waves	2	4	**8**
			Dry Spells	3	5	**15**
			Extreme Rainfall	4	3	**12**
			Wind Speeds	5	2	**10**
	Sea Level Rise	Increases in sea levels and wave overtopping, along with increased occurrence of coastal storms, will put the built environment at risk. This will include housing and critical infrastructure, which are typically built along the coast	Sea Level Rise	5	5	**25**
			Wave Height	4	3	**12**
			Tides	4	4	**16**
			Storm Surges	4	2	**8**
	Flooding	Coastal, fluvial, pluvial and groundwater flooding will put additional stress and risk on the built environment. This additional risk will cause all areas in the built environment to suffer (businesses, residential, critical infrastructure, etc.)	Coastal & Tidal	5	5	**25**
			Fluvial	5	5	**25**
			Pluvial	4	4	**16**
			Groundwater	4	3	**12**
Transport	Extreme Weather Events	Increases in wind speeds, cold snaps and rainfall will put a stress on transport networks, which may lead to disruptions of transport services during extreme events	Cold Snaps	5	3	**15**
			Heat Waves	2	4	**8**
			Dry Spells	2	5	**10**
			Extreme Rainfall	3	3	**9**
			Wind Speeds	4	2	**8**
	Sea Level Rise	Projected rises in sea level, wave heights and occurrence of coastal storms will put transport services (such as roads and the DART) that are along the coast and close to tidal rivers at increased risk	Sea Level Rise	4	5	**20**
			Wave Height	4	3	**12**
			Tides	3	4	**12**
			Storm Surges	4	2	**8**
	Flooding	Increases in coastal, fluvial and pluvial flooding will cause road damage, which can lead to disruption of transport services	Coastal & Tidal	5	5	**25**
			Fluvial	5	5	**25**
			Pluvial	4	4	**16**
			Groundwater	4	3	**12**
Biodiversity	Extreme Weather Events	Projected increases in temperature, wind speeds, cold snaps and rainfall will put an increased stress on biodiversity, by causing damage, habitat loss and increasing the prevalence of invasive species	Cold Snaps	5	3	**15**
			Heat Waves	4	4	**16**
			Dry Spells	4	5	**20**
			Extreme Rainfall	4	3	**12**
			Wind Speeds	3	2	**6**

IMPACT AREAS	CLIMATE RISKS	DESCRIPTION	PARAMETER	CONSEQUENCE	LIKELIHOOD	FUTURE RISK
Biodiversity	Sea Level Rise	Rising sea levels, wave heights and occurrence of coastal storms will greatly affect coastal habitats, with estuaries and wetlands being particularly at risk	Sea Level Rise	4	5	**20**
			Wave Height	4	3	**12**
			Tides	3	4	**12**
			Storm Surges	4	2	**8**
	Flooding	Increasing extreme flood events can cause loss of habitats and damage to ecosystems	Coastal & Tidal	4	5	**20**
			Fluvial	3	5	**15**
			Pluvial	2	4	**8**
			Groundwater	2	3	**6**
Waste Management	Extreme Weather Events	Projected increases in temperature, heat waves and droughts may increase the risk of fires in landfill sites and can also increase the prevalence of vermin and odour	Cold Snaps	2	3	**6**
			Heat Waves	4	4	**16**
			Dry Spells	4	5	**20**
			Extreme Rainfall	5	3	**15**
			Wind Speeds	1	2	**2**
	Sea Level Rise	Increases in sea levels and tides will put pressure on sanitation systems (these are typically situated at low levels) located close to the coast	Sea Level Rise	4	5	**20**
			Wave Height	4	3	**12**
			Tides	4	4	**16**
			Storm Surges	2	2	**4**
	Flooding	Flooding of landfill sites increases the risk of surface and groundwater contamination	Coastal & Tidal	4	5	**20**
			Fluvial	3	5	**15**
			Pluvial	4	4	**16**
			Groundwater	5	3	**15**
Water Resources	Extreme Weather Events	Projected increases in temperature, cold snaps and rainfall will affect flows and quality of water resources. Temperature increases and dry spells will result in a reduction of water resource availability, whilst cold snaps can cause disruption of water services	Cold Snaps	5	3	**15**
			Heat Waves	4	4	**16**
			Dry Spells	5	5	**25**
			Extreme Rainfall	5	3	**15**
			Wind Speeds	1	2	**2**
	Sea Level Rise	Rising sea levels, wave heights and tides put water supply and aquifers at risk. Therefore, sea level rise will need to be constantly managed to avoid flooding and salt water intrusion of groundwater, which may lead to a greater risk of inundating groundwaters	Sea Level Rise	4	5	**20**
			Wave Height	3	3	**9**
			Tides	4	4	**16**
			Storm Surges	3	2	**6**
	Flooding	Increases in flooding incidents put more pressure on water systems, which are typically located at the lowest elevation possible and therefore are at a greater risk of flooding	Coastal & Tidal	5	5	**25**
			Fluvial	4	5	**20**
			Pluvial	4	4	**16**
			Groundwater	5	3	**15**

APPENDIX II: TOTAL EMISSIONS IN DUBLIN CITY

This section examines the resulting total emissions from the different sectors in Dublin City. The total emissions from the various sectors in Dublin City amount to 2,810,880 tonnes of CO_2 equivalent. The sectors that produced the most emissions were residential, commercial and transport, producing 34.7%, 33.2% and 24.8% respectively, of total emissions in Dublin City. From this analysis, these three sectors should be the main targets of energy and emission reduction initiatives.

Figure 28 illustrates the total CO_2 equivalent emissions in tonnes of CO_2 by sector and fuel type. Waste and wastewater are all expressed as CO_2 equivalent, and are not broken down by fuel type, as the data provided was in terms of different GHG emissions.

From this analysis, Codema found that the commercial sector used the most electricity in Dublin City, and had the highest emissions from electricity (55%) as a result. This may be due to the number of retail and office outlets in Dublin City, which mostly use electricity as their main energy source. The residential sector had the highest CO_2 emissions for natural gas, accounting for 67% of the total gas emissions in Dublin City. Meanwhile, the transport sector accounted for 99% of all diesel emissions in Dublin City. It should be noted that the residential, commercial and transport sectors had the highest emissions and consume more fossil fuels than other sectors.

A more in-depth review of Dublin City's energy use, emissions and methodologies for this baseline may be found in Codema's publication *Dublin City Baseline Emissions Report 2016*.

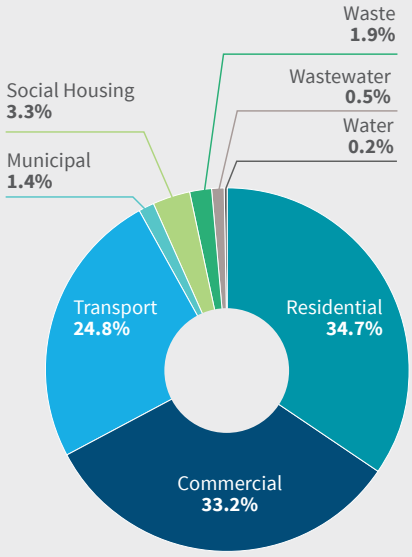


Figure 27 Share of Total Emissions in Dublin City

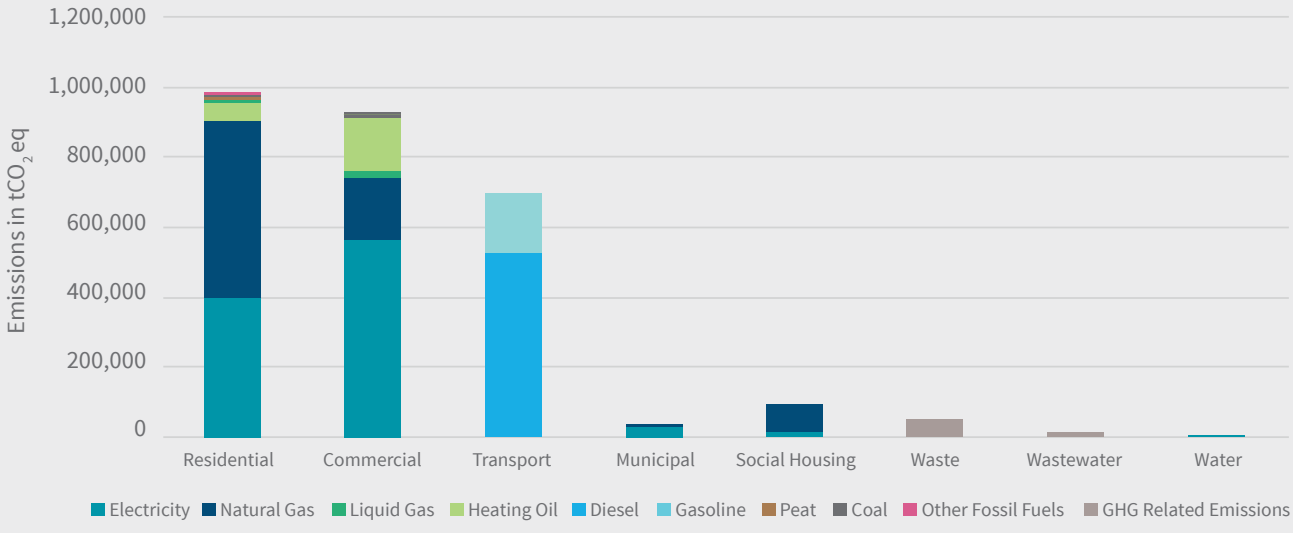


Figure 28 Total tCO_2eq Emissions in Different Sectors

Table 9 Dublin City's 2016 Energy and Emissions Inventory in the Covenant of Mayors for Climate & Energy

SECTOR		FINAL ENERGY CONSUMPTION (MWh)															
		ELECTRICITY	HEAT/COLD	FOSSIL FUELS								RENEWABLE ENERGIES					TOTAL
				NATURAL GAS	LIQUID GAS	HEATING OIL	DIESEL/GAS OIL	GASOLINE	LIGNITE	COAL	OTHER FOSSIL FUELS	PLANT OIL	BIOFUEL	OTHER BIOMASS	SOLAR THERMAL	GEO-THERMAL	
BUILDINGS, EQUIPMENT, FACILITIES AND INDUSTRIES																	
Municipal buildings, equipment/facilities		25,285	-	44,081	-	59	2,143	-	-	-	-	-	-	-	844	-	72,412
Tertiary (non municipal) buildings, equipment/facilities		1,057,927	-	723,341	20,667	620,006	-	-	-	-	-	-	-	70,267	-	57,867	2,550,075
Residential buildings		902,994	-	2,831,806	3,707	220,343	-	-	247	5,430	25,761	-	16	1,312	-	-	3,991,615
Public Lighting		27,270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27,270
Industry	Non-ETS	165,229	-	136,321	18,840	41,590	-	-	178	40,879	-	-	533	36,969	-	-	440,537
	ETS (not recommended)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL		**2,178,705**	**-**	**3,735,549**	**43,214**	**881,998**	**2,143**	**-**	**425**	**46,308**	**25,761**	**-**	**549**	**108,548**	**844**	**57,867**	**7,081,910**
TRANSPORT																	
Municipal fleet		-	-	-	-	-	17,350	376	-	-	-	-	-	-	-	-	17,726
Public Transport		910	-	-	565	-	634,331	215,496	-	-	-	-	-	-	-	-	851,302
Private and commercial transport		1,945	-	-	1,209	-	1,356,476	460,824	-	-	-	-	-	-	-	-	1,820,454
SUBTOTAL		**2,855**	**-**	**-**	**1,774**	**-**	**2,008,157**	**676,696**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2,689,482**
OTHER																	
Agriculture, Forestry, Fisheries		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		**2,181,559**	**-**	**3,735,549**	**44,988**	**881,998**	**2,010,300**	**676,696**	**425**	**46,308**	**25,761**	**-**	**549**	**108,548**	**844**	**57,867**	**9,771,392**

SECTOR		CO_2 EMISSIONS [t] / CO_2 EQ. EMISSIONS [t]															
		ELECTRICITY	HEAT/COLD	FOSSIL FUELS				FOSSIL FUELS				RENEWABLE ENERGIES					TOTAL
				NATURAL GAS	LIQUID GAS	HEATING OIL	DIESEL/GAS OIL	GASOLINE	LIGNITE	COAL	OTHER FOSSIL FUELS	PLANT OIL	BIOFUEL	OTHER BIOMASS	SOLAR THERMAL	GEO-THERMAL	
BUILDINGS, EQUIPMENT, FACILITIES AND INDUSTRIES																	
Municipal buildings, equipment/facilities		11,821	-	9,023	-	15	566	-	-	-	-	-	-	-	-	-	21,425
Tertiary (non municipal) buildings, equipment/facilities		494,581	-	148,068	4,733	159,342	-	-	-	-	-	-	-	-	-	-	806,729
Residential buildings		422,150	-	579,671	849	56,628	-	-	88	1,852	6,798	-	-	-	-	-	1,068,034
Public Lighting		12,749	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12,749
Industry	Non-ETS	77,252	-	27,905	4,314	10,689	-	-	63	13,940	-	-	-	-	-	-	127,277
	ETS (not recommended)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL		**1,018,544**	**-**	**764,667**	**9,896**	**226,673**	**566**	**-**	**151**	**15,791**	**6,798**	**-**	**-**	**-**	**-**	**-**	**2,043,087**
TRANSPORT																	
Municipal fleet		-	-	-	-	-	4,580	95	-	-	-	-	-	-	-	-	4,675
Public Transport		425	-	-	129	-	167,463	54,305	-	-	-	-	-	-	-	-	222,323
Private and commercial transport		909	-	-	277	-	358,110	116,128	-	-	-	-	-	-	-	-	475,423
SUBTOTAL		**1,335**	**-**	**-**	**406**	**-**	**530,153**	**170,527**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**702,422**
OTHER																	
Agriculture, Forestry, Fisheries		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER NON-ENERGY RELATED																	
Waste Management																	52,647
Waste water management																	12,723
TOTAL		**1,019,886**	**-**	**764,667**	**10,302**	**227,239**	**530,154**	**170,527**	**151**	**15,773**	**6,798**	**-**	**-**	**-**	**-**	**-**	**2,810,881**

REFERENCES

1. **Government of Ireland.** Climate Action and Low Carbon Development Act 2015. 2015. Available from: http://www.irishstatutebook.ie/eli/2015/act/46/enacted/en/pdf
2. **Department of Communications, Climate Action and Environment.** National Mitigation Plan. 2017. Available from: https://www.dccae.gov.ie/documents/National Mitigation Plan 2017.pdf
3. **Department of Communications, Climate Action and Environment.** National Adaptation Framework. 2018. Available from: https://www.dccae.gov.ie/documents/National Adaptation Framework.pdf
4. **Department of Housing, Planning and Local Government.** Project Ireland 2040 - National Planning Framework. 2018. Available from: http://npf.ie/wp-content/uploads/Project-Ireland-2040-NPF.pdf
5. **Department of Communications, Climate Action and Environment.** Local Authority Adaptation Strategy Development Guidelines. 2018 Available from: https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/14/LA%20Adaptation%20Guidelines.pdf
6. **IPCC.** Special Report on Global Warming of 1.5°C - Summary for Policymakers. 2018. Available from: http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf
7. **World Meteorological Organization.** State of Climate in 2017 – Extreme Weather and High Impacts. Available from: https://public.wmo.int/en/media/press-release/state-of-climate-2017-–-extreme-weather-and-high-impacts
8. **United Nations.** United Nations Development Programme [Internet]. Available from: http://www.undp.org/content/undp/en/home/sustainable-development-goals.html
9. **Department of Communications, Climate Action and Environment.** The Sustainable Development Goals National Implementation Plan 2018-2020. 2018. Available from: https://www.dccae.gov.ie/documents/DCCAE-National-Implement-Plan.pdf
10. **World Economic Forum.** The Global Risks Report 2017 12th Edition. 2017. Available at: http://www3.weforum.org/docs/GRR17_Report_web.pdf
11. **ICLEI.** ICLEI The Five Milestone Process [Internet]. Available from: http://archive.iclei.org/index.php?id=81012.
12. **European Commission.** Special Eurobarometer 479 Future of Europe – Climate change. 2018. Available from: http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/survey/getsurveydetail/instruments/special/surveyky/2217
13. **The Citizens' Assembly.** Third Report and Recommendations of the Citizens' Assembly: How the State Can Make Ireland a Leader in Tackling Climate Change. 2018. Available from: https://www.citizensassembly.ie/en/How-the-State-can-make- Ireland-a-leader-in-tackling-climate-change/Final-Report-on-how-the-State-can-make-Ireland-a-leader-in-tackling-climate-change/Climate-Change-Report-Final.pdf
14. **Central Statistics Office.** Census of Population 2016 [Internet]. Available from: https://www.cso.ie/en/census/census2016reports/
15. **Met Éireann.** Met Éireann - Major Events [Internet]. Available from: http://www.met.ie/climate-ireland/major-events.asp
16. **Met Éireann.** Climate of Ireland [Internet]. Available from: http://www.met.ie/climate-ireland/climate-of-ireland.asp
17. **Climate Ireland** [Internet]. Available from: https://www.climateireland.ie/#/
18. **EPA.** Ensemble of regional climate model projections for Ireland. 2015. Available from: http://www.epa.ie/pubs/reports/research/climate/EPA%20159_Ensemble%20of%20regional%20climate%20model%20projections%20for%20Ireland.pdf
19. **Walsh S, Dwyer N.** Surface Wind, in EPA. The Status of Ireland's Climate. 2012. Available from: https://www.climateireland.ie/web_resource/resources/status-rep/Surface-Wind.pdf Available from: https://www.climateireland.ie/web_resource/resources/status-rep/Surface-Wind.pdf
20. **O'Dwyer B, Alexander PJ.** Essential Climate Information [Internet]. Available from: https://www.climateireland.ie/web_resource/pdf/localAuthority/essentialClimateInformation.pdf
21. **Irish Committee on Climate Change.** 3rd Scientific Statement Climate and Sea Level Change [Internet]. Available from: https://www.ria.ie/sites/default/files/climate-change-3rd-scientific-statement.pdf
22. **Carter JG, Cavan G, Connelly A, Guy S, Handley J, Kazmierczak A.** Climate Change and the City: Building Capacity for Urban Adaptation. Progress in Planning. 95:1–66. 2015. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0305900614000397
23. **Campbell-Lendrum D, Corvala C.** Climate Change and Developing-Country Cities: Implications For Environmental Health and Equity. Urban Health. 84(1):109–17. 2007.
24. **Hunt A, Watkiss P.** Climate Change Impacts and Adaptation in Cities: A Review of the Literature. Climate Change. 104(1):13–49. 2011. Available from: https://doi.org/10.1007/s10584-010-9975-6
25. **EPA.** Ireland's Environment 2008. 2008. Available from: http://www.epa.ie/pubs/reports/indicators/irlenv/
26. **National Steering Group for Major Emergency Management.** A Framework for Major Emergency Management. 2006. Available from: http://mem.ie/wp-content/uploads/2015/05/A-Framework-For-Major-Emergency-Management.pdf

27. **Dublin City Council.** Major Emergency Plan. 2015. Available from: http://www.dublincity.ie/sites/default/files/content/WaterWasteEnvironment/Major_Emergency_Planning/Documents/Major_Emergency_Plan_2015.pdf
28. Department of Housing, Planning and Local Government. 2017. Technical Guidance Document L - Conservation of Fuel and Energy - Buildings other than Dwellings. Available from: https://www.housing.gov.ie/sites/default/files/publications/files/tgd_l_2017_for_buildings_other_than_dwellings.pdf
29. **NTA, DCC.** Canal Cordon Report 2017. 2018. Available from: https://www.nationaltransport.ie/wp-content/uploads/2018/05/Canal_Cordon_Report_2017.pdf
30. **International Union for Conservation of Nature.** [Internet]. Available from https://www.iucn.org/
31. **Brennan M, Mills G, Ningal T.** Dublin Tree Canopy Study 2017 [Internet]. Available from: https://www.researchgate.net/profile/Michael_Brennan/publication/316441902_Dublin_Tree_Canopy_Study_Final_Report/links/58fe8cc7a6fdcc8ed50c85bc/Dublin-Tree-Canopy-Study-Final-Report.pd
32. **European Commission.** Non-paper Guidelines for Project Managers: Making Vulnerable Investments Climate Resilient [Internet]. Available from: https://climate-adapt.eea.europa.eu/metadata/guidances/non-paper-guidelines-for-project-managers-making-vulnerable-investments-climate-resilient/guidelines-for-project-managers.pdf

TABLE OF FIGURES

TABLE OF TABLES

ABBREVIATIONS

AAMP	Ambient Air Quality Monitoring Programme
AASL	Annual Average Sea Level
AEP	Annual Event/Exceedance Probability
BER	Building Energy Rating
CARO	Climate Action Regional Office
CCAP	Climate Change Action Plan
CCC	Conscious Cup Campaign
CFRAM	Catchment Flood Risk Assessment and Management
CHP	Combined Heat and Power
CMT	Crisis Management Team
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2eq	Carbon Dioxide Equivalent
COP	Conference of the Parties
DAFM	Department of Agriculture, Food and the Marine
DCC	Dublin City Council
DCCAE	Department of Communications, Climate Action and Environment
DDHS	Dublin District Heating System
DEC	Display Energy Certificate
DMURS	Design Manual for Urban Roads and Streets
DHPLG	Department of Housing, Planning and Local Government
DLAs	Dublin Local Authorities
DTTAS	Department of Transport, Tourism and Sport
EIA	Environmental Impact Assessment
EMRW	Eastern Midlands Regional Waste
EPA	Environmental Protection Agency
EPC	Energy Performance Contract
EPO	Energy Performance Officer
EPRP	Energy Performance Related Payment
ESCo	Energy Service Company
ETS	Emissions Trading Scheme
EU	European Union
FRC	FloodResilienCity
GDA	Greater Dublin Area
GHG	Greenhouse gas
GWh	Gigawatt hour
ICLEI	International Council for Local Environmental Initiatives
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
km	Kilometre
KPI	Key Performance Indicator
kWh	Kilowatt hour
LAPN	Local Authority Prevention Network
LECP	Local Economic and Community Plan
LIDAR	Light Detection and Ranging
M&R	Monitoring and Reporting
M&V	Measurement and Verification

MaaS	Mobility-as-a-Service
MEM	Major Emergency Management
MSL	Mean Sea Level
MWh	Megawatt hour
NAF	National Adaptation Framework
NEEAP	National Energy Efficiency Action Plan
NMP	National Mitigation Plan
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxide
NPF	National Planning Framework
NREAP	National Renewable Energy Action Plan
NTA	National Transport Authority
nZEB	nearly Zero Energy Building
ODM	Observed Difference in Mean
OPW	Office of Public Works
PES	Principal Emergency Service
PM_{10}	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
PRA	Principal Response Agency
PV	Photovoltaic
QBC	Quality Bus Corridor
RD&D	Research, Development and Demonstration
RSA	Road Safety Authority
SAFER	Strategies and Actions for Flood Emergency Risk
SBIR	Small Business Innovation Research
SDZ	Strategic Development Zone
SEAI	Sustainable Energy Authority of Ireland
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
SEDA	Spatial Energy Demand Analysis
SEU	Significant Energy User
SO_2	Sulphur Dioxide
SPC	Strategic Policy Committee
SuDS	Sustainable urban Drainage Systems
tCO_2	Tonnes of Carbon Dioxide
UCD	University College Dublin
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VOICE	Voice of Irish Concern for the Environment
WHO	World Health Organisation
WMO	World Meteorological Organisation

Comhairle Cathrach
Bhaile Átha Cliath
Dublin City Council

Codema
Dublin's Energy Agency